Operative Dictations in General and Vascular Surgery

Third Edition

Jamal J. Hoballah
Carol E. H. Scott-Conner
Hui Sen Chong

Springer

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Editors

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ISBN 978-3-319-44795-7 ISBN 978-3-319-44797-1 (eBook)
DOI 10.1007/978-3-319-44797-1

Library of Congress Control Number: 2017945824

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Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To my husband Harry who has always been there for me. (CS-C)

To my wife Leila, my sons Jawad and Nader, and my sister Wafa for their love and support. (JJH)

To my parents Yew Kiang Chong and Sew Ying Chung with their never ending support,

To my husband Kent Lee who is my rock and my stability,

To all my colleagues and residents at the University of Iowa who have grown and matured with me over the years. (H-S C)

Preface

A Special Word to Surgical Residents and Fellows

The operative dictation, or "op note" as it is commonly called, is one of the most important pieces of the medical record that a surgeon creates. In an era when we increasingly rely upon electronic "templates" and check lists, it is especially important to accurately record what actually happened in the operating room. This includes the indications, the findings, the steps in the procedure, who participated, and the sutures and devices that were used. This accurate yet efficient recording is a crucial skill that all surgeons must learn. It is, however, rarely taught. This book will help you with every phase of every dictation.

This is a book we wished we had when we were residents. It is a book we want our residents to have and to use. Read it before going into the OR to do a case. For each operation, we list the indications and the essential technical steps, as well as common variations and complications. Make it your practice to scan through this material before you scrub. This will serve as a quick reminder and an excellent preparation for the case at hand.

Then, in the operating room, concentrate on the details of the particular case – the findings and any particular variation in technique. Adapt the standardized operative dictation note to your needs and promptly document what occurred. Consolidate what you learn by taking notes. Learn the technical variations favored by individual attending surgeons with whom you scrub. Note their preferences in suture materials, patient positioning, and other small details.

Surgery is made up of thousands of small details. Sooner than you might believe, you will be facing your board exams and then the even greater challenge of working independently. When you do, this book will prove to be a valuable resource. It will help you recall what you have learned and determine your own technical preferences.

The 3rd edition of this book, once again, seeks to put a world of technical information in your pocket, or OR locker. New operations have been added, so that the book continues to contain the majority of procedures commonly performed by general and vascular surgeons. All chapters have been comprehensively revised to incorporate new variations in technique and indications.

Most chapters have new authors who have thoroughly revised the material. A third editor, Hui Sen Chong, an experienced minimally invasive surgeon, has been added.

We hope you will enjoy using this unique resource. We welcome your comments or suggestions.

Beirut, Lebanon Jamal J. Hoballah, MD, MBA, FACS
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Part I

General Surgery: Esophagus

1 Ivor Lewis Esophagectomy (Laparotomy, Right Thoracotomy with Thoracic Anastomosis)

Evgeny V. Arshava and Kalpaj R. Parekh

Indications

- Carcinoma of the middle third of the esophagus (tumors located more than 25 cm and up to 30 cm from the incisors)
- Carcinoma of the distal third of the esophagus with proximal extent extending to 30 cm from the incisors
- Inadequate length of gastric conduit for cervical anastomosis
- High-grade dysplasia in Barrett's esophagus with proximal extent extending to 30 cm from the incisors
- Rarely esophageal disorders requiring near-total esophagectomy (e.g., sigmoid esophagus secondary to achalasia)

Essential Steps

Abdominal Dissection

1. Single-lung ventilation via double-lumen endotracheal tube.
2. Upper midline abdominal incision and abdominal exploration.
3. Divide the gastrocolic ligament, preserve the right gastroepiploic vessels, and divide the left gastroepiploic and short gastric vessels.
4. Divide the gastrohepatic ligament and preserve the right gastric artery.
5. Divide the left gastric vessels.
6. Dissect hiatus and mobilize distal esophagus circumferentially within mediastinum.
7. Gastric drainage procedure: pyloromyotomy, pyloroplasty, or Botox injection to prevent delayed gastric emptying.
8. *Initiate staple line to create the 4–5 cm-wide gastric conduit (optional).*
9. Create feeding jejunostomy.
10. Close laparotomy.

Thoracic Dissection

11. Reposition patient in the left lateral decubitus position.
12. Right posterolateral thoracotomy through the fifth intercostal space.
13. Divide the azygos vein.
14. Dissect the esophagus from the hiatus up toward the thoracic outlet. Include paraesophageal and subcarinal lymph nodes in the specimen.
15. Pull stomach into the chest and create a 4–5 cm-wide gastric conduit.
16. Divide the esophagus proximally and remove the specimen.

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© Springer Science+Business Media, LLC 2017
J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_1

17. Perform stapled/sutured esophagogastric anastomosis.
18. *Close hiatus around the distal stomach.*
19. Place the chest tube and close the chest.

Note These Variations

- Creation of the gastric conduit in the abdomen versus in the chest
- Stapled vs sutured anastomosis (size of stapler and type of suture)
- Pyloromyotomy vs pyloroplasty vs Botox injection

Complications

- Anastomotic leak
- Anastomotic stricture
- Gastric necrosis
- Delayed gastric emptying
- Injury to the tracheobronchial tree
- Splenic injury
- Chylothorax
- Hiatal hernia
- Reflux and dumping syndrome

Template Operative Dictation

Preoperative Diagnosis *Carcinoma/high-grade dysplasia* of the *middle/lower third of the esophagus/other*

Procedure Ivor Lewis esophagectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with *carcinoma/high-grade dysplasia of the esophagus extending from ___ to ___ cm/other. (If carcinoma, details of preoperative staging and any neoadjuvant chemotherapy and radiation therapy are given.)* Esophagectomy was indicated.

Description of Procedure Patient was positioned supine. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general anesthesia, the patient was intubated with a double-lumen endotracheal tube.

An upper midline laparotomy was performed from the xiphoid process to the umbilicus. The abdomen was explored for metastatic disease, and *none was noted/describe other findings*. The left triangular ligament was divided and the left lobe of the liver was retracted.

The stomach was inspected and the right gastroepiploic artery determined to have a palpable pulse. The gastrohepatic ligament was divided. A *replaced/accessory left hepatic artery was identified and preserved/divided*. The right gastric artery was preserved. The left gastric vascular pedicle was identified and divided proximally, including all adjacent lymph nodes in the specimen.

Attention was then directed to the hiatus. The phrenoesophageal ligament was divided. The distal esophagus was encircled with a Penrose drain for retraction. The hiatus was enlarged and circumferential mediastinal esophageal dissection was carried up to the level of the inferior pulmonary ligament.

The gastrocolic ligament was incised in its avascular portion and divided toward the hiatus, dividing the short gastric vessels with care taken to preserve the right gastroepiploic vessels. A *portion of the greater omentum was preserved on the greater curvature for subsequent buttressing around the anastomosis.* The greater curvature of the stomach was then mobilized toward the pylorus, and posterior adhesions of the stomach to the retroperitoneum were taken down.

A Kocher maneuver was performed (very rarely needed).

A *pyloromyotomy/Heineke-Mikulicz pyloroplasty/injection of Botox* was performed to improve gastric emptying postoperatively.

At approximately the level of the third large vein ("crow's foot") along the lesser curvature, lymphatic tissue and vessels were mobilized and divided. Starting from the lesser curvature of the stomach, several stapler loads were sequentially *applied toward the fundus of the stomach, thus creating a 4–5 cm-wide gastric conduit and ensuring a 5 cm margin distal to the tumor. The specimen was removed and sent to pathology to confirm that both margins are adequate and free of tumor. The gastric conduit stapler line was then oversewn with a running absorbable suture of ___.*

A feeding *Stamm/Witzel* jejunostomy was placed 20 cm distal to ligament of Treitz and secured to the abdominal wall with multiple tacking sutures.

Hemostasis in the abdomen was assured. The fascia was closed with *a running suture of ____*. The skin was closed with *skin staples/subcuticular sutures.*

The patient was repositioned in the left lateral decubitus position and re-prepped. A right posterolateral thoracotomy was performed through the fifth intercostal space with division of the latissimus dorsi muscle and preservation of the serratus anterior muscle. Single-lung ventilation was established, allowing for anterior retraction of the lung and exposure of the posterior mediastinum. The inferior pulmonary ligament was divided. The azygos vein was isolated and divided. The esophagus was then dissected circumferentially from the level of the hiatus toward the thoracic inlet. The vagal nerves were divided at the level of the azygos vein and cephalad dissection was performed with care to avoid injury to the recurrent laryngeal nerves. Paraesophageal and subcarinal lymph nodes were included with the specimen. Visible lymphatic were carefully ligated.

The esophagus was divided proximally *with a linear cutting stapler/electrocautery.*

The stomach was gently pulled into the chest with care to avoid torsion. Gastroesophageal anastomosis was then performed.

[Choose One]

If sutured: A gastrostomy was performed distal to the proximal staple line. A two-layered anastomosis was constructed between the distal esophagus and the stomach using an inner layer of running ___ and an outer interrupted layer of ___.

If stapled with a linear stapler: A gastrostomy was performed 3 cm distal to the staple line. Interrupted sutures were placed to align the gastric conduit and esophagus. A 35 mm long linear cutting stapler was placed into the cervical esophagus and gastric conduit to create the anastomosis. A nasogastric tube was advanced through the anastomosis and toward the pylorus under direct visualization. The anastomosis was then completed with a full thickness running inner layer of __ suture and an outer interrupted __ suture seromuscular layer.

If stapled with circular stapler: Sizers were used for esophagus to select a ___-mm circular stapler (use at least 25 mm). A full thickness purse-string suture was placed on the esophagus and tied after the anvil was inserted. A gastrostomy was then made/*a small area on the gastric conduit staple line was incised* and the circular stapler inserted into the stomach. The spike was advanced through the anterior wall of the stomach at least 2 cm away from the staple line and engaged with the anvil. The EEA stapler was closed and fired, and two complete donuts were noted. The nasogastric tube was advanced through the anastomosis and toward the pylorus. The gastrostomy was closed with a linear stapler/*in two layers with suture*.

A portion of the omentum was wrapped around the anastomosis and tacked to the apex of the pleura with interrupted sutures.

The hiatus was closed around the stomach with interrupted __sutures.

Two thoracostomy tubes were placed. After adequate re-expansion of the lung, the thoracotomy was closed with figure-of-eight pericostal sutures followed by a running __ suture in layers.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Carol E. H. Scott-Conner, M.D., in the previous edition.

McKeown Esophagectomy/Three Incision Esophagectomy (Laparotomy, Right Thoracotomy with Cervical Anastomosis)

2

Evgeny V. Arshava and Kalpaj R. Parekh

Indications

- Carcinoma of the middle or upper third of the esophagus
- High-grade dysplasia of the middle or upper third of the esophagus
- Rarely: esophageal disorders requiring near-total esophagectomy

Essential Steps

Thoracic Dissection

1. Single-lung ventilation via double-lumen endotracheal tube.
2. Right posterolateral thoracotomy through the fifth or sixth intercostal space.
3. Divide the azygous vein.
4. Dissect the esophagus from hiatus into the apex and include paraesophageal and subcarinal lymph nodes into the specimen.
5. Further dissect esophagus bluntly with finger into the thoracic inlet.
6. Avoid injury to the recurrent laryngeal nerves.
7. Place chest tube and close the chest.

Abdominal and Cervical Dissection

1. Double-lung ventilation via double-lumen endotracheal tube.
2. Upper midline abdominal incision and abdominal exploration.
3. Divide the gastrocolic ligament, preserve the right gastroepiploic artery, and divide the left gastroepiploic artery and short gastric arteries.
4. Divide the gastrohepatic ligament and preserve the right gastric artery.
5. Divide the left gastric vessels.
6. Dissect hiatus and mobilize distal esophagus within mediastinum
7. Gastric drainage procedure: pyloromyotomy, pyloroplasty, or Botox injection to prevent delayed emptying.
8. Perform cervical incision along the left sternocleidomastoid muscle and divide strap muscles
9. Mobilize and divide cervical esophagus.
10. Esophagus is drawn into the abdomen.
11. Create a 4–5 cm-wide gastric conduit and remove specimen.
12. Deliver the conduit atraumatically into the neck incision, with proper orientation within the chest.
13. Perform cervical anastomosis.
14. Create feeding jejunostomy.
15. Close laparotomy and neck incision.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_2

Note These Variations

- Left decubitus vs. modified left decubitus (original McKeown) position
- Pyloromyotomy vs. pyloroplasty vs. Botox injection

Complications

- Anastomotic leak
- Anastomotic stricture
- Gastric necrosis
- Delayed gastric emptying
- Injury to the tracheobronchial tree
- Recurrent laryngeal nerve injury
- Splenic injury
- Chylothorax
- Hiatal hernia
- Reflux and dumping syndrome

Template Operative Dictation

Preoperative Diagnosis *Carcinoma/high-grade dysplasia* of the *upper/middle/distal esophagus/other*

Procedure McKeown esophagectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with *carcinoma/high-grade dysplasia of the esophagus extending from ___ to ___ cm/other. (If carcinoma, details of preoperative staging and any neoadjuvant chemotherapy and radiation therapy are given.)* Esophagectomy was indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general anesthesia, the patient was intubated with a double-lumen endotracheal tube. The patient was then positioned in the left decubitus position. The *patient was placed in a modified left decubitus position with right arm "free draped," and the table is later turned to allow for abdominal and cervical incisions without repositioning of the patient (original McKeown approach).*

A right posterolateral thoracotomy was performed through the *fifth* intercostal space with division of latissimus dorsi muscle and preservation of the serratus anterior. Single-lung ventilation was established, allowing for anterior retraction of the lung and exposure of the posterior mediastinum. The inferior pulmonary ligament was divided. The azygous vein was dissected and divided. The esophagus was then dissected circumferentially from the level of the hiatus into the thoracic inlet. Paraesophageal and subcarinal lymph nodes were dissected and incorporated with the specimen. Finger dissection was further performed to mobilize the esophagus to the level of the thoracic inlet.

A thoracostomy tube was placed. After adequate re-expansion of the lung, the thoracotomy was closed with figure of eights pericostal absorbable sutures followed by a running __ sutures in layers.

The patient was repositioned supine. The abdomen was explored for metastatic disease, and *none was noted/describe other findings*. The left triangular ligament was divided and the left lobe of the liver was retracted.

The stomach was inspected and the right gastroepiploic artery determined to have a palpable pulse. The gastrohepatic ligament was divided. A *replaced/accessory left hepatic artery was identified and preserved/divided*. The right gastric artery was preserved. The left gastric vascular pedicle was identified and divided proximally, including all adjacent lymph nodes in the specimen.

Attention was then directed to the hiatus. The phrenoesophageal ligament was divided. The distal esophagus was encircled with a Penrose drain for retraction. The hiatus was enlarged and circumferential mediastinal esophageal dissection was carried up to the level of the inferior pulmonary ligament.

The gastrocolic ligament was incised in its avascular portion and divided toward the hiatus, dividing the short gastric vessels with care taken to preserve the right gastroepiploic vessels. A *portion of the greater omentum was preserved on the greater curvature for subsequent buttressing around the anastomosis.* The greater curvature of the stomach was then mobilized toward the pylorus, and posterior adhesions of the stomach to the retroperitoneum were taken down.

A Kocher maneuver was performed (very rarely needed).

A *pyloromyotomy/Heineke-Mikulicz pyloroplasty/injection of Botox* was performed to improve gastric emptying postoperatively.

At approximately the level of the third large vein ("crow's foot") along the lesser curvature, lymphatic tissue and vessels were mobilized and divided. Starting from the lesser curvature of the stomach, several stapler loads were sequentially applied toward the fundus of the stomach, thus creating a 4–5 cm-wide gastric conduit and ensuring a 5 cm margin distal to the tumor. The gastric conduit stapler line was then oversewn with a running absorbable suture of ___.

Attention was then turned to the left neck. A skin incision was made along the anterior border of the left sternocleidomastoid muscle, starting at the sternal notch and extending slightly above the cricoid cartilage. The platysma was divided and dissection continued medially to the sternocleidomastoid muscle and carotid sheath and laterally to the thyroid. The omohyoid and strap muscles were divided with electrocautery. The middle thyroid vein and the inferior thyroid artery were ligated and divided. Care was taken to protect the recurrent laryngeal nerve. The deep cervical fascia was incised, and with further dissection toward the vertebral bodies, the esophagus was identified, gently mobilized circumferentially, and encircled with a Penrose drain. The cervical esophagus is further mobilized from the superior mediastinum with gentle traction and finger dissection.

The nasogastric tube was withdrawn and cervical esophagus divided with a linear cutting stapler. *The specimen was removed and sent to pathology to confirm that both margins are adequate and free of tumor.*

The gastric conduit was delivered through the mediastinum into the neck without torsion. The gastroesophageal anastomosis was then performed.

[Choose One:]

If stapled with a linear stapler: A gastrotomy was performed 3 cm distal to the staple line. Interrupted sutures were placed to align the gastric conduit and esophagus. A 35 mm long linear cutting stapler was placed into the cervical esophagus and gastric conduit to create the anastomosis. A nasogastric tube was advanced through the anastomosis and toward the pylorus under direct visualization. The anastomosis was then completed with a full thickness running inner layer of __ suture and an outer interrupted __ suture seromuscular layer.

If sutured: A gastrotomy was performed 2 cm distal to the staple line.

A two-layered anastomosis was constructed between the distal esophagus and the stomach using an inner layer of running ___ and an outer interrupted layer of ___.

A drain was placed by the anastomosis and hemostasis achieved. The platysma was reapproximated with a running/interrupted ___ suture. The cervical incision was closed with interrupted/*running* ___ suture.

Feeding *Stamm/Witzel* jejunostomy was placed 20 cm distal to ligament of Treitz and secured to abdominal wall with multiple tacking sutures.

Hemostasis in the abdomen was assured. The fascia was closed with *a running suture of* ____. The skin was closed with *skin staples/subcuticular sutures.*

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

3 Transhiatal Esophagectomy

Mohammad A. Bashir

Indications

- *Carcinoma/high-grade dysplasia* of the *lower third of the esophagus/gastric cardia*
- Rarely: benign stricture, severe neuromuscular dysfunction, or perforation

Essential Steps

1. Midline abdominal incision.
2. Divide the gastrocolic ligament.
3. Preserve the right gastroepiploic artery, ligate the left gastroepiploic artery, and ligate the short gastric arteries.
4. Dissect the lesser curvature.
5. Preserve the right gastric and *aberrant left hepatic artery if present.*
6. Ligate the left gastric vessels.
7. Dissect the hiatus, mobilizing the esophagus from below.
8. Kocher maneuver.
9. *Gastric drainage procedure to prevent delayed emptying or Botox injection.*
10. Oblique neck incision.
11. Dissect anterior to the sternocleidomastoid muscle.
12. Avoid traction injury or cautery injury to the recurrent laryngeal nerve.
13. Mobilize the cervical esophagus.
14. Divide the esophagus in the neck and stomach in the abdomen.
15. Pull the specimen down through the abdomen and remove.
16. Create the gastric conduit.
17. Pull the stomach up into cervical incision.
18. Cervical anastomosis: *sutured/stapled.*
19. Place drain adjacent to the anastomosis in the neck.
20. Close the hiatus around the stomach.
21. Check hemostasis and close wounds.

Complications

- Major hemorrhage
- Injury to the tracheobronchial tree
- Recurrent laryngeal nerve injury
- Splenic injury
- Gastric necrosis
- Pneumothorax
- Chylothorax
- Anastomotic leak
- Empyema/mediastinitis

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_3

Template Operative Dictation

Preoperative Diagnosis *Carcinoma/high-grade dysplasia* of the *lower third of the esophagus/ gastric cardia/other*

Procedure Transhiatal esophagectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had developed dysphagia and on workup was found to have *dysplasia/carcinoma of the esophagus extending from ___ to ___ cm/other. (If carcinoma, detail preoperative staging and any neoadjuvant chemotherapy and radiation therapy given.)* Esophagectomy was indicated.

Description of Procedure The patient was taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. He was positioned on the operating table with arms tucked and pressure points padded. The abdomen, chest, and left neck were prepped and draped in the usual sterile fashion. An upper midline incision was made and the abdomen explored. *No evidence of metastatic disease was found/other.*

Attention was then turned to the greater curvature of the stomach, where a palpable gastroepiploic vessel was identified. The left gastroepiploic and short gastric vessels were *ligated with 2-0 silk and divided/or utilizing the Ligasure device*. The right gastroepiploic pedicle was carefully preserved. When the greater curvature was fully mobilized, attention was turned to the lesser curvature. Gentle cephalad traction was placed on the stomach and the lesser sac was entered. The right gastric artery was preserved and the left gastric artery was similarly identified. No anomalous left hepatic artery was identifiable; therefore, the left gastric artery was ligated and divided/*stapled*. The dissection of the lesser curvature was continued to the pylorus. An extensive Kocher maneuver was performed.

Attention was then turned to dissection of the hiatus. The phrenic vein was doubly ligated and divided/ *avoided*; the phrenoesophageal ligament was divided using sharp and blunt dissection. The mediastinum was entered anterior to the esophagus. The left triangular ligament was divided and the esophagus mobilized circumferentially.

The pylorus was identified *and 2-0 silk traction sutures placed on either side. Using needle tip electrocautery, the serosa was incised and the muscle was divided carefully all the way to the mucosa avoiding injury to it/alternately a total of 200 units of Botox were injected in all four quadrants of the pylorus.*

Attention was turned to the neck. The skin was incised obliquely along the medial border of the left sternocleidomastoid muscle extending from the level of the thyroid cartilage to the sternal notch. Dissection was then carried out dividing the platysma and omohyoid and ligating the middle thyroid vein. Blunt dissection was extended to the prevertebral fascia and tracheoesophageal groove. The sternocleidomastoid muscle and carotid artery were gently retracted laterally; care was taken to avoid medial retraction to the recurrent laryngeal nerve. The cervical esophagus was then bluntly mobilized, taking care to avoid injury to the trachea and the right recurrent laryngeal nerve.

At that point we started our mediastinal dissection bluntly from the hiatus and from the neck incision to divide all the esophageal attachments anteriorly and posteriorly.

With the esophagus now free of its attachments, a linear cutting stapler was fired in the neck to create the proximal margin. The entire esophagus was advanced into the abdomen. A *linear cutting stapler* was used to divide the stomach below the gastroesophageal junction, establishing the distal margin. Creation of a the gastric conduit was performed by resecting the GE junction and the lesser curvature of the stomach down to the level of crow's foot of veins using ___ staplers. A suction drain was placed from the neck into the mediastinum and attached to a Penrose drain. The Penrose drain was fixed to the stomach and oriented. The entire apparatus was advanced through the hiatus, bringing the gastric fundus out through the cervical incision with care taken to avoid torsion of the stomach.

[Choose One:]

***If stapled anastomosis*:** The esophagus and gastric conduit were then aligned and a gastrotomy performed. A limb of a linear cutting stapler was placed down both the cervical esophagus and gastric fundus. The stapler was fired, creating a side-to-side functionally end-to-end anastomosis. A nasogastric tube was advanced through the anastomosis with the end resting distal to the pylorus. The remaining enterotomy was closed in two layers with interrupted 4-0 PDS and 3-0 Vicryl.

If sutured: A two-layer anastomosis was constructed between the distal esophagus and stomach using an inner layer of running 4-0 PDS and an outer layer of 3-0 Vicryl. The nasogastric tube was advanced through the anastomosis and down through the pylorus.

A closed suction drain was placed in the cervical bed and the incision irrigated and closed in the usual fashion. *The pyloromyotomy/pyloroplasty site was reinforced with omentum in a patch fashion.* The hiatus was reapproximated around the stomach and secured with interrupted 2-0 silk suture. *A feeding jejunostomy was created approximately 20 cm from the ligament of Treitz in the usual fashion utilizing a Witzel tunnel and multiple abdominal wall tacking sutures* (Chap. 39).

Attention was then turned to closure. The abdominal fascia was closed with *number 1 PDS suture*. The skin was closed with *skin staples/subcuticular sutures of ___/other.*

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Carol Scott-Conner, M.D., in the previous edition.

4 Transhiatal Esophagogastrectomy with Colonic Interposition

Evgeny V. Arshava and Kalpaj R. Parekh

Indications

- Carcinoma of the esophagus and end-stage benign conditions where gastric conduit is not available/suitable
- Salvage operation for prior failed esophageal replacement

Contraindications

- Colonic malignancy or extensive diverticulosis
- Extensive diverticulosis and active diverticulitis

Essential Steps

1. Upper midline abdominal incision and abdominal exploration.
2. Identify the segment of the colon for reconstruction and assess the mesenteric vessels.
3. Measure the length of the colon needed for interposition (from the left ear lobe to the xiphoid process using an umbilical tape).
4. Divide colon and mobilize mesenteric pedicle.

Transhiatal esophagogastrectomy

5. Divide the gastrocolic ligament and divide the gastroepiploic and short gastric vessels to mobilize the greater curvature for subtotal versus total gastrectomy.
6. Assure adequate lymphadenectomy for carcinoma.
7. Divide the gastrohepatic ligament and divide the left/right gastric vessels to mobilize the lesser curvature.
8. Dissect hiatus and circumferentially mobilize the distal esophagus within the mediastinum.
9. Perform cervical incision along the sternocleidomastoid muscle and divide strap muscles.
10. Perform transhiatal mobilization of the intrathoracic esophagus.
11. Mobilize and divide cervical esophagus.
12. Divide distal *stomach/duodenum* to complete gastrectomy and remove entire specimen.
13. *Gastric drainage procedure (pyloromyotomy or pyloroplasty) or Botox injection to prevent delayed emptying.*

Colonic reconstruction

14. Deliver the conduit in an isoperistaltic fashion into the neck.
15. Perform stapled/sutured esophagocolonic anastomosis.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_4

16. Perform stapled/sutured anastomosis of the colon to antrum, duodenum, or proximal jejunum.
17. Restore colon continuity with stapled/sutured anastomosis.
18. Close hiatus around the colon.
19. Place the chest tubes and close the chest.
20. Create feeding jejunostomy.
21. Close laparotomy and neck incisions.

Complications

- Anastomotic leak
- Anastomotic stricture
- Conduit necrosis
- Late redundancy of the transposed colon
- Reflux
- Injury to the tracheobronchial tree
- Recurrent laryngeal nerve injury
- Splenic injury
- Chylothorax
- Hiatal hernia

Note These Variations

- Transhiatal versus transthoracic mobilization of the esophagus
- Subtotal versus total gastrectomy
- "Supercharged colon conduit" (vascular reimplantation – not described here)
- Position of colon in posterior mediastinum versus substernal location for cervical anastomosis
- Intrathoracic (as described in Chap. 1) versus cervical anastomosis (transhiatal esophagectomy as described in Chap. 3)
- Distal anastomosis of the colon to antrum versus jejunum versus duodenum (rarely)
- Pyloromyotomy vs. pyloroplasty vs. Botox injection

Template Operative Dictation

Preoperative Diagnosis *Carcinoma/high-grade dysplasia* of the *upper/middle/distal esophagus/other*

Procedure Transhiatal esophagectomy with colon interposition

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with large gastroesophageal junction carcinoma/synchronous esophageal and gastric carcinoma. *(If carcinoma, details of preoperative staging and any neoadjuvant chemotherapy and radiation therapy given.)*

Esophagectomy with colon interposition is indicated.

Description of Procedure Patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. Patient was positioned with arms tucked and neck slightly hyperextended with a shoulder roll and rotated to the right with all bony prominences appropriately padded.

An upper midline laparotomy was performed from the xiphoid process to the umbilicus. The abdomen was explored for metastatic disease, paying close attention to the liver. The left triangular ligament was divided and the left lobe of the liver was retracted. The tumor was identified and assessed for resectability.

The colon was approached and mobilized first to assure its adequate perfusion before reconstruction. The greater omentum was dissected off the transverse colon and the splenic and hepatic flexures were mobilized.

[Choose One:]

If left colon interposition: The descending colon is mobilized along the white line of Toldt. The mesentery was transilluminated to identify the middle colic vessels, the ascending branch of the middle colic artery, and the inferior mesenteric vein.

The middle colic artery and vein were dissected at their origin to preserve the right and left colonic branches. Vascular clamps were applied at the origin of the middle colic vessels. Pulsation of the marginal artery and perfusion of the colon was assessed throughout the case. This was confirmed later at the beginning of the reconstruction prior to dividing the middle colic vessels at their origin.

The distal transverse colon was retracted cephalad (typically reaching the xiphoid) and was marked with the stitch at the point of the ascending left colic branch. Using an umbilical tape, the distance between the left ear lobe and the xiphoid process was measured. The same distance was measured on the colon heading proximally (typically to mid ascending colon) where a second marking stitch was placed. Branches of the right colic and ileocolic vessels within this segment were dissected and temporarily occluded with clamps.

If right colon interposition: The ascending colon, cecum, and terminal ileum were mobilized. The ileocolic and right colic vessels were dissected at their origin and temporary occluded with vascular clamps to assure adequate perfusion via the middle colic vessels.

The transverse colon was retracted cephalad (typically reaching the xiphoid) and was marked with the stitch at the tether point of the middle colic vessel. Using an umbilical tape, the distance between the left ear lobe to the xiphoid process was measured. The same distance was measured on the colon proximally and a second marking stitch placed (typically at the region of terminal ileum).

The esophagogastrectomy was performed. The left triangular ligament was divided and the left lobe of the liver was retracted.

A Kocher maneuver was performed.

The phrenoesophageal ligament was divided to dissect the right and left crus of the diaphragm. The distal esophagus was encircled with a Penrose drain to aid in retraction. Dissection was continued circumferentially around the esophagus into the mediastinum, as high as possible.

The greater curvature of the stomach was mobilized, and dissection was continued toward the pylorus. The gastrohepatic ligament was incised. The short gastric, left gastroepiploic, right gastroepiploic vessels, and left and right gastric vessels were divided. The stomach was then retracted superiorly with a liver retractor. Posterior adhesions of the stomach to the retroperitoneum were divided. *Posterior gastric artery was divided.*

Note *All gastric vessels were divided at their origin to assure adequate lymphadenectomy (for synchronous gastric malignancy).*

Note *Dissection toward pylorus the distal stomach was performed just passed the planned line of gastrectomy.*

[Choose One:]
Subtotal gastrectomy*:* The stomach was divided with the linear cutting stapler across the antrum.

Total gastrectomy*:* A total gastrectomy was performed, dividing the proximal duodenum just past the pylorus with the linear cutting stapler.

Attention was then turned to the left neck. A skin incision was made along the anterior border of the sternocleidomastoid muscle starting in the sternal notch and extending slightly above the cricoid cartilage. The platysma was divided and dissection continued medially to the sternocleidomastoid muscle, carotid sheath, and lateral to the thyroid. The omohyoid and strap muscles were divided with electrocautery. The middle thyroid vein and the inferior thyroid artery were ligated and divided. Care was taken to protect the recurrent laryngeal nerve. The deep cervical fascia was incised, and with further dissection toward the vertebral bodies, the esophagus was identified. The esophagus was circumferentially mobilized and encircled with a Penrose drain. It was then mobilized out of the superior mediastinum with gentle traction and finger dissection.

Through the abdomen, the hiatus was enlarged to allow a hand entry. Through both the hiatal and neck incisions, the posterior and anterior esophageal attachments were divided using gentle blunt finger dissection.

The nasogastric tube was withdrawn and esophagus divided with a linear cutting stapler. The circumferentially mobilized esophagus was then pulled into the abdomen, division of the remaining lateral attachments completed, and the specimen removed. The proximal esophageal margin was sent for frozen section to assure absence of malignancy.

Once the perfusion of the colon conduit was assured, the colon was divided at the sites marked by the stitches with a cutting stapler to assure optimal reach without redundancy for the anastomosis.

A posterior mediastinal tunnel was used for final placement of the conduit.

For substernal route *(in cases where the region of posterior mediastinum was not appropriate for placement of the conduit): a 5 cm substernal tunnel was created extrapleurally. The diaphragm was incised on its anterior midline aspect and resected back several centimeters on each side of the substernal window to prevent compressive obstruction of the colon. The thoracic inlet was enlarged by removing the medial aspect of the left clavicle, the left half of the manubrium, and the medial segment of the first rib.*

The *transverse colon (for left colon conduit)*/the *ascending colon (for right colon conduit) was delivered* atraumatically, in an isoperistaltic fashion into the cervical incision. It was checked to be tension free and without torsion before creation of the coloesophageal anastomosis.

The coloesophageal anastomosis was then performed.

Note For right colon interposition, the terminal ileum may be anastomosed to the esophagus.

[Choose One:]

If stapled with linear stapler: A colotomy was performed 3 cm distal to the staple line. Interrupted sutures were placed to align the colon and esophagus. A linear cutting stapler was placed into the cervical esophagus and colonic conduit *to create* the anastomosis.

The anastomosis was then completed with a full thickness running inner layer of __ suture and an outer interrupted __ suture seromuscular layer.

If stapled with circular stapler: Sizers were used for the esophagus to select a ___-mm circular stapler (use at least 25 mm). A full thickness purse-string suture was placed on the esophagus and tied after the anvil was inserted. The stapler was passed through the open end of intra-abdominal colon. The spike was advanced through the antimesenteric side of the colon at the staple line and engaged with the anvil. The stapler was closed and fired and two complete donuts were noted/describe other findings.

If sutured: The stapled line of the colon was excised. End-to-end *single/two-layered* hand-sewn anastomosis was constructed between the distal esophagus and the colon using an inner layer of *running/interrupted* ___ and an outer interrupted layer of ___.

A nasocolonic tube was advanced through the anastomosis prior to its completion.

After completion of the anastomosis, the colon was gently withdrawn into the abdomen to straighten it. It was then sutured to the hiatus (or *to diaphragm* – for retrosternal position) to prevent its herniation.

A stapled (or *sutured) cologastric/colojejunal* anastomosis was then completed. Specify end-to-end or side-to-end fashion.

If cologastric anastomosis: To decrease postoperative reflux, the anastomosis was performed on the posterior aspect of the stomach near the greater curvature at the 1/3 point distal to the cardia.

If colojejunal anastomosis*: Approximately 15 cm distal to the ligament of Treitz, a 40 cm long* Roux-en-Y jejunal loop was created. It was anastomosed proximally to the distal end of the colon and distally to the proximal jejunum.

The colon continuity was restored with a hand-sewn end-to-end/*stapled side-to-side* anastomosis: Ascending colon to left colon (for left conduit)/*ileum to transverse colon* (for right conduit).

A feeding *Stamm/Witzel* jejunostomy was placed 20 cm distal to ligament of Treitz and secured to the abdominal wall with multiple tacking sutures.

A drain was placed by the coloesophageal anastomosis and the cervical wound was closed with interrupted/*running* ___ sutures.

Hemostasis in the abdomen was assured. The fascia was closed with *a running suture of* ____. The skin was closed with *skin staples/subcuticular sutures.*

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Minimally Invasive Esophagectomy

5

Denise T. Lee and Edward H. Chin

Indications

- Surgically resectable esophageal cancer
- High-grade dysplasia of the esophagus
- Massive esophageal dilatation due to benign disease (end-stage achalasia, Chagas' disease)

Essential Steps

1. Esophagogastroduodenoscopy *and bronchoscopy*
2. Double-lumen endotracheal tube

Stage I: Thoracoscopic Mobilization of the Intrathoracic Esophagus

3. Left lateral decubitus position with the right arm secured above the head.
4. Deflate the right lung.
5. Insert thoracoscopic ports in the right chest.
6. Thoracoscopic exploration of the chest *and mediastinal lymphadenectomy for frozen section*.
7. Place suture in the central tendon of the right diaphragm.

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8. Divide the inferior pulmonary ligament.
9. Dissect around the esophagus; pass Penrose drain around the esophagus for retraction.
10. Divide the azygos vein.
11. Dissect the esophagus cephalad toward the thoracic inlet, including all lymph nodes en bloc, and caudad to the crus of the diaphragm.
12. Free the esophagus from the thoracic duct and aorta, dividing branches as needed.
13. Place Penrose in thoracic inlet for later retrieval during cervical dissection.
14. Inject local anesthetic into intercostal spaces; place chest tube for drainage.
15. Close thoracoscopic port sites.

Stage II: Laparoscopic Construction of the Gastric Conduit

16. Reposition patient supine and reprep the chest and abdomen for laparoscopy.
17. *Exchange double-lumen endotracheal tube for single-lumen tube*.
18. Insert abdominal laparoscopic ports.
19. Insert self-retaining liver retractor to retract the left lobe of the liver.
20. Divide the hepatogastric ligament exposing the right crus and dissect to the left crus.
21. Continue dissection in retroesophageal window cephalad, taking care not to enter the thoracic cavity.
22. Divide the phrenogastric attachments.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_5

23. Divide the short gastric vessels along the greater curvature.
24. Divide the hepatoduodenal ligaments.
25. Perform Kocher maneuver to fully mobilize the pylorus.
26. Divide retrogastric attachments.
27. Identify and mobilize lymph nodes and fatty tissue of the celiac axis.
28. Divide left gastric vessels with endovascular stapler or LigaSure vessel sealing device.
29. Place additional 11-mm port in the right lower quadrant to facilitate the retraction of the stomach during creation of gastric tube.
30. Create gastric tube by stapling parallel to greater curvature while gently retracting the stomach cephalad and caudad.
31. Perform a pyloroplasty or pyloromyotomy by dividing the pylorus along the anterior wall, suction the gastric tube, then close the incision transversely.
32. Create jejunostomy tube by needle catheter technique or using 14-French catheter.
33. Suture the tip of the gastric tube to the lesser curvature of the specimen.

Stage III: Cervical Anastomosis

34. Make a low cervical incision with dissection down through the platysma to the deep prevertebral fascia.
35. Dissect the cervical esophagus laterally and retrieve the Penrose drain.
36. While insufflating the abdomen to maintain direct visualization, pull the gastric tube through the hiatus into the neck using the Penrose drain, maintaining appropriate orientation.
37. Perform esophageal anastomosis using an EEA stapler or hand-sewn technique.
38. Insert nasogastric tube across the anastomosis with end in the gastric tube.
39. Resect the distal end of the gastric tube with a linear stapler.
40. Retract the distal end of the gastric tube to align the conduit while observing the neck anastomosis.
41. Affix gastric tube to diaphragmatic hiatus.
42. Close laparoscopic port sites and neck incision.
43. *Toilet bronchoscopy*.

Note These Variations

- Type of suture and use of pledgets.
- Type and size of stapling device.
- Laparoscopic or thoracoscopic staging prior to operation.
- Confirmation of jejunostomy tube placement with contrast X-ray.
- If the hiatal opening appears narrowed, incisions may be made in the crura to relieve tension on the gastric tube.
- Esophageal anastomosis with alternative technique: hand-sewn or side-to-side stapled.
- Bronchoscopy before and after the operation.
- Decision to start with laparoscopic portion prior to thoracoscopic.
- Decision to create a narrow gastric tube vs. leave stomach intact.
- Pyloroplasty vs. pyloromyotomy as gastric drainage procedure.

Complications

- Injury to the lungs, esophagus, aorta, spleen, transverse colon, trachea, bronchi, vagus, and recurrent laryngeal nerves
- Chylothorax from thoracic duct injury
- Damage to, twisting of, or devascularization of the gastric tube
- Anastomotic leak either in the neck or in the thoracic cavity

Template Operative Dictation

Preoperative Diagnosis Esophageal cancer *or end-stage achalasia*, *Chagas' disease*

Postoperative Diagnosis Same

Procedure Minimally invasive esophagectomy

Indications This is a ___-year-old *male/female* who presented with _____ and was subsequently diagnosed with esophageal cancer/*end-stage achalasia*. A staging workup was undertaken with *CT scan/PET scan/endoscopic ultrasound/ needle biopsy* that demonstrated surgically resectable disease. After a discussion of the risks, benefits, and alternatives to surgery, the patient elected to undergo minimally invasive esophagectomy.

Description of Procedure *A thoracic epidural catheter was placed by anesthesia for postoperative pain control.* Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Esophagogastroduodenoscopy was performed to assess the extent of the tumor. *Given the midthoracic location of the tumor*, *bronchoscopy was also performed.* Following induction of general anesthesia, the patient was intubated with a double-lumen endotracheal tube and placed in the left lateral decubitus position with the right arm raised and all pressure points padded appropriately. The right chest was prepped and draped in the usual sterile fashion.

A 10-mm camera port was inserted in the *eighth/ninth* intercostal space anterior to the midaxillary line. Another 10-mm port was placed at the *eighth/ninth* intercostal space in the posterior axillary line. Two 5-mm ports were placed inferior to the tip of the scapula and anterosuperiorly in the fifth intercostal space. Single lung ventilation was established, allowing for medial retraction of the lung and exposure of the mediastinum. A 30° laparoscope was used to explore the chest and no abnormalities were found (*detail abnormalities* and *biopsies taken*). A suture was placed in the costophrenic recess anteriorly to provide traction on the diaphragm and provide exposure of the distal thoracic esophagus. The inferior pulmonary ligament was divided and the lung retracted cephalad. Care was taken to avoid injury to the inferior pulmonary vein.

The mediastinal pleura overlying the esophagus was incised to the level of the azygos vein. The esophagus was then encircled with a Penrose drain to assist with retraction. The azygos vein was divided using a vascular load stapler. A lymph node dissection was performed and remained en bloc with the surgical specimen.

The recurrent laryngeal nerves were identified superiorly and protected. The thoracic duct was identified and lymphatic attachments to the esophagus were clipped and divided. Branches between the aorta and esophagus were also clipped and divided (*or coagulated with a harmonic scalpel*). The remainder of the thoracic esophagus was mobilized circumferentially from the thoracic inlet to the level of the diaphragm. No bleeding, air leaks, or chyle leaks were visualized. The Penrose drain was placed in the thoracic inlet for later retrieval. __ mL of bupivacaine was injected into the intercostal space, and a *28 French* thoracostomy tube placed. The right lung was reinflated and the airway and lung were examined for air leaks. The thoracic ports were closed.

The patient was turned to the supine position. *The double-lumen endotracheal tube was exchanged for a single-lumen endotracheal tube.* The abdomen was reprepped and draped in the standard surgical manner. An 11-mm port was placed in the right epigastrium. Two 5-mm ports were placed along the right costal margin for liver retraction, one 5-mm port in the left costal margin, and one 5-mm port in the left epigastrium opposite the 11-mm port. The left lobe of the liver was retracted using a self-retaining system.

The hepatogastric ligament was divided toward the right crus of the diaphragm, with dissection of the right and left crura. Dissection of the esophageal hiatus was continued to the top of the left crus and the phrenogastric attachments were divided in this area. Care was taken not to enter the thoracic cavity and to maintain the phrenoesophageal attachments to preserve abdominal pneumoperitoneum.

The stomach was mobilized by the division of the short gastric vessels along the greater curve and the gastrocolic omentum. Care was taken to avoid the gastroepiploic vessels and arcade, and attention was paid to avoid injury to the transverse colon. The hepatoduodenal attachments were divided along the lateral duodenum and the stomach was mobilized superiorly. Care was taken not to handle the stomach directly to avoid damaging the vascular supply. The lymph nodes and fat around the celiac axis were dissected and mobilized. The left gastric artery was divided with a vascular stapler (*or LigaSure*).

Another 11-mm port was inserted in the right lower quadrant, and an atraumatic grasper was used to retract the pylorus inferiorly. An endoscopic stapler was placed above the right gastric artery and fired perpendicular to the lesser curve with attention paid to preserving the first arterial arcades. __ staple loads were used to create the gastric tube as the stapling progressed cephalad parallel to the greater curve. Throughout the stapling, cephalad and caudad traction was maintained to limit inadvertent twisting or shortening of the gastric tube.

After creation of the gastric tube, a *pyloroplasty/pyloromyotomy* was performed. Stay sutures were first placed above and below the anterior aspect of the muscle. The muscle was opened from the duodenal side along the length of the pyloric channel using harmonic scalpel. The gastric tube was suctioned clean through the pyloroplasty, and the incision was then closed __ stitches, in two layers.

A feeding jejunostomy was placed using a *needle catheter system/14-French catheter*. A loop of jejunum was identified approximately 30 cm distal to the ligament of Treitz. The jejunum was tacked to the abdominal wall in the left *mid/lower* quadrant using intracorporeal suturing (*or automated suturing device*). The needle and guidewire were inserted through the abdominal wall into the jejunum, with insufflation of 10 mL of air confirming proper placement of the catheter. The loop of jejunum was tacked to the abdominal wall circumferentially covering the entry site. An additional stitch was placed several centimeters away to secure the bowel loop and avoid torsion.

The phrenoesophageal membrane was circumferentially mobilized at the hiatus, and the end of the gastric tube was sutured to the lower edge of the specimen. The abdomen was deflated and the laparoscopic equipment was withdrawn.

A cervical collar incision was made at this point and taken down through the platysma to the prevertebral fascia. The Penrose drain that had previously been left in the thoracic inlet was retrieved and the cervical esophagus was dissected free. The recurrent laryngeal nerves were again visualized and care was taken not to damage them.

The laparoscope was reinserted and the abdomen was re-insufflated. The esophageal specimen was withdrawn through the neck, while the gastric tube was pulled into the hiatus under direct laparoscopic vision. The appropriate alignment of gastric tube was confirmed with the gastroepiploic arcade toward the left crus. *Incisions were made in the left and right crura to relieve tension on the gastric tube through the hiatal opening*.

The esophageal anastomosis was performed in the neck by dividing the cervical esophagus 2 cm below the cricopharyngeus using an automatic purse-string device. An end-to-side anastomosis was performed with a 25-mm EEA stapler between the cervical esophageal stump and the fundic tip of the gastric tube (*anastomotic techniques may vary*). The EEA rings were inspected and found to be intact. A nasogastric tube was inserted and passed across the anastomosis with its tip in the gastric tube. The distal tip of the gastric tube was resected with a linear stapler.

The laparoscope was reinserted and the gastric tube was gently retracted to ensure that there was no redundancy of the conduit. The anastomosis was carefully observed through the cervical incision as the tube was retracted and no tension or dehiscence of the anastomosis was noted. The gastric tube was sutured to the hiatus laparoscopically to prevent later development of a hiatal hernia and to maintain orientation. The greater curve of the stomach was secured to the left crus, the anterior aspect of the tube was secured to the anterior crus, and the lesser curve of the tube was secured to the right crus.

The liver retractor was withdrawn and the 11-mm port defects were closed under direct vision. The abdomen was deflated and the skin was closed with a *subcuticular suture of* ___. The skin of the cervical incision was reapproximated without closure of the platysma. *Bronchoscopy was performed prior to extubation*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in satisfactory condition.

Acknowledgment This chapter was contributed by Edward Y. Chan, MD, in the previous edition.

6 Transabdominal Nissen Fundoplication

Riley K. Kitamura and Linda P. Zhang

Indications

- Chronic gastroesophageal reflux in patients unresponsive to optimal medical management
- Chronic gastroesophageal reflux with Barrett's esophagus, severe esophagitis, or peptic stricture
- Chronic gastroesophageal reflux with extra-esophageal manifestations such as asthma, chest pain, or aspiration
- Gastroesophageal caused by paraesophageal hernia (Nissen fundoplication is performed concurrently with the paraesophageal hernia repair)
- Children with gastroesophageal reflux causing severe esophagitis, pulmonary compromise, or failure to thrive
- Lung transplant recipients with gastroesophageal reflux
- Any of the above, but unsuitable for laparoscopic repair

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Essential Steps

1. Decompress the stomach with an orogastric tube.
2. Upper midline incision.
3. Explore the abdomen and confirm pathology.
4. Incise the phrenoesophageal membrane.
5. Dissect both crura, encircling the esophagus.
6. Identify and preserve both vagus nerves.
7. Close the hiatus if enlarged.
8. Divide the short gastric vessels to mobilize the fundus.
9. Calibrate the wrap with esophageal bougie.
10. Create wrap involving the anterior and posterior aspects of the fundus.
11. Check hemostasis.
12. Close the abdomen.

Note These Variations

- Hiatal closure with or without mesh
- Vagus nerves encircled in wrap or excluded from wrap
- Use of bougie
- Use of pledgets during wrap
- Modification
  - Rossetti: Wrap using the anterior wall of the fundus alone
- Partial fundoplication
  - Dor: 180° to 200° wrap
  - Toupet: 270° posterior wrap
  - Belsey Mark IV: Transthoracic 240° wrap

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_6

Complications

- Esophageal or gastric perforation
- Dysphagia/obstruction
- Wrap too loose, tight, or long
- Hiatal closure too tight (causing dysphagia) or loose (recurrent paraesophageal hernia)
- Vagus nerve injury
- Splenic injury
- Vena cava or left hepatic vein injury
- Undiagnosed motility disorders (achalasia, spasm, scleroderma)

Preoperative Diagnosis Chronic GERD refractory to medical management

Postoperative Diagnosis Same

Procedure Transabdominal Nissen fundoplication

Indications This is a ____-year-old *male/female* with *reflux/biopsy proven reflux esophagitis* that had been medically managed previously. The patient was seen in office and elected for surgical management of *his/her* gastric reflux to minimize the need for long-term medication in the future.

Description of the Procedure After informed consent was obtained, the patient was brought to the operating room and placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Venodyne boots were applied and an orogastric tube was inserted. A Foley catheter was placed under sterile conditions. All pressure points were padded and the patient was prepped and draped using aseptic technique.

A vertical midline incision was made from the umbilicus to just left of the xiphoid. The subcutaneous tissue and fascia were divided with electrocautery and the abdomen was entered under direct vision. The patient was placed in reverse Trendelenburg and the hiatus of the abdominal esophagus and the bilateral crura were visualized. The hiatus appeared *enlarged/abnormal*. A fixed retractor was then used to elevate the inferior sternum and retract the left lobe of the liver. This exposed the esophagogastric junction and hiatal crus completely.

The cephalad portion of the gastrohepatic ligament was incised taking care to identify and preserve any aberrant left hepatic artery. Next, the phrenoesophageal membrane was opened transversely, and this incision was extended to the left and right margins of the diaphragmatic hiatus. The esophagus was circumferentially freed with blunt dissection taking care to identify and avoid injury to the anterior and posterior vagus nerves. A P*enrose drain/nylon tape* was used to encircle the esophagus at the GE junction.

[Choose One:]
There was adequate intra-abdominal esophageal length (approximately 2–3 cm) .

The esophagus was retracted caudally to assist in dissecting the distal 5–6 cm of the intrathoracic esophagus.

The superior most short gastric vessels were divided with a vessel-sealing device. This was continued until the short gastric vessels were divided to the level of the angle of *His*, completely mobilizing the gastric fundus.

The crural opening was closed with interrupted ________ (silk or Ethibond) sutures, approximately 1 cm apart. At the end of this approximation, the crus was snug around the esophagus, allowing less than one fingerbreadth of space between the diaphragm edges and esophagus.

The orogastric tube and all esophageal monitors/probes were removed, and a 56-French bougie was passed through the esophagogastric junction. The crura closure was noted to be appropriately tight. To create a 360° wrap around the esophagus, the fundus was brought around the posterior aspect of the esophagus to form the medial aspect of the wrap. The wrap was able to rest behind the stomach without slippage or tension. The wrap edges were approximated with 2-0 ________ (silk or Ethibond) sutures and *included a muscular bite of the esophagus anteriorly*. A total of __sutures were used, spaced approximately 1 cm apart, so the length of the wrap was approximately 2 cm. Care was taken to ensure these sutures did not enter the esophageal or gastric lumens nor cause injury to the vagus nerves. The bougie was then removed and the tightness of the wrap was checked using a finger inserted between the wrap and esophagus. The area was irrigated and hemostasis was checked.

The fascia was closed using ____ sutures in a *running/interrupted* fashion. After the subcutaneous tissue was irrigated, the skin was closed using *staples/subcuticular sutures of* ____. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated without difficulty. *She/he* was brought to the recovery room in stable condition.

Acknowledgment This chapter was contributed by Scott Q. Nguyen, MD, in the previous edition.

Laparoscopic Nissen Fundoplication

7

Jessica K. Smith

Indications

- Reflux esophagitis unresponsive to maximal medical treatment and confirmed with 24-h pH probe
- History of aspiration and/or recurrent pneumonias
- Complications of longstanding reflux: erosive esophagitis, vocal cord changes, esophageal stricture, and Barrett's esophagus
- Unwillingness or inability to remain on lifelong acid suppression therapy
- Symptomatic paraesophageal hernia with reflux
- Children with severe esophagitis, recurrent pneumonia, or failure to thrive

Essential Steps

1. Supine or modified lithotomy with a steep reverse Trendelenburg position.
2. Foley catheter and nasogastric or orogastric tube.
3. Induce pneumoperitoneum.
4. Mark xiphoid and bilateral costal margins.
5. Place the first 5- or 12-mm trocar just to the left of midline 12–15 cm below the xiphoid depending on the height of the patient.
6. Inspect the abdomen with a 30° or 45° 5- or 10-mm laparoscope.
7. Place four additional trocars:
   - Operating ports: Two 12-mm trocars are placed in the bilateral subcostal margins in the midclavicular line. A 5-mm trocar can be used on the right side depending on instrumentation and preferences.
   - Assistant port: One 5- or 12-mm trocar is placed in the left anterior axillary line at the same level as the camera port.
   - Liver retractor: Depending on the retractor to be used, one 5- or 10-mm trocar is placed in the right midaxillary line at the same level as the camera port. (Note: If a Nathanson retractor is used, a 5 mm incision is made just below the xiphoid to accommodate the instrument).
8. Elevate and retract the left lobe of the liver to expose the hiatus.
9. Downward traction on the stomach to reduce hernia if present, held in place by the assistant. If a hiatal hernia is present, the hernia sac should be circumferentially incised to reduce the hernia contents below the diaphragm and mobilize the esophagus to obtain at least 2 cm of intra-abdominal length (Chap. 12).

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_7

10. Open the gastrohepatic ligament at the pars flaccida to expose the caudate lobe and right crus.
11. Develop the medial plane between the right crus and the esophagus.
12. Continue peritoneal incision over the hiatus.
13. Expose the left crus and decussation.
14. Complete atraumatic circumferential dissection of the esophagus.
15. Create a large enough retroesophageal window such that there is excellent visualization of the left upper quadrant looking from the right side.
16. Identify and preserve both vagus nerves.
17. Close the crura such that a small amount of space remains between the topmost stitch and the esophagus.
18. Divide the short gastric vessels to mobilize the fundus.
19. Pass an esophageal bougie under direct visualization with the laparoscope. Use 56–60-Fr bougie.
20. Create a loose floppy wrap by passing the fundus behind the esophagus and performing the "shoeshine" maneuver.
21. Suture the fundus to itself with the first stitch to size the wrap with the bougie in place.
22. Withdraw the bougie under direct visualization with the laparoscope.
23. Place two additional sutures in the fundoplication which include the anterior esophageal wall and create a wrap length of 2 cm just below the GE junction.
24. May perform the following gastropexy stitches: A stitch at the 3 o'clock position of the wrap which includes the wrap, esophagus, and left crus. A posterior stitch which includes the wrap and the crural repair. A third stitch at the 9 o'clock position which includes the wrap, esophagus, and the right crus.
25. Ensure hemostasis.
26. Remove the liver retractor under direct visualization and inspect for bleeding.
27. Remove ports under direct visualization, closing any dilated fascial defects.
28. Release pneumoperitoneum.
29. Proceed with skin closure.

Variations

- Position of the patient
- Size of the esophageal bougie
- Type of liver retractor
- Type of suture
- Suturing device and intra- or extracorporeal knot tying
- Gastropexy sutures
- 30° or 45° laparoscope

Complications

- Trocar injuries to the vessels or viscera
- Injury to the esophagus
- Injury to the spleen or stomach
- Wrap too loose or too tight causing recurrent reflux or dysphagia
- Hiatal closure too tight, causing esophageal obstruction
- Hiatal closure too loose, permitting paraesophageal herniation or wrap slippage
- Injury to the vagus nerves
- Pneumothorax or tension pneumothorax

Template Operative Dictation

Preoperative Diagnosis *Reflux esophagitis/Barrett's esophagus/aspiration due to reflux/other*

Procedure Laparoscopic Nissen fundoplication

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had *biopsy-proven reflux esophagitis/Barrett's esophagus/aspiration due to reflux/other. This had been refractory to medical management/the patient did not want to remain on lifelong acid suppression therapy/other*. The decision was made to proceed with laparoscopic Nissen fundoplication.

Description of Procedure The patient was placed on the operating table on a secured vacuum beanbag/split-leg table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. *A Foley catheter and nasogastric/orogastric tubes were placed. The legs were placed in stirrups with appropriate padding*. The right arm was tucked to accommodate the liver retractor. *The beanbag was placed to suction to secure the patient*. The abdomen was prepped and draped in the usual sterile fashion. The xiphoid and costal margins were marked with a marking pen. A point 12 cm from the xiphoid just to the left of midline was chosen for the camera port. A transverse incision was made to accommodate a 5/12-mm trocar.

[Choose One:]

For Veress needle: *The Veress needle was inserted in the left upper quadrant at Palmer's point. Proper position was confirmed by aspiration and saline meniscus test. A 5-/12-mm trocar was then inserted.*

For Hasson cannula: *The fascia was elevated and incised. Entry into the peritoneum was confirmed visually and no bowel was noted in the vicinity of the incision. Two figure-of-eight sutures of 2-0 Vicryl were placed and the Hassan cannula inserted under direct vision. The sutures were anchored around the cannula.*

The abdomen was insufflated with carbon dioxide to a pressure of 15 mmHg. The patient tolerated the pneumoperitoneum well. The 30°, 5-/10-mm laparoscope was inserted and the abdomen inspected. No injuries from Veress needle or initial trocar placement were noted. Additional trocars were then inserted under direct vision in the following locations: Two 5-/12-mm trocars were placed in the bilateral subcostal margins in the midclavicular line. An assistant port using a 5-/12-mm trocar was placed in the left anterior axillary line at the same level as the camera port. The final fifth 5-/12-mm trocar was placed in the right midaxillary line at the same level as the camera port for the liver retractor. No injuries were noted during port placement.

The patient was placed in reverse Trendelenburg position. A liver retractor was introduced in the right subcostal port to elevate the left lobe of the liver and expose the hiatus. A 10-mm endoscopic Babcock clamp was introduced through the left assistant port and used to grasp the stomach and gently pull it toward the left lower quadrant.

The gastrohepatic ligament was opened with the *ultrasonic shears/electrocautery* beginning at the pars flaccida. The peritoneum was incised anteriorly over the hiatus to the left crus. The right crus was identified and cleared of investing tissue and the medial plane between the right crus and esophagus was developed and the crural decussation visualized. The dissection was then carried over the arch of the crura. The left crus was similarly dissected and the phrenoesophageal ligament divided. The vagus nerves were identified and protected. The esophagus was gently elevated with a closed grasper, and dissection progressed underneath the esophagus until the esophagus was fully mobilized and a large retroesophageal window had been created.

An *esophageal retractor/Penrose drain* was then passed under the esophagus. The esophagus was encircled to include the vagus nerves and the Penrose secured with *large endoscopic clips/Endoloop tie*. The assistant then released the stomach and grasped the Penrose to maneuver the esophagus.

The superior most short gastric vessels were divided with ultrasonic shears and the fundus of the stomach was completely mobilized. The nasogastric/orogastric tube was removed. With the esophagus and stomach in a neutral position, a 56-Fr bougie was slowly passed under direct visualization with the laparoscope.

Attention was then directed to the hiatus. __ simple interrupted sutures of *0 Ethibond/Silk/Tycron* were placed to approximate the hiatus behind the esophagus, and the __-Fr bougie was inserted to ensure that the hiatal closure is appropriately tight. At least 2 cm of intra-abdominal esophagus was observed.

With the esophagus gently retracted anteriorly, a grasper was passed behind the esophagus and the fundus grasped and pulled over to the right side behind the esophagus. It passed easily and the proper orientation was ensured by performing the “shoeshine” maneuver. The wrap was approximated to itself without tension using a 2-0 silk suture, creating a 360° floppy wrap around the distal esophagus. The esophageal bougie was then removed. Two additional sutures were placed in the wrap which included a partial-thickness bite of esophagus to anchor the wrap. A wrap length of 2 cm was formed just below the GE junction.

[Optional]: Three additional gastropexy sutures were placed using 2-0 silk suture. The first stitch was placed at the 3 o’clock position of the wrap which included the wrap, esophagus, and left crus. A posterior stitch which included the wrap and the crural repair was placed. A third stitch was placed at the 9 o’clock position which included the wrap, the esophagus, and the right crus.

Hemostasis was achieved. The liver retractor was removed under direct visualization and the liver inspected for any bleeding. The trocars were removed one at a time and the fascial openings carefully inspected. Any dilated defects were reapproximated with a transfascial suture. Pneumoperitoneum was released, the laparoscope was withdrawn, and the umbilical trocar was removed. The skin was closed with subcuticular sutures of ___ and Steri-Strips/skin adhesive.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in satisfactory condition.

8 Laparoscopic Partial Fundoplication

Peter Nau

Indications

1. Symptoms of gastroesophageal reflux disease (GERD) refractory to maximal medical management

   Symptoms that are best treated by anti-reflux surgery include heartburn and regurgitation, particularly in those that have a positive response to medical management. Atypical symptoms such as cough, hoarseness, globus sensation, or vocal cord changes are less likely to positively respond to anti-reflux surgery, and the patient should be counseled as such.
2. Intolerance of anti-reflux medications due to side effect profile
3. Unwillingness to sustain polypharmacy acid suppression regimen to control symptoms
4. Complications from poorly controlled reflux including Barrett's esophagus, erosive esophagitis, and esophageal strictures
5. Objective evidence of ineffective esophageal motility

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Essential Steps

1. Appropriate positioning and anchoring of patient to operative table to allow for steep reverse Trendelenburg, supine, and split-leg position.
2. Thoughtfully position the five trocars to allow for optimal visualization and access to the foregut structures.
3. Identify and dissect the crura bilaterally and posteriorly to identify the confluence of the right and left sides.
4. Mobilize the esophagus sufficiently to achieve enough abdominal esophagus for a tension-free fundoplication placed on the distal esophagus.
5. Carefully reapproximate the crura with space to accommodate the esophagus without constriction.
6. Create of a loose anterior (180° Dor) or posterior partial fundoplication (270° Toupet).

Note These Variations

- Anterior (180° Dor)
- Posterior partial fundoplication (270° Toupet)
- Intraoperative upper endoscopy

Complications

1. Injury to underlying viscera while obtaining access and placing trocars

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_8

2. Esophageal, splenic, or gastric injury from excessive tension or inaccurate dissection of hiatus
3. Hiatal closure too tight or too loose
4. Wrap placed under tension due to incomplete dissection of the fundus, wrap placed too tight, and/or wrap twisting during retroesophageal passage
5. Injury to vagus nerves
6. Injury to pleura causing pneumothorax

Operative Template

Preoperative Diagnosis Gastroesophageal reflux disease refractory to maximal medical management

Postoperative Diagnosis Gastroesophageal reflux disease refractory to maximal medical management

Procedure Performed Laparoscopic partial (Dor/Toupet) fundoplication

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was then initiated per anesthesia protocol. The patient was then placed into the French or split-leg position with all pressure points adequately padded, towels fixed around the patient's lower extremities, and footboards in place to appropriately anchor the patient to the bed. An orogastric tube was placed to assist with gastric decompression. The patient's abdomen was then prepped and draped in the usual sterile fashion.

[Note]
In most cases, the arms can both be extended to allow for anesthesia access should this become necessary. Foley catheter placement is determined at surgeon's discretion.

Following this, a stab incision was made in the left upper quadrant, and a Veress needle was passed into the abdominal cavity. Having verified an appropriate opening pressure, the abdomen was insufflated with CO_2 to a pressure of 15 mmHg. A five-port technique was used. A 12-mm port was placed 15 cm caudal to the xiphoid process and just left of midline. 5-mm ports were placed in the anterior axillary lines bilaterally. A 12-mm port was placed 12 cm lateral to the xiphoid process along the left costal margin. A flexible liver retractor was inserted through the lateral right upper quadrant port, and the left liver lobe was elevated with the self-forming liver retractor. The last 5-mm port was then placed in the right midclavicular line for the surgeon's left hand. Next, the patient was placed into steep reverse Trendelenburg position to facilitate visualization of the foregut structures.

[Note]
A Hassan port can be used for accessing the abdominal cavity. It is important to note that this may result in inaccurate port placement due to the changes in the abdominal wall contour that occur after insufflation. The camera trocar can be a 5-mm port should the surgeon chose to use a 5-mm camera. It is important to place this trocar lateral enough to avoid creating parallax from the camera. The left hand working port should be placed after retracting the liver so as to avoid obstruction of the instruments the surgeon's left hand will use.

Through the operating left midclavicular port, a harmonic energy device was used to divide the lesser omentum. Dissection was then continued cephalad and the right crus was identified. The potential space between the right crus and esophagus was developed with blunt dissection and the harmonic energy device. Dissection was carried cephalad and laterally taking down the phrenoesophageal ligament and identifying the left crus.

[Note]
It is important to dissect the crus rather than dissect the esophagus as this will avoid inadvertent esophageal injuries. The surgeon may choose to initiate dissection at the left crus first. In some cases, there may be an accessory left hepatic artery encountered within the gastrohepatic liga-

ment. This can be preserved if it does not interfere with the operation. In the event that it hinders operative visualization, it is best to first manually occlude the vessel with a laparoscopic grasper to verify that this is an accessory rather than replaced blood vessel. In the absence of hepatic ischemia, the vessel can be clipped proximally and distally and transected with the energy device.

Once dissection is carried as far posteriorly along the left crus as possible, attention was turned to the greater curvature of the stomach. The short gastric vessels were then transected using the harmonic energy device starting at the mid-body of the stomach. Dissection was continued superiorly to facilitate identification and complete dissection of the left crus. Once this was completed, attention was returned to the right crus where dissection was completed to provide for identification of the posterior crural confluence. Next, a retroesophageal window was created to allow for the fundoplication to pass without resistance. A Penrose drain was then passed around the esophagus and fixed in place with an Endoloop.

[Note]

There are often posterior short gastric vessels and retrogastric attachments that need to be transected. If these are left intact, passing the fundus posterior to the esophagus without undue tension can be prohibitively difficult. Furthermore, leaving too many short gastric vessels intact can make cephalad and medial rotation of the stomach difficult. In the setting of an anterior, partial fundoplication, the short gastric vessels can often be left intact. Finally, it is imperative that adequate intra-abdominal esophagus is obtained to ensure that the fundoplication is placed around the esophagus and without tension. This may necessitate mediastinal dissection in the event that the patient has a hiatal hernia.

[Choose One:]

Posterior fundoplication (270° Toupet)

The posterior crura were then reapproximated using __ sutures making sure that there was adequate space for the esophagus. For completion of the posterior 270° fundoplication, the fundus of the greater curvature of the stomach was visualized through the retroesophageal window and grasped and brought posterior to the esophagus. Attention was paid to ensure that the greater curve was not twisted during passage of the fundus. A shoeshine maneuver was then completed to ensure that there was not inappropriate tension on the wrap. A 270°, 2–2.5 cm Toupet fundoplication was then created again using interrupted 2-0 silk sutures. This was done first on the right side with the initial, most proximal stitch incorporating the esophagus, fundus, and right crura. The next two stitches included only the esophagus and stomach. The process was completed in a mirror image on the left side. The wrap was then fixed to the diaphragm with two posterior stitches between the wrap and the right crura adjacent to the crural confluence.

Anterior fundoplication (180° Dor)

The posterior crura were then reapproximated using __ sutures making sure that there was adequate space for the esophagus. For completion of the anterior 180° fundoplication, the fundus was grasped and draped anteriorly over the esophagus to assess for a tension-free wrap. A row of three, 2-0 silk sutures were placed between the fundus, esophagus, and left pillar of the crus to recreate the angle of His. The initial stitch was placed cephalad with subsequent stitches working caudally. The fundus was then again rolled over the esophagus medially with three additional 2-0 silk sutures placed between the right crura and the fundus to complete the anterior fundoplication. Finally, two additional stitches are placed between the fundus and the hiatus anteriorly to help alleviate any tension on the wrap and to close up the space across the anterior hiatus.

[Note]

There are many different approaches for reapproximating the crura including variable suture size, intra- vs. *extracorporeal suturing, and third-party suturing devices. There is not one absolute correct method for completion of this step. Passage of the esophageal bougie for sizing of the crural closure can be performed at the surgeon's discretion. It is a potentially hazardous maneuver and must be done with direct communication between the anesthesia and surgery staff.*

An intraoperative EGD was performed showing no blood in the stomach or esophagus. Following insufflation of the stomach, the wrap was inspected during retroflexion and was noted to be appropriately tight in the proper position. Blood at the upper quadrant was suctioned out and the 5 mm liver retractor was removed. Following this, the abdomen was deflated, all ports were removed under direct visualization, and the skin edges were reapproximated with 4-0 absorbable monofilament stitches. Long-acting local anesthetic was injected into all port sites and all wounds were dressed with surgical skin adhesive. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room without any difficulties and was brought to the PACU in a stable condition.

9 Laparoscopic Magnetic Sphincter Augmentation Device Using the Linx System

Peter Nau

Indications

– Symptoms of GERD refractory to maximal medical management
– Intolerance of anti-reflux medications due to side effect profile
– Unwillingness to sustain polypharmacy acid suppression regimen to control symptoms
– Complications from poorly controlled reflux including Barrett's esophagus, erosive esophagitis, and esophageal strictures

Essential Steps

1. Appropriately position and anchor patient to the operative table to allow for steep reverse Trendelenburg, supine and split-leg position.
2. Thoughtfully position five trocars to allow visualizing and accessing the esophagus.
3. Dissect the esophagus and preserve the phrenoesophageal ligament and hepatic branch of the vagus nerve.
4. Mobilize posterior vagus off the esophagus.
5. Consistently and accurately size the esophagus with manufacturer-provided sizing device.
6. Position the MSAD and lock it in place.

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Complications

1. Injury to underlying viscera while obtaining access and placing trocars
2. Esophageal or gastric injury
3. Inappropriately sized MSAD resulting in poor reflux control or dysphagia

Operative Template

Preoperative Diagnosis Gastroesophageal reflux disease refractory to maximal medical management

Postoperative Diagnosis Gastroesophageal reflux disease refractory to maximal medical management

Procedure Performed Laparoscopic magnetic sphincter augmentation device (MSAD) implantation

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was then initiated per anesthesia protocol. The patient was then placed into the French or split-leg position with all pressure points adequately padded, towels fixed around the patient's lower

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_9

extremities, and footboards in place to appropriately anchor the patient to the bed. An orogastric tube was placed to assist with gastric decompression. The patient's abdomen was then prepped and draped in the usual sterile fashion.

Notes *In most cases, the arms can both be extended to allow for anesthesia access should this become necessary. Foley catheter placement is determined at surgeon's discretion, but is typically unnecessary if the patient voided prior to surgery.*

Following this, a stab incision was made in the left upper quadrant and a Veress needle was passed into the abdominal cavity. Having verified an appropriate opening pressure, the abdomen was insufflated with CO_2 to a pressure of 15 mmHg. A five-port technique was used. A 5-mm port was placed 15 cm caudal to the xiphoid process and just left of midline. 5-mm ports were placed in the anterior axillary lines bilaterally. A port was placed 12 cm lateral to the xiphoid process along the left costal margin and a mirror image 5-mm port in the right abdominal wall. Through the right lower quadrant port, a flexible liver retractor was inserted and the left liver lobe was elevated with self-forming liver retractor. Next, the patient was placed into steep reverse Trendelenburg position to facilitate visualization of the foregut structures.

Notes *A Hasson port can be used for accessing the abdominal cavity. It is important to note that this may result in inaccurate port placement due to the changes in the abdominal wall position that occur after insufflation. The larger, left-sided working port needs to be able to accommodate the MSAD which is just slightly larger than 5 mm in diameter. Contrasting the port placement for a Nissen fundoplication, the right lateral port is placed more laterally to allow for appropriate angles to dissect the esophagus, utilize the esophageal sizing device and placement of the MSAD.*

The operation was begun by identification of the left crus. The lesser omentum was then retracted anteriorly and the hepatic branch of the vagus nerve was identified. A window in the lesser omentum was created caudal to this structure to obtain better visualization of the right crus during MSAD placement. An additional window in the lesser omentum was created cephalad to the hepatic branch of the vagus. Dissection of the esophagus was started here, moving from a medial to lateral direction. The phrenoesophageal ligament moving from a medial to lateral direction. The phrenoesophageal ligament was identified and preserved during this process. The fundus of the stomach was then grasped through the assistant port and retracted lateral and inferiorly to facilitate visualization of the left crus. The esophagus was then mobilized off of the left crus as far posteriorly as possible. Attention was then turned back to the right crus. The hepatic branch of the anterior vagus was again identified and preserved. Approximately 1 cm distal to this landmark, a retroesophageal window was created. This was done with serial sweeping motions to bluntly dissect the esophagus off of the crura. A Penrose drain was then passed around the esophagus and fixed in place with an Endoloop. Having done this, the posterior vagus was identified and dissected bluntly off of the esophagus to allow for placement of the MSAD.

Notes *Dissection can be completed with a harmonic energy device, bipolar energy device, or simple cautery depending on the surgeon's comfort level. It is often helpful to transfer the Penrose drain through the potential space between the esophagus and the posterior vagus nerve to assist with MSAD sizing and placement.*

Next, the esophageal sizing device provided by the manufacturer was inserted through the left-sided working port, through the retroesophageal window anterior to the vagus nerve, and deployed at least two times to find the appropriate size for the MSAD. Having determined the device size, the MSAD was delivered through the left-sided working port and passed anterior to the posterior vagus and around the esophagus. The two ends were fixed together using the locking mechanism and the Penrose drain was removed.

Notes *During the sizing maneuver, everything including the orogastric tube must be removed from the esophagus. Furthermore, it is important* *to exclude the posterior vagus from this measurement so as to avoid inappropriate sizing of the esophagus. An intra-op endoscopy following MSAD implantation to investigate for inadvertent injuries to the esophagus and stomach can be performed at the surgeon's discretion.*

Blood at the upper quadrant was suctioned out and the 5-mm liver retractor was removed. Following this, the abdomen was deflated, all ports were removed under direct visualization, and the skin edges were re-approximated with 4-0 absorbable monofilament stitches. Long-acting local anesthetic was injected into all port sites and all wounds were dressed with surgical skin adhesive. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room without any difficulties and was brought to the PACU in a stable condition.

Transthoracic Collis Gastroplasty and Nissen Fundoplication

10

Simon Fitzgerald and Edward H. Chin

Indication

- Gastroesophageal reflux disease with inadequate intra-abdominal esophageal length for standard transabdominal Nissen fundoplication

Essential Steps

1. Intubate with double-lumen endotracheal tube or an endotracheal tube with endobronchial blocker and deflate the left lung.
2. Place the patient in right lateral decubitus position.
3. Perform a left posterolateral thoracotomy in the sixth or seventh intercostal space. Can optionally excise 1 cm of eighth rib posteriorly.
4. Incise the mediastinal pleura overlying the esophagus.
5. Divide the inferior pulmonary ligament for additional exposure.
6. Mobilize the esophagus from the level of the carina to the diaphragm, dividing aortic branches as necessary.
7. Identify and preserve the vagus nerves.
8. Place a Penrose drain around the esophagus for traction.
9. Dissect the hernia sac from the right and left crura.
10. Divide the phrenoesophageal membrane and enlarge the hiatus bluntly.
11. Incise the gastrohepatic ligament in an avascular plane.
12. Divide the short gastric vessels.
13. Reapproximate the right and left crura posteriorly with two to four permanent sutures; leave untied until gastroplasty and fundoplication completed. Pledgets may be used to reinforce the sutures.
14. Retract the fundus of the stomach into the chest.
15. Pass a 54–60-French esophageal bougie into the stomach along the lesser curvature.
16. Divide the fundus with a gastrointestinal anastomosis (GIA) stapler parallel to the lesser curvature.
17. Oversew gastric staple lines with running 2-0 silk sutures.
18. Create 360° floppy Nissen fundoplication around the neoesophagus.
19. Secure the wrap with two to three interrupted sutures of 2-0 silk, incorporating a partial thickness bite of anterior esophagus or neoesophagus with each bite.
20. Remove the bougie.
21. Gently reduce the wrap into the abdomen.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_10

22. Tie previously placed crural sutures.
23. Confirm that the surgeon's index finger passes through the hiatus next to the esophagus.
24. *If the hiatal hernia defect was very large, consider reinforcement with an onlay of biologic mesh.*
25. Place a *28-French* thoracostomy tube.
26. Close the thoracotomy incision.

Note These Variations

- Double-lumen endotracheal tube or endobronchial blocker may be used to achieve single-lung ventilation.
- Number of sutures used to close the hiatus and to create gastric wrap.
- Optional use of pledget reinforcement of the sutures used to close the hiatus.
- One centimeter of eighth rib can be excised posteriorly for improved exposure.
- Short gastric vessels may be divided with harmonic scalpel or silk ties.
- Hiatal closure may be reinforced with biologic mesh.

Complications

- Leakage from gastric staple lines
- Ischemic necrosis of gastroplasty tube
- Injury to the esophagus, vagus nerves, stomach, and spleen
- Dysphagia due to excessively tight wrap or hiatal closure
- Recurrent hiatal hernia
- Gastroesophageal reflux

Template Operative Dictation

Preoperative Diagnosis Gastroesophageal reflux disease with the short esophagus

Postoperative Diagnosis Same

Procedure Transthoracic Collis gastroplasty with Nissen fundoplication

Indications The patient is a ___-year-old *male/female* with long-standing gastroesophageal reflux disease refractory to medical management who has elected for surgical management. *His/her* preoperative endoscopy and upper GI series demonstrated findings concerning for a foreshortened esophagus.

Description of Procedure A *thoracic epidural catheter was placed by anesthesia for perioperative pain control*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After general anesthesia was induced, the patient was intubated with a double-lumen endotracheal tube *or single-lumen tube with an endotracheal blocker*, placed in the right lateral decubitus position, and padded appropriately. The operating table was flexed to widen the rib space. The left chest was prepped and draped in the standard sterile fashion.

Single-lung ventilation was established by deflating the left lung.

[Choose One]
If posterolateral thoracotomy: An incision was performed through the sixth *or seventh* intercostal space. The latissimus dorsi was divided. *A 1-cm segment of the eighth rib was excised posteriorly.* The chest cavity was then entered. The inferior pulmonary ligament was divided with electrocautery to the level of the inferior pulmonary vein to assist with exposure.

If muscle sparing thoracotomy: A left-sided incision was made in the sixth intercostal space, from the midaxillary line to the anterior border of the latissimus dorsi muscle. The anterior border of the latissimus dorsi muscle and the serratus anterior muscle were exposed. The anterior portion of the latissimus dorsi muscle was elevated off the chest wall and preserved. The serratus anterior muscle was split along its direction and chest entry was obtained.

The mediastinal pleura overlying the esophagus was longitudinally incised, and the distal esophagus circumferentially dissected, dividing aortic branches as necessary. The esophagus was encircled with a Penrose drain for gentile retraction. The right and left vagus nerves were identified and carefully preserved. Dissection was continued inferiorly to expose the right and left crura.

The esophagus was retracted anteriorly to expose the phrenoesophageal membrane, which was divided with blunt and sharp dissection. The left crus was then retracted laterally, and the hiatus was spread to better visualize the stomach. The herniated stomach/cardia of the stomach was freed circumferentially from the hiatus, and the sac excised. The gastrohepatic ligament was identified and divided in an avascular plane. The short gastric vessels were *divided using the harmonic scalpel/ligated with 2-0 silk sutures* taking care to avoid excessive traction on the spleen.

The crura were approximated posterior to the esophagus with *two to four* interrupted sutures of 0 Ethibond and left untied. *Note: Pledget reinforcement of the sutures is optional.* Despite adequate mediastinal dissection, there was inadequate length of intra-abdominal esophagus for a good hiatal hernia repair with fundoplication. Therefore, transthoracic Collis gastroplasty was deemed to be necessary. The fundus of the stomach was delivered into the chest using a Babcock clamp.

A 54–60-French bougie was placed to size the neoesophagus diameter. The bougie tip was advanced to the distal stomach and placed along the lesser curvature. The fundus was then divided parallel to the lesser curvature with a 60-mm gastrointestinal anastomosis (GIA) stapler loaded with 3.5-mm staples, resulting in an approximately 4–5-cm neoesophagus. *Both staple lines were oversewn with running 3-0 absorbable sutures in a seromuscular fashion.*

Then, a 360° floppy Nissen fundoplication was constructed using *two to three interrupted 2-0 silk sutures.* Each suture incorporated the left and right side of the fundus, and an anterior bite of the esophagus or neoesophagus. Care was taken to avoid injuring the anterior vagus nerve.

The bougie was then removed, and the stomach returned to the abdomen. The crural sutures were then tied down, ensuring that a finger could still be passed behind the esophagus. The chest was irrigated and appropriate homeostasis obtained. The divided mediastinal pleura was reapproximated with a running 3-0 Vicryl suture. A 28-French thoracostomy tube was placed, and the thoracotomy incision was closed.

If posterior lateral thoracotomy: *Heavy absorbable pericostal sutures were used to close the intercostal muscles. The muscular layers were closed with 2-0 Vicryl suture.*

The skin was closed with *staples/a running subcuticular suture of 4-0 suture.* The procedure was well tolerated. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated without incident and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Mark Shapiro, M.D., in the previous edition.

11 Laparoscopic Collis Gastroplasty and Nissen Fundoplication

Mohamad H. Alaeddine,
Ghassan A. Shamseddine, and Bassem Y. Safadi

Indications

- Gastroesophageal (GE) reflux disease with short esophagus
- Paraesophageal hiatal hernia with short esophagus

Essential Steps

1. Position the patient in modified lithotomy with reverse Trendelenburg for better exposure of the GE junction.
2. Place five ports in the upper abdomen: The first (camera) port should be high around 12–15 cm below the xiphoid process.
3. Place the two working ports a "handsbreadth" away from the camera port in the upper abdomen on each side of the midline.
4. Place a 5-mm port on the left side in the anterior axillary line.
5. Retract the liver.
6. Open the pars flaccida and divide all peritoneal covers over the crura and esophagus.
7. Identify the posterior vagus nerve and develop a retrogastric window.
8. Divide the short gastric vessels and mobilize the fundus.
9. Release all mediastinal attachments of the distal esophagus.
10. If after all the mobilization the GE junction does not rest at least 2 cm below the crura, a Collis gastroplasty is warranted.
11. Perform intraoperative endoscopy to accurately identify the GE junction and mark the exact location on the serosal side with the aid of the endoscope.
12. Place a 48-Fr bougie transorally into the stomach.
13. Exchange the left-sided 5-mm port for a 12-mm port.
14. Introduce an angulated laparoscopic stapler via the left-sided port and staple transversely across the fundus to reach the bougie around 3 cm below the GE junction (more than one fire may be needed).
15. Fire another staple line vertically snugly along the bougie to the angle of His (thus excising a wedge of the fundus and creating a 3-cm extension of the GE junction).
16. Complete the procedure as a standard fundoplication: closure of the crura and the creation of a 360° wrap around the neo-esophagus.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_11

17. Take care to place the fundic flaps at and above the level of the GE junction.
18. Remove the Bougie and check the integrity of the staple line with endoscopy or methylene blue.

Note These Variations

- A combined laparoscopic/thoracoscopic approach can be done with the endoscopic stapler placed from the chest oriented alongside the esophagus to lengthen it. Both right- and left-sided thoracoscopic approaches have been described.
- Another approach is to use a circular stapler similar to the vertical banded gastroplasty approach. The circular stapler is fired 3–4 cm below the GE junction creating window that allows the firing of the vertical stapler.

Complications

- Bleeding
- Dysphagia
- Staple line leak
- Pulmonary embolism

Template Operative Dictation

Preoperative Diagnosis Gastroesophageal reflux disease

Procedure Laparoscopic Collis gastroplasty with fundoplication

Postoperative Diagnosis Same, with short esophagus

Indications Gastroesophageal reflux disease refractory to medical therapy with short esophagus

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The patient was placed in the modified lithotomy position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

A 10-mm incision was made 12 cm below the xiphoid process to the left of midline. Then under direct vision, a 10-mm trocar was inserted and the abdomen was inflated with CO_2 till 14 mmHg. Then under direct laparoscopic vision, a 10-mm trocar was inserted into the left subcostal area in the epigastric region to be used as the right hand working port, and another 10-mm trocar was inserted into the right subcostal area for the left hand. Another 5-mm trocar was inserted into the left anterior axillary line at the umbilical level for the assistant.

The operating table was placed in reverse Trendelenburg position, and the left lobe of the liver was retracted laterally to expose the esophageal hiatus using a Nathanson fixed liver retractor through a 5-mm subxiphoid incision.

Then using the LigaSure® or Ultracision®, the gastrohepatic ligament (pars flaccida) was then divided. The right diaphragmatic crus was identified and the peritoneum at its border was incised all the way to reach the phreno-esophageal membrane anteriorly. That was divided from the right to the left to reach the left crus of the diaphragm. Then with blunt dissection along an avascular plane, the stomach was separated from the crura posteriorly to create a retrogastric tunnel allowing us to place a Penrose around the proximal stomach just below the GE junction. The short gastric vessels were then sealed and divided and the fundus was well mobilized. With gentle traction on the esophagus, all mediastinal attachments and small vessels were divided allowing adequate mobilization of the distal esophagus. Despite that we felt that the GE junction remained *at/above* the level of the crura.

To confirm our suspicion, intraoperative flexible endoscopy confirmed the location of the GE junction. With transillumination the squamocolumnar junction was identified and a point 3 cm distal to that on the cardia was marked with a suture.

At this stage, we decided to proceed with a lengthening gastroplasty. The most lateral 5-mm port on the left was exchanged with a 12-mm port. Then we introduced the 12-mm roticulating endoscopic stapler 45 mm with 3.8-mm cartridge, and with downward traction on the fundus, a transverse application of the stapler was fired aiming to the marking suture placed 3 cm below the GE junction. We placed a 48-Fr OG bougie transorally and into the stomach. Another transverse application of the Endo GIA 45-mm stapler was done to reach the bougie level. The stapler was then applied parallel to the bougie and snug to it aiming to the GE junction until a wedge of the fundus was excised and a "wedge lengthening Collis gastroplasty" was done. There was no significant bleeding from the staple line. The bougie was pulled back into the esophagus and with gentle traction on the esophagus the crura of the diaphragm were outlined. There was a 3-cm posterior defect that was approximated with three interrupted 0-Ethibond sutures with pledgets. We then passed the fundus in the retrogastric tunnel from left to right under minimal tension. The bougie was reintroduced and the two flaps of fundus were sutured together anteriorly with 2-0 ( )nonabsorbable suture. Using that suture for traction, the fundoplication was pushed up above the GE junction and two more sutures placed 1 cm apart were taken bringing the fundoplication together. Those incorporated the anterior wall of the esophagus. The fundus was secured posteriorly to the crural pillars of the diaphragm using a nonabsorbable suture. The bougie was removed and an orogastric tube was placed. Methylene blue filling of the tube showed no leak.

Hemostasis was secured. The trocars were removed under vision. The abdomen was deflated. The fascia defects at the 10- and 12-mm trocar sites were closed with absorbable sutures. The wounds were closed with 4-0 Monocryl continuous subcuticular sutures. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and left the operating room in good condition.

Laparoscopic Repair of Paraesophageal Hernia with Nissen Fundoplication

12

Jennifer L. Salluzzo and Kurt E. Roberts

Indications

- Symptomatic paraesophageal hernia
  - GERD unresponsive to medical treatment
  - Regurgitation, recurrent aspiration
  - Dysphagia
  - Anemia from Cameron ulcer(s)
  - Shortness of breath

Essential Steps

1. Decompress the stomach with an orogastric tube if possible.
2. Access the peritoneal cavity, place ports and liver retractor, and reduce hernia contents if applicable.
3. Take down superior short gastric vessels.
4. Dissect the plane between the left crus and the hernia sac and carry anteriorly toward the right crus.
5. Open the gastrohepatic ligament and identify the right crus.
6. Dissect the plane between the right crus and the hernia sac and meet the previous dissection plane anteriorly until the entire hernia sac is reduced.
7. Identify and preserve the right (posterior) and left (anterior) vagus nerve.
8. Dissect the retro-esophageal space so that the left crus can be seen from the right side.
9. Place a Penrose drain around the GE junction.
10. Circumferentially dissect the esophagus superiorly until 3–5 cm of esophagus is in the abdominal cavity.
11. Close the hiatus posteriorly.
12. Place a bougie down the esophagus into the stomach.
13. Create a loose floppy wrap involving the anterior and posterior aspects of the fundus.
14. Suture wrap to the esophagus to prevent the wrap from sliding.
15. Remove bougie.
16. Remove ports and liver retractor.
17. Skin closure.

Note These Variations

- Access to the abdomen (Veress needle, open Hasson, Optiview)
- May begin dissection on the right or left side of the crura
- Hiatal closure (anterior, posterior)
- Placement of mesh to reinforce crural closure
- Size of bougie (56–60 French)
- Completion endoscopy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_12

Complications

- Esophageal perforation
- Gastric perforation
- Injury to the vagus nerve
- Wrap or hiatal closure too tight leading to dysphagia
- Wrap or hiatal closure too loose leading to recurrent hiatal hernia or slipped wrap

Template Operative Dictation

Preoperative Diagnosis See indications

Procedure Laparoscopic paraesophageal hernia repair with Nissen fundoplication

Postoperative Diagnosis ___

Indications This is a ____old male/female with_________.

Description of Procedure The patient was taken to the operating room and placed in a supine position with both arms out. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Lower extremity compression boots were placed on the patient. General endotracheal anesthesia was induced. The patient's abdomen was prepped and draped in the usual sterile fashion.

Note: *Access to the peritoneal cavity can be obtained in various ways* (Veress needle, open Hasson, Optiview)

A left upper quadrant 5 mm incision was made, and the Veress needle introduced. A saline drop test was performed to confirm correct placement, and the abdomen was insufflated with CO2 up to 15 mmHg. The camera was inserted through the 5 mm VersaStep port. The abdomen was inspected. No injuries were identified.

The following ports were placed without difficulties: A right upper quadrant 5 mm port, an upper midline 12 mm port to the left of midline halfway between the xiphoid and umbilicus, and a left lateral 5 mm port halfway between the 12 mm port and the umbilicus. *A small subxiphoid incision/an additional 5 mm right lower quadrant port* was made for introduction of a Nathanson liver retractor. The left lobe of the liver was retracted allowing excellent visualization of the hiatus.

The hiatus was approached from the left side beginning by taking the superior several short gastric vessels with the *Sonicision/energy device*. The plane between the left crus and hernia sac was identified and entered with the Sonicision. The dissection was carried anteriorly toward the right crus. The anterior vagus nerve was identified and left intact. The gastrohepatic ligament was opened and the right crus identified. Once again the plane between the crus and the hernia sac was identified, entered, and carried anteriorly to meet the prior dissection. Both anterior and posterior vagi were preserved throughout the entire case. Reduction of the herniated contents into the abdominal cavity was achieved after the sac was circumferentially *dissected/resected*.

The posterior esophageal window was dissected so that the left crus could be visualized from the right side. A Penrose drain was pulled through the retro-esophageal space, placed around the GE junction, secured to itself, and used for retraction. The esophagus was circumferentially dissected superiorly *10–12 cm* until 3–5 cm of the distal esophagus above the GE junction remained without any tension in the abdominal cavity. During this dissection, the entire hernia sac was reduced. *0 Surgidac ™/silk sutures* were placed to approximate the posterior crura with the *Endostitch ™ device/others. The closure was deemed appropriately tight by placement of a __ French bougie into the stomach/describe other methods*.

Next, the posterior fundus was pulled through the retro-esophageal space. A bougie of 56–60 French was introduced by the anesthesiologist and advanced into the stomach under direct visualization without difficulties. A shoe shine maneuver was performed to ensure that the fundus is not twisted. Using the *Endostitch ™ device/others*, __ *sutures* were placed between the anterior fundus on the left, to the posterior fundus on the right. A bite of esophageal wall just to right of the anterior vagus nerve was included with *all stitches/the second and third stitch*.

[Optional]

An upper endoscopy was performed showing good positioning of the wrap and no twisting on retroflexion. No intraluminal blood or mucosal injury was seen. The esophagus, stomach, and duodenum were otherwise normal. The abdomen was inspected and good hemostasis and no injuries were identified. All instruments and ports were removed. The 12 mm fascial defect was closed with a figure-of-eight 0 Vicryl suture. The skin was closed with subcuticular stitches and skin glue was applied. All sponge, instrument, and needle counts at the end of the case were correct.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transported to the PACU in stable condition.

13 Cricopharyngeal Myotomy and Operation for Pharyngoesophageal (Zenker's) Diverticulum

Alyssa Kanaan, Rami Saade, and Nabil Fuleihan

Indication

- Symptomatic Zenker's diverticulum: dysphagia, aspiration, regurgitation, halitosis, malnutrition, and dehydration due to fear of inability to eat or drink

Essential Steps

1. Endotracheal intubation, tube shifted to the left side.
2. Perform esophagoscopy and identify the diverticulum.
3. Pack the diverticulum with gauze to help identify it during transcervical surgical exposure.
4. Insert an esophageal dilator into the esophagus under direct vision to assist in cricopharyngeal myotomy and to minimize the risk of esophageal stenosis.
5. Insert NG to be used after surgery for feeding.
6. Create a transverse incision along a skin crease between the hyoid and clavicle 4 cm above the edge of the clavicle.
7. Elevate subplatysmal flaps.
8. Retract the sternocleidomastoid muscle laterally.
9. Divide fascial attachments along the anterior border.
10. Retract the strap muscles anteromedially.
11. Divide the anterior belly of the omohyoid muscle inferiorly (specially in large diverticulae).
12. Identify the recurrent laryngeal nerve as blunt dissection is carried out to expose the posterior aspect of the pharynx, larynx, and esophagus, and protect it before ligation of the thyroid vessels if needed, depending on mobility on the thyroid lobe.
13. Retract the trachea, strap muscles, and thyroid gland medially. Take a stay suture at the neck of the diverticulum for retraction.
14. Identify the diverticulum and free it from the surrounding tissues down to its base attachment to the esophagus.
15. Perform a long cricopharyngeal myotomy.
16. Excise the pouch or invert it or suspend by a suturing or stapling technique.
17. Check hemostasis.
18. Close the wound.

Note These Variations

- Sutured or stapled resection of the diverticulum.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_13

- Diverticulopexy technique. After a cricopharyngeal myotomy and freeing the diverticulum, the sac is tacked with 2-0 silk sutures superiorly to the prevertebral fascia.

Complications

- Fistula
- Wound infection
- Bleeding
- Recurrence
- Recurrent laryngeal nerve palsy
- Pneumomediastinum
- Mediastinitis

Template Operative Dictation

Preoperative Diagnosis Symptomatic Zenker's diverticulum

Procedure Transcervical diverticulectomy

Postoperative Diagnosis Same

Indications This____-year-old *male/female* with large symptomatic Zenker's diverticulum requiring diverticulectomy for management.

Description of Procedure The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A time-out was completed verifying correct patient, procedure, site, positioning, and implant(s) and/or special equipment prior to beginning this procedure.

Esophagoscopy was performed and the diverticulum was identified and packed with gauze to assist during surgical exposure. Then an esophageal dilator and a nasogastric feeding tube were inserted under direct vision. The neck was prepped and draped in the usual sterile fashion. A transverse incision was done along a skin crease between the hyoid and clavicle. It was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. Then subplatysmal flaps were elevated and the sternocleidomastoid muscle retracted laterally for better exposure. The fascial attachments along the anterior border were divided and the strap muscles retracted anteromedially. The anterior belly of the omohyoid muscle was divided inferiorly. The attention was turned to identify the recurrent laryngeal nerve. It was successfully identified to avoid injuring it as blunt dissection was carried out to expose the posterior aspect of the pharynx, larynx, and esophagus and to protect it before the thyroid vessels were ligated. Then the trachea and thyroid gland were retracted medially. The diverticulum was then identified and freed it from the surrounding tissues down to its base attachment to the esophagus. A long cricopharyngeal myotomy was performed and the pouch was then *excised with a linear stapler/excised and closed in layers with sutures/inverted and tacked to the precervical fascia so that the mouth of the diverticulum was dependent*.

Hemostasis was achieved and the fascia was closed with ____. The skin was closed with *skin staples/subcuticular sutures of* ____.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

14 Transoral Surgery for Zenker's Diverticulum

Alyssa Kanaan, Rami Saade, and Nabil Fuleihan

Indication

- Symptomatic Zenker's diverticulum: dysphagia, aspiration, malnutrition, and dehydration due to the fear of inability to eat or drink

Essential Steps

1. Place a dental guard to protect the maxillary teeth.
2. Insert a bivalved laryngoscope or a diverticuloscope into the oral cavity to expose the common wall between the esophagus and the diverticulum (with the endotracheal tube anterior to the anterior flange of the scope).
3. Advance the lower flange of the diverticuloscope until it inserts in the diverticulum and the upper flange in the esophagus.
4. Remove food debris in the diverticulum if present.
5. Use a rigid 0 or 30° telescope connected to a video camera to magnify the view.
6. Examine the diverticular pouch carefully for any lesions.
7. Biopsy any suspicious lesions.
8. Abort the procedure in case of malignancy.
9. Expose the diverticular common wall with the flanges of the scope.
10. Divide the diverticular common wall with a disposable Endo GIA stapler by placing the blade containing the cartridge into the esophageal lumen and the opposite blade into the diverticulum.
11. Approximate the blades around the common wall, and confirm their position using the scope.
12. Activate the stapler (repeated firing may be needed).
13. Use the scope again to examine the diverticulum, esophagus, and the incision for any perforation or foreign bodies.
14. Remove the diverticuloscope under vision.

Note This Variation

- Co_2, KTP laser, or cautery can be used instead of the stapler for the cricopharyngeal myotomy.

Complications

- Esophageal perforation
- Bleeding
- Foreign body sensation
- Odynophagia

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_14

- Recurrence
- Mediastinitis

Template Operative Dictation

Preoperative Diagnosis Symptomatic Zenker's diverticulum

Procedure Transoral operation for Zenker's diverticulectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with a symptomatic Zenker's diverticulum requiring diverticulectomy for management.

Description of Procedure The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. The neck was hyperextended. A time-out was completed verifying correct patient, procedure, site, positioning, and implant(s) and/or special equipment prior to beginning this procedure.

A dental guard was placed to protect the maxillary teeth. A diverticuloscope was inserted to identify the diverticulum and the common wall between the esophagus and the diverticulum. The diverticuloscope was inserted until its lower flange rested in the diverticulum and its upper one in the esophagus. Food debris was suctioned. Using a rigid 0/30° scope connected to a video camera, the diverticular pouch was carefully examined and was found to be free of any lesions. Using an Endo GIA, the diverticular common wall was divided by placing the stapler blade containing the stapler cartridge into the esophageal lumen and the opposite blade into the diverticulum. The position of the blades was confirmed using the scope. The stapler was fired ___ times to ensure complete cricopharyngeal myotomy. The scope was used again to examine the esophagus, diverticulum, and incised common wall for any perforation, foreign bodies, or bleeding. The diverticuloscope was removed under vision.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

15 Esophagomyotomy for Achalasia and Diffuse Esophageal Spasm

Carol E.H. Scott-Conner

Indications

- Achalasia
- Diffuse esophageal spasm

Essential Steps

1. Left posterolateral thoracotomy through the sixth or seventh interspace.
2. Incise the inferior pulmonary ligament and retract the lung cephalad.
3. Incise the pleura overlying the esophagus.
4. Mobilize the esophagus.
5. Longitudinal incision through muscular layers to expose the submucosa.
6. Extend the myotomy for the entire length of hypertrophied segment proximally and onto the stomach distally.
7. Check hemostasis and integrity of the mucosa.
8. Close the pleura over the esophagus.
9. Close the chest with chest tube drainage.

Note This Variation

- Length of myotomy, both proximally and distally

Complications

- Inadequate myotomy
- Esophageal or gastric perforation
- Gastroesophageal reflux

Template Operative Dictation

Preoperative Diagnosis *Achalasia/diffuse esophageal spasm*

Procedure Esophagomyotomy via left thoracotomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had developed dysphagia and on workup was found to have *achalasia/diffuse esophageal spasm*. The decision was made for esophagomyotomy. Because of *previous failed procedures/length of myotomy required/anticipated difficulty of the procedure*, an open approach was required.

Description of Procedure Time-outs were performed using both preinduction and pre-incision

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_15

safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following smooth induction of general anesthesia, the patient was intubated with a double-lumen endotracheal tube, placed in a right lateral decubitus position, and padded appropriately. The left chest was prepped and draped in the usual sterile fashion.

A standard left posterolateral thoracotomy was performed through the seventh intercostal space. Single-lung ventilation was established, allowing for anterior retraction of the lung and exposure of the mediastinum. No abnormalities were noted. The inferior pulmonary ligament was incised to allow the lung to be retracted cephalad, exposing the mediastinal pleura overlying the esophagus.

A longitudinal incision was made in the mediastinal pleura and the esophagus was exposed and gently mobilized. It was encircled with a Penrose drain and elevated, delivering the hypertrophied distal segment and several centimeters of proximal stomach into the operative field.

A longitudinal incision was made from just above the hypertrophied segment extending down onto the stomach. This was deepened through the hypertrophied circular muscle layer until the submucosa was encountered. All hypertrophied circular muscle fibers were carefully divided. Proximally the myotomy extended beyond the hypertrophied segment and distally onto the stomach for approximately *1 cm/other. The myotomy measured___ cm in length*. The submucosa pouted out adequately. Hemostasis was achieved by the cautious use of *electrocautery/fine sutures* of 4-0 silk. Mucosal integrity was demonstrated by instillation of air into the nasogastric tube; *no bubbles were observed in a saline-filled field/bubbles were observed to come from the* (*specify location*).

If inadvertent mucosal injury: *The injury was repaired with interrupted sutures of 4-0 Vicryl to the mucosa and the muscular layers closed with interrupted 3-0 silk. The esophagus was rotated and a myotomy made in a fresh location on the opposite side in a similar manner*.

The Penrose drain was removed and the esophagus allowed to return to its normal location. The mediastinal pleura was closed with a running suture of 3-0 Vicryl, leaving a small gap at the inferior aspect.

The chest was irrigated and hemostasis checked and closed in layers with ___ sutures. Two ___ French chest tubes were placed.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

16 Laparoscopic Esophagomyotomy with Partial Fundoplication

Carol E.H. Scott-Conner

Indication

- Achalasia

Essential Steps

1. Induce the pneumoperitoneum and place ports.
2. Place a liver retractor.
3. Incise the phrenoesophageal ligament; avoid injury to the anterior vagus.
4. Mobilize the distal esophagus.
5. Perform a myotomy.
6. Check the distal esophagus for integrity and completion of myotomy.
7. Perform a partial fundoplication.

Note This Variation

- Toupet (posterior) or Dor (anterior) partial fundoplication

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Complications

- Esophageal perforation/leak
- Pneumothorax
- Gastroesophageal reflux
- Inadequate myotomy
- Injury to vagus nerves

Template Operative Dictation

Preoperative Diagnosis Achalasia

Procedure Laparoscopic myotomy with *anterior/posterior* partial fundoplication

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed progressive dysphagia and on workup was found to have achalasia. Laparoscopic myotomy with *anterior/posterior* partial fundoplication was chosen for management.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. The patient was then placed in the *lithotomy/split leg* position. *A Foley*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_16

catheter was placed. The abdomen was then prepped and draped in the usual sterile fashion.

An incision was made in the *epigastric region*. The *Veress needle/open Hassan technique* was used to gain entry into the peritoneum. Proper position was confirmed by aspiration and a saline meniscus test. The abdomen was insufflated with carbon dioxide to a pressure of 15 mm. A *5 mm/10 mm* trocar was then inserted and inspection of underlying bowel contents did not reveal any injury. The following ports were placed: a 10-mm left subcostal port, a 5-mm right subcostal port, a left lower quadrant 5-mm port at the anterior axillary line, and a 5-mm right lower quadrant port for liver retractor.

The liver was retracted cephalad and laterally, and the patient was placed in a reverse Trendelenburg position. The gastric fundus was grasped and gently retracted caudally. The pars flaccida of the gastrohepatic ligament was incised; *an anomalous hepatic artery was identified and protected*. The peritoneum just medial to the right crus is incised and the phrenoesophageal fat pad was removed using *ultrasonic shears/electrocautery*. Dissection of the phrenoesophageal ligament was limited to the space anterior to the esophagus. The mediastinum was entered bluntly by gentle medial traction upon the lateral aspects of the hiatus anterior to the esophagus. The anterior vagus nerve was identified, freed from the surface of the esophagus, and thus mobilized out of harm's way. Approximately 7 cm of distal esophagus was easily visualized.

The anterior fibers of the esophagus were then scored in a longitudinal fashion with hook cautery and the myotomy was performed, exposing the intact submucosa. Dissection was carried out approximately 2 cm distal to the squamocolumnar junction.

The abdomen was irrigated with saline and no leak was noted upon endoscopic insufflation. The lower esophageal sphincter opened easily upon gentle insufflation, confirming an adequate myotomy. The endoscope was withdrawn.

[Choose One:]

If Dor fundoplication: *The superior most short gastric vessels were taken down. The fundus was then grasped and rolled up over the myotomy and tacked in place with several interrupted sutures of ___.*

If Toupet fundoplication: *The superior most short gastric vessels were taken down. The mobile fundus was then pulled behind the esophagus and tacked to the edges of the myotomy on both sides with interrupted ___ sutures.*

Hemostasis was checked. Secondary trocars were removed under direct vision. *No bleeding was noted/trocar site bleeding was controlled by electrocautery/suture placement*. The laparoscope was withdrawn and the umbilical trocar removed. The abdomen was allowed to collapse. All trocar sites greater than 5 mm were closed with ___. The skin was closed with subcuticular sutures of ___ and Steri-Strips.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in satisfactory condition.

Part II

General Surgery: Stomach and Duodenum

Upper Endoscopy: Diagnostic and Therapeutic

17

Ryan Conway and Yehudith Assouline-Dayan

Indications

- *Supplementary workup for upper GI complaints*:
  – Dysphagia.
  – Odynophagia.
  – Gastroesophageal reflux disease.
  – Abnormal barium radiograph/CT scan.
  – Asses the degree of injury following caustic ingestion.
  – Investigation of iron deficiency anemia.
  – Unremitting epigastric pain.
  – Persistent vomiting.
- *Therapeutic measures*:
  – Foreign body impaction
  – Gastrointestinal bleeding
  – Dilation of esophageal stricture (peptic stricture/postsurgical stricture/caustic stricture/malignant stricture)
  – Treatment of achalasia with pneumodilation/Botox injection or POEM (peroral esophageal myotomy)
  – Percutaneous insertion of gastrostomy or jejunostomy
  – Surveillance for neoplasia in patients with conditions predisposing to malignancy (such as Barrett's esophagus, gastric ulcer, gastric polyposis, pernicious anemia, intestinal metaplasia, previous gastrectomy, familial polyposis)

Contraindication

- Severe comorbidities and inability to tolerate conscious sedation
- Recent gastrointestinal anastomoses (relative)

Essential Steps

1. Position in the left lateral decubitus position.
2. Adequately anesthetize the oropharynx with lidocaine spray.
3. Adequate intravenous sedation and analgesia.
4. Place bite block.
5. Place endoscope in the oropharynx and advance it under direct endoscopic visualization.
   - Intubate the esophagus and advance into the stomach.
   - Biopsy the esophagus if abnormality noted.
   - Inspect Z-line and note its location from the incisors.
   - Biopsy Z-line if irregular or the presence of Barrett's metaplasia.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_17

6. Advance endoscope down to the third/fourth portion of the duodenum.
7. Withdraw the endoscope and inspect the duodenum, pylorus, antrum, gastric body, fundus, and esophagus for abnormalities.
   - Biopsy if needed.
   - Retroflex the endoscope to view the gastric fundus and gastroesophageal junction.
   - Photograph any significant findings and document this in operative note.
8. Excess air is suctioned out and the endoscope is completely withdrawn.

Note These Variations

Savary/Maloney Dilation

- A guide wire was advanced into the esophagus under direct visualization through the endoscope's working channel or under fluoroscopic guidance and advanced into the stomach.
- Sequential dilations are then performed to achieve adequate dilation (usually 36–54 Fr maximum dilator size).

Balloon Dilation

- *Through the scope (TTS) balloon dilators*:
  – Utilized for simple strictures with a diameter of 12–14 mm.
  – Passed under visualization/fluoroscopy.
  – With/without wire guidance across strictures.
  – Available in either single or multiple diameters.
  – Advance balloon to the region of interest, with the center of stricture lying in the center of the balloon.
  – Serially dilate the stricture (6–8 mm, 8–10 mm, 10–12 mm, 12–15 mm).
  – It is generally recommended that strictures not be dilated more than 3 mm above current luminal size.
- *Pneumatic balloons (30–40 mm diameter)*:
  – Utilized for forceful disruption of lower esophageal sphincter (LES)/anastomotic and pyloric strictures.
  – Introduced over a wire/under fluoroscopic guidance.
  – Pneumatic balloon is placed across the area of interest and position confirmed with fluoroscopy with radiopaque markers on the catheter and within the balloon.
  – Usually inflated to pressure of 7–15 psi and maintained for 15–60 s.
  – Esophageal perforation reported in 4–7 % of cases.

Botox Injection into the Lower Esophageal Sphincter (LES)

- Neurotoxin that inhibits acetylcholine release at motor neuron presynaptic terminals and thereby promotes LES relaxation
- Injected with a sclerotherapy needle in four aliquots into each quadrant, 1 cm above the LES, with a total of 100 units
- Symptomatic reduction in achalasia up to 75 % of cases

Rubber Band Ligation of Esophageal Varices

- An endoscope with an elastic band delivery system attached is advanced into the esophagus.
- Esophageal variceal mucosa and submucosa are suctioned into the delivery system, and a rubber band is placed on the varices causing subsequent strangulation, sloughing, and eventual fibrosis, resulting in obliteration of the varices.

Injection Sclerotherapy of Esophageal Varices

- An endoscope is advanced into the esophagus and the varices identified at the gastroesophageal junction.
- A flexible sclerotherapy needle is passed through the endoscope and the sclerosant is injected into the vein or the surrounding area. Then most commonly used sclerosants are ethanolamine and sodium tetradecyl sulfate.

Epinephrine Injection into Gastrointestinal Bleeder

- Similarly a flexible injection needle is advanced through an endoscope, and epinephrine is injected into the mucosa surrounding the gastrointestinal bleeder.
- An injection of dilute (1:10,000) epinephrine in 1 mL aliquots around the bleeding points has traditionally been used effectively.

Argon Plasma Coagulation (APC)

- Utilized for gastrointestinal bleeder or gastric antral vascular ectasia (GAVE) disease.
- Select the appropriate power setting (W) and argon flow rate (L/min).
- A gas flowmeter adjusts to allow argon flow rates between 0.5 and 7 L/min.
- In general, higher power setting (70–90 W) and higher flow rate (1–2 L/min) are utilized in the stomach.
- Heat generated by APC devitalizes, coagulates, and desiccates tissue uniformly at the same depth, limited to 3 mm at most. Automatically limited depths, as well as the absence of tissue vaporization, are safety guard against thin wall perforations.

Complications

- Esophageal, gastric, or duodenal perforation
- Bleeding from biopsy site(s)
- Inadequate therapeutic intervention
- Missed diagnostic abnormality
- Complication from sedation
- Laryngospasm

Template Operative Dictation

Preoperative Diagnosis *Dysphagia/gastroesophageal reflux/gastrointestinal bleeding/other*

Procedure Upper endoscopy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* presented with *dysphagia/gastroesophageal reflux/gastrointestinal bleeding/other* was found to have clinical and radiological features to support the diagnosis.

Description of Procedure Written consent was obtained prior to the procedure. The patient was brought to the *OR/endoscopy suite*. Based on the pre-procedure assessment, including review of the patient's medical history, medications, allergies, and appropriate physical exam, the patient was deemed to be an appropriate candidate for conscious sedation. Prior to proceeding, the patient's name, date of birth, and procedure to be undertaken were verified at the time-out.

The patient was then placed in the *left lateral decubitus/supine* position, and adequate sedation was achieved with the use of *fentanyl and midazolam/Demerol/propofol/general anesthesia/other*. The oropharynx was adequately anesthetized with lidocaine spray and a bite block was placed. An *Olympus endoscope* (*GIF-H180*)/*other* was then placed in the oropharynx and advanced under endoscopic visualization. The esophagus was intubated. The endoscope was advanced to the gastric antrum and through the pylorus and up to the *third/fourth* portion of the duodenum. The endoscope was then withdrawn slowly. The first, second, third, and fourth portions of the duodenum appeared endoscopically normal/other. The pylorus was normal/other. The antrum was endoscopically normal/other. The gastric body distended normally and the gastric folds appeared normal and flattened with insufflation. A retroflexed view of the fundus and GE junction revealed no abnormalities. The esophagus appeared endoscopically normal and the Z-line was normal at ___cm from the incisors. There were no esophagitis or esophageal varices. (*Photographs of detail abnormalities that were taken*)

If biopsies were taken: Biopsies of the ______ were obtained using a *biopsy forceps/snare* and sent to pathology for permanent processing. Hemostasis was ensured.

If biopsy was obtained for CLO test: *Biopsy of the antrum/other was obtained*, *and CLO test was sent off*.

Excess air was removed and the endoscope was withdrawn. The patient was assessed and was in satisfactory condition at the termination of the procedure. The patient was transferred to the recovery area.

Complications: The patient tolerated the procedure well and *no complications were noted/complications were noted as* _____.

Percutaneous Endoscopic Gastrostomy

18

Carol E.H. Scott-Conner

Indication

- Need for prolonged enteral nutrition
- Palliative decompression of the gastrointestinal tract (in cases of malignancy)

Essential Steps

1. Sedation and topical analgesia of the oropharynx.
2. Pass endoscope into the stomach and insufflate with air.
3. Identify light reflex on the skin of the anterior abdominal wall and indent skin with a finger to confirm position within the stomach.
4. Local anesthesia at chosen site.
5. Make small incision.
6. Pass snare down biopsy channel of endoscope and position.
7. Pass introducer needle into the stomach and through loop of snare, under direct endoscopic visual control.
8. Pass guide wire into the stomach.
9. Tighten snare around guide wire and withdraw endoscope, snare, and guide wire.
10. Attach gastrostomy tube.
11. Pull retrograde into the stomach and out through the abdominal wall.
12. Reinsert gastroscope and inspect site; confirm position of bumper of gastrostomy.
13. Secure tube to the skin.

Note These Variations

- On occasion done as Seldinger technique with introducer and placement of Foley catheter ("push technique").
- Variations exist that allow gastroscope to be replaced over guide wire.
- PEG-PEJ tube allows a jejunostomy tube to be passed through pylorus.
- T-bars may be placed to secure the stomach to anterior abdominal wall.

Complications

- Premature tube dislodgement, resulting in peritonitis
- Leakage around tube
- Necrosis of gastric wall
- Perforation of the intervening transverse colon

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_18

Template Operative Dictation

Preoperative Diagnosis *Head and neck malignancy/other* with need for *prolonged enteral nutrition/palliative decompression of the gastrointestinal tract*

Procedure Percutaneous endoscopic gastrostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* required prolonged enteral nutrition because of *stroke/neuromuscular disorder/head and neck malignancy/other*. Percutaneous endoscopic gastrostomy was chosen as the route of nutritional support.

Description of Procedure The patient was taken to the *procedure suite/operating room*. Topical analgesia of the oropharynx was induced using ___.

Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *He/she* was sedated with ___.

After adequate sedation, a mouthpiece was placed in the patient's mouth, and the endoscope was passed down into the stomach. No abnormalities were noted. The stomach was insufflated with air, and the endoscope positioned in the midportion and directed toward the anterior abdominal wall. With the room darkened and intensity turned up on the endoscope, a good light reflex was noted on the skin of the abdominal wall in the left upper quadrant. Finger pressure was applied at the light reflex with adequate indentation on the stomach wall on endoscopy. A polypectomy snare was passed into the stomach, opened fully, and positioned so that the loop encircled the point of demonstrated finger indentation.

The overlying skin was anesthetized with lidocaine and a 5-mm incision was made at the chosen site. The introducer needle with overlying catheter was passed through this incision and into the stomach under visualization with the gastroscope. The needle and catheter were gently captured by the endoscopic snare. The looped end of the guide wire was passed and snared. The needle and catheter were removed.

The endoscope, snare, and guide wire were then withdrawn and pulled back out of the mouth. The looped end of the braided suture bonded to the gastrostomy tube was threaded through the loop of the guide wire and the whole thing pulled back into the stomach until the ___-cm mark of the gastrostomy tube was noted at skin level.

The gastroscope was reintroduced and adequate placement of the gastrostomy tube was confirmed and photo documentation obtained. The gastrostomy tube end was cut to length and the clamping appendage was placed. *A collecting bag was applied*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the post-anesthesia care unit in good condition.

19 Open (Stamm) Gastrostomy

Naina Bagrodia and Hui Sen Chong

Indications

- Need for prolonged enteral feeding when percutaneous endoscopic gastrostomy (PEG) is contraindicated
- Need for prolonged enteral support secondary to esophageal obstruction, head and neck trauma or malignancy, and impaired swallowing or neurological dysfunction or to avoid irritation of a constant indwelling nasogastric feeding tube
- Need for enteral decompression secondary to chronic obstruction from non-resectable malignancy
- Adjunct to complex, open abdominal procedures, especially poor-risk or elderly patients in whom prolonged postoperative enteral access for nutritional support is anticipated

Essential Steps

1. Small upper midline incision.
2. Identify the stomach.
3. Pass a tube through the abdominal wall at desired site.
4. Purse-string suture on the anterior surface of the stomach.
5. Insert tube into stomach.
6. Tie purse-string suture, securing the stomach around the catheter.
7. Place and tie a second outer purse-string suture.
8. Anchor the stomach to the abdominal wall at catheter entrance site.
9. Check for torsion and tension.
10. Close the abdomen.
11. Secure the catheter to the skin.

Note These Variations

- Initial incision in the left mid-rectus region as opposed to the upper midline
- Type and size of catheter

Complications

- Insertion into the colon
- Distal migration of the catheter causing pyloric obstruction
- Leakage around catheter
- Tube dislodgement

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_19

Template Operative Dictation

Preoperative Diagnosis Need for prolonged enteral *nutrition/decompression/other* secondary to *esophageal obstruction/neurological dysfunction/other*

Procedure Stamm gastrostomy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who requires prolonged enteral *nutrition/decompression* because of *esophageal obstruction/neurological dysfunction/other* and was unable to tolerate other routes of access due to ___. Stamm gastrostomy was chosen as the route of *nutritional support/decompression*.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion. A small upper midline incision was made and was deepened through the subcutaneous tissues using electrocautery. Hemostasis was achieved. The linea alba was incised and the peritoneal cavity entered. The abdomen was explored, and *adhesions were lysed using electrocautery/sharply under direct vision with Metzenbaum scissors*.

The stomach was identified, and a location on the anterior abdominal wall lying directly above the greater curvature and some distance from the primary incision was selected as the exit site through which the stomach would be anchored. The mid-anterior stomach wall was grasped with a Babcock forceps, and the stomach reached the overlying anterior abdominal wall without tension. A small incision was made at the anterior abdominal wall location, and the ___ *-French mushroom catheter/Malecot tube/Foley catheter/other* was passed through the anterior abdominal wall and into the abdominal cavity.

A purse-string suture of ___-0 *silk/Vicryl* was placed on the mid-anterior surface of the stomach, and a gastrotomy was made using *electrocautery/a scalpel* in the central portion of the purse-string. The *catheter/Malecot tube/other* was inserted into the lumen of the stomach. The purse-string suture was tied to secure the stomach around the *catheter/Malecot tube/other. A second, outer concentric purse-string suture of ___-0 was placed and tied to invert the gastric wall about the tube*.

The gastric wall was then anchored to the anterior abdominal wall at the catheter entrance site with several ___*-0 silk/Vicryl* sutures. No tension was noted on the gastric wall. The catheter was snugged upward and secured to the skin with a 3-0 *nylon/other* suture.

Hemostasis was confirmed and omentum was brought adjacent to the surgical field. The fascia was closed with *a running suture of ____/other*, and the skin was closed with *skin staples/subcuticular sutures of ___/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Philip M. Spanheimer, MD, in the previous edition.

20 Gastrojejunostomy

Vincent T. Wu and Hui Sen Chong

Indications

- Peptic ulcer disease with gastric outlet obstruction
- Gastric outlet obstruction from unresectable cancer of the pancreas, duodenum, and periampullary origin

Essential Steps

1. Upper midline incision.
2. Explore the abdomen and confirm pathology.
3. Identify the mobile portion of the greater curvature of stomach and loop of proximal jejunum.
4. *If antecolic*:
   - *Measure jejunum 30 cm from the ligament of Treitz and bring antecolic (pull omentum to the right and pass jejunum to left of bulk of omentum).*
5. *If retrocolic*:
   - *Create a window in the transverse mesocolon to the left of the middle colic vessels.*
   - *Measure jejunum 30 cm from the ligament of Treitz and bring the loop retrocolic.*
6. *If stapled*:
   - *Align the loop and chosen region of greater curvature with two stay sutures of 3-0 silk.*
   - *Create gastrostomy and jejunostomy, and use suction/sponge forceps to remove any leftover particles of food and fiber from the stomach.*
   - *Insert linear cutting stapler and fire.*
   - *Check staple line for hemostasis.*
   - *Close enterotomies with linear stapler/two-layered sutured closure.*
7. *If sutured*:
   - *Align the loop and chosen region of greater curvature of stomach.*
   - *Place back wall of interrupted 3-0 silk Lembert sutures.*
   - *Open the stomach and jejunum and use suction/sponge forceps to remove any leftover particles of food and fiber from the stomach; achieve hemostasis.*
   - *Place an inner layer of continuous 3-0 Vicryl to posterior and anterior walls.*
   - *Place an outer layer of 3-0 silk Lembert sutures.*
8. Check the anastomosis for integrity and patency of both limbs (afferent and efferent).

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_20

9. Place omentum over the gastrojejunostomy.
10. *Suture the stomach to the transverse mesocolon* (*if retrocolic*).
11. Check for hemostasis.
12. Close the abdomen in the usual fashion.

Note These Variations

- Biopsy tumor if no tissue diagnosis previously obtained.
- Antecolic vs. retrocolic.
- Stapled vs. sutured.
- Jejunojejunostomy may be added to avoid bile reflux.

Complications

- Failure to empty
- Stricture
- Anastomotic leak

Template Operative Dictation

Preoperative Diagnosis Gastric outlet obstruction due to *unresectable carcinoma of pancreas/duodenum/ampulla/peptic ulcer disease/other*

Procedure Gastrojejunostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed gastric outlet obstruction due to *unresectable carcinoma of the pancreas/duodenum/ampulla/peptic ulcer disease/other*. Gastrojejunostomy was indicated to bypass the obstruction/other.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from the xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The linea alba was identified, grasped and elevated, and incised and the peritoneal cavity entered. Care was taken not to injure the abdominal contents below. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors. Tumor was identified in the following locations* (*detail*). *Biopsy of ___ was performed and submitted for pathology*.

[Choose One]
If antecolic: *A mobile loop of jejunum 30 cm distal to the ligament of Treitz was identified, passed to the left of the omentum, and brought to lie comfortably adjacent to the greater curvature of the stomach.*

If retrocolic: *An opening was created in the transverse mesocolon. The transverse colon was retracted upward and the ligament of Treitz was identified. The transverse mesocolon was carefully incised to the left of the middle colic vessels near the ligament of Treitz, and care was taken to avoid the large vessels of the arcade. A mobile loop of jejunum 30 cm distal to the ligament of Treitz was identified and passed through the window in the transverse mesocolon. It was brought to lie comfortably adjacent to the greater curvature of the stomach.*

If stapled: *The jejunum and gastric wall were approximated with two stay sutures of 3-0 silk. A gastrotomy and jejunostomy were made and the linear cutting stapler inserted, closed, and fired. The staple line was inspected for hemostasis. The stomach had retained particles of food and/or fiber. These were removed with suction irrigation and/or a sponge forceps. The enterotomy was closed with a linear stapler/a two-layer sutured closure of 3-0 Vicryl and 3-0 silk.*

If sutured: *A two-layered sutured anastomosis was then constructed using interrupted 3-0* *silk Lembert sutures for the outer layer and running 3-0 Vicryl for the inner layer*.

The anastomosis was tested for integrity and patency of both the afferent and efferent limbs.

If retrocolic: *The mesocolon was sutured to the gastric wall with interrupted sutures of 3-0 silk to prevent herniation*.

[*Optional*: *Some authors may choose to create a Braun anastomosis to divert bile away from the stomach*, *thus decreasing the risk of bile reflux gastritis*]

A side-to-side stapled/hand-sewn (*technique as described above*) *jejunojejunostomy was created between the afferent and efferent limb ___ cm distal to the gastrojejunostomy. Once completed*, *the anastomosis was palpated and its patency confirmed*.

[*Optional*]: *The nasogastric tube was palpated and confirmed to be in a good position*.

Omentum was placed over the gastrojejunostomy. Hemostasis was checked. (*Optional*: *Multiple interrupted through-and-through retention sutures of ____ were placed*.) The fascia was closed with *a running suture of ____/a Smead-Jones closure of interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ___/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Lori Soni, M.D., in the previous edition.

Laparoscopic Gastrojejunostomy

21

Jennifer L. Salluzzo and Kurt E. Roberts

Indications

- Gastric outlet obstruction (peptic ulcer disease, unresectable cancer of the pancreas, duodenum, periampullary region)
- Reconstruction after gastric resection

Essential Steps

1. Decompress the stomach with an orogastric tube and then remove the tube.
2. Access the peritoneal cavity (Veress, Hasson, Optiview), and place ports.
3. Access the lesser sac through the gastrocolic ligament, approximately 5 cm proximal to pylorus.
4. Take down gastrocolic ligament proximally about 8 cm.
5. Identify the ligament of Treitz.
6. Bring a loop of the jejunum up to the posterior wall of the stomach.
7. Place stay sutures between the stomach and jejunum.
8. Create gastrotomy and enterotomy.
9. Create two-layer anastomosis.
10. Perform EGD, leak test.
11. Remove ports.
12. Skin closure.

Note These Variations

- Access to the abdomen (Veress, Hasson, Optiview)
- Creation of anastomosis (hand-sewn, stapled, hybrid, Endostitch)
- Completion endoscopy

Complications

- Failure to empty
- Gastric perforation/injury
- Afferent/efferent limb obstruction
- Bile reflux
- Anastomotic leak
- Anastomotic stricture

Template Operative Dictation

Preoperative Diagnosis Gastric outlet obstruction due to *unresectable carcinoma of pancreas/duodenum/ampulla/peptic ulcer disease/other*

Procedure Laparoscopic gastrojejunostomy/EGD

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_21

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed gastric outlet obstruction due to *unresectable carcinoma of the pancreas/duodenum/ampulla/peptic ulcer disease/other. Laparoscopic gastrojejunostomy was indicated to bypass the obstruction/other*.

Description of Procedure The patient was taken to the operating room and placed in a supine position with both arms out. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Lower extremity compression boots were placed on the patient. The patient received DVT and weight-based antibiotic prophylaxis. General endotracheal anesthesia was induced. The patient's abdomen was prepped and draped in the usual sterile fashion.

A *Veress needle/open Hasson technique/other* was used to access the peritoneal cavity through an *infraumbilical/other* incision. Pneumoperitoneum up to 15 mmHg was established. The underlying contents were inspected. No injuries were identified. The following ports were placed under direct vision: a left lateral 12 mm port, then a more medial left upper quadrant 5 mm port, and a right upper quadrant 5 mm port.

The stomach was retracted superiorly. The lesser sac was entered through the gastrocolic ligament. Five centimeter proximal to the pylorus, the gastrocolic ligament was taken down with the *Sonicision™/Ligasure/other energy devices* up to 10 cm toward the angle of His. Next, the transverse colon was elevated and the ligament of Treitz identified. The jejunum was run 20–30 cm distal to the ligament of Treitz. This loop of bowel was placed adjacent to the stomach in an antecolic, isoperistaltic fashion. Four 0-Vicryl sutures were placed to approximate the small bowel to the stomach and serve as a posterior layer.

Using the *Sonicision™ device/other energy device*, a gastrotomy and enterotomy were made. A side-to-side stapled anastomosis was created using the *Endo GIA™ 60 purple stapler*. The common enterotomy was then closed in two layers using the *Endo Stitch™* device.

[*Optional*: *some authors routinely check for anastomotic leak.*]

If upper endoscopy is performed: The upper endoscope was passed through the mouth, down the esophagus and through the gastrojejunal anastomosis. The gastrojejunostomy was easily negotiated and visualization of the jejunum revealed viable pink mucosa that was not under tension. The endoscope was withdrawn into the stomach. A leak test was performed by insufflating the stomach with air while simultaneously flooding the operative field with normal saline and clamping the proximal and distal jejunal limbs. No leak was identified. The stomach was decompressed and the intra-abdominal fluid suctioned.

If insufflation is performed without upper endoscopy: The stomach was insufflated with air through an oral Ewald tube/orogastric tube/others that was placed into the stomach. A leak test was performed by insufflating the stomach with air while simultaneously flooding the operative field with normal saline and clamping the proximal and distal jejunal limbs. No leak was identified.

The abdomen was inspected and no injuries were identified as well as good hemostasis was seen. All instruments and ports were removed. The 12 mm fascial defect was closed with a *figure-of-eight 0-Vicryl suture*. All skin incisions were closed with *4-0 Caprosyn* subcuticular sutures followed by skin glue. The sponge, instrument, and needle counts at the end of the case were correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transported to PACU in a stable condition.

22 Plication of Perforated Peptic Ulcer

Vincent T. Wu and Hui Sen Chong

Indication

- Perforated duodenal ulcer

Essential Steps

1. Upper midline incision.
2. Culture and aspirate any peritoneal fluid.
3. Explore the abdomen with special attention to the stomach and duodenum and identify perforation.
4. Place interrupted sutures across the margins of perforation.
5. Bring healthy omentum over the defect and secure in place by tying previously placed sutures.
6. Lavage the peritoneal cavity with large volumes of normal saline.
7. Check the position of the nasogastric tube.
8. Check for hemostasis.
9. JP drain placement.
10. Close the abdomen.

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Note These Variations

- Decision to plicate, rather than resect or excise and close as pyloroplasty, is based on size and location of perforation, patient's risk and hemodynamic status, and surrounding tissue condition.
- Biopsy of the ulcer and biopsy of antrum for CLO test.
- Intraoperative upper endoscopy.
- Pack skin open if significant contamination observed.

Complications

- Subphrenic abscess
- Gastrointestinal bleeding
- Recurrence of ulcer

Template Operative Dictation

Preoperative Diagnosis Acute abdomen and perforated viscus

Procedure Plication of perforated duodenal ulcer

Postoperative Diagnosis Perforated duodenal ulcer

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_22

Indications ____-year-old *male/female* developed *acute abdomen/epigastric pain/leukocytosis* with free air on *upright chest X-ray/lateral decubitus abdominal film/computed tomography scan of abdomen*.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made from the xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues with hemostasis achieved by electrocautery. The linea alba was identified and incised, and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. A large quantity of *bilious/turbid* fluid was suctioned from the peritoneal cavity *and cultured. No evidence of malignancy was noted when the abdomen was explored*. The stomach and duodenum were inspected and palpated and a small anterior perforation of a *gastric/duodenal* ulcer was found (*describe location*). Because of the patient's *age/condition/absence of previous ulcer history*, the decision was made to proceed with plication rather than resection.

[*Optional*]: *biopsy of the ulcer margin was obtained and sent off to r/o malignancy.*

Three/four interrupted sutures of 2-0 silk were placed through healthy duodenal tissue in such a fashion as to span the perforation. These were left untied for now. A mobile portion of viable omentum was brought up, placed over the perforation, and secured in place by tying the previously placed sutures over it in such a manner as to completely close the hole in the duodenum. Care was taken to avoid excess tension.

[*Optional*]: *An upper endoscopy was performed. An adult Olympus scope was advance into the patient's stomach and duodenum. The area of ulceration was confirmed*; __ *quadrant biopsies of the ulcer were/were not obtained. Biopsy of the antrum was obtained for CLO test*.

During this time, an air leak test was performed and the repair was noted to be air tight/describe other findings.

Hemostasis was checked. The position of the nasogastric tube was verified. The abdomen was copiously lavaged with warm saline. *A 10 Fr JP drain was placed adjacent to the repair and stitched to the abdominal wall with* __ *suture*. (*Optional*: *Multiple interrupted through-and-through retention sutures of* ____*were placed*.) The fascia was closed with *a running suture of* _____*/a Smead-Jones closure of interrupted* _____. The skin was *packed open/closed with skin staples/subcuticular sutures of* _____*/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D., in the previous edition.

Laparoscopic Plication of Perforated Ulcer

23

Roy R. Danks

Indications

- Perforated ulcer with adequate laparoscopic access
- Patient able to tolerate laparoscopic procedure with above findings

Essential Steps

1. Monitors at the head.
2. Nasogastric tube and Foley to decompress the stomach and bladder.
3. Induce pneumoperitoneum.
4. Insert the first trocar below the umbilicus.
5. Inspect the abdomen.
6. Second and third trocars (5 mm) triangulate with the laparoscope.
7. Aspirate and culture fluid.
8. Identify the perforation.
9. Place interrupted sutures across the perforation and leave untied.
10. Bring omentum up and tie sutures over the perforation.
11. Test with air under saline.
12. Irrigate the abdomen.
13. Close 10/11-mm trocar site.

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Note These Variations

- Open vs. closed entry with Veress needle.
- Thirty degree laparoscope will, in general, give the best visualization. The decision to plicate rather than resect or excise and close as pyloroplasty is based on size and location of perforation, patient's risk and hemodynamic status, the experience of the surgeon, and surrounding tissue condition.
- Perform upper endoscopy with biopsy.
- Exclude malignancy if gastric ulcer.
- Closed suction drain in subhepatic space.

Complications

- Leakage from plication site
- Subphrenic abscess
- Gastrointestinal bleeding
- Duodenal stenosis

Template Operative Dictation

Preoperative Diagnosis Pneumoperitoneum due to perforated ulcer

Procedure Laparoscopic plication of perforated ulcer

Postoperative Diagnosis Same, perforated *gastric/duodenal* ulcer

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_23

Indications _____-year-old *male/female* developed *acute abdomen/epigastric pain/leukocytosis* with free air on *upright chest X-ray/lateral decubitus abdominal film/computed tomography scan of abdomen*.

The risks, benefits, indications, and alternatives were discussed with the patient/his or her durable power of attorney (DPOA) prior to the operation, and informed consent was obtained in writing.

Preoperative Antibiotic ____________ was administered prior to incision.

VTE Prophylaxis The patient was given (low molecular weight heparin, unfractionated heparin) subcutaneously preoperatively. Pneumatic compression devices were applied and functioning prior to induction of general anesthetic.

Description of Procedure The patient was placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped with and draped in the usual sterile fashion.

Local anesthetic was infiltrated in the skin and subcutaneous tissues. An incision was made in a natural skin line below/above the umbilicus.

[Choose One]

For Veress needle: *The umbilical raphe was grasped with a Kocher and elevated and the Veress needle inserted. Proper position was confirmed by aspiration and saline meniscus test. Opening intra-abdominal pressure was ____ mmHg. Pneumoperitoneum was created with* CO_2. *A 10-/11-mm trocar was then inserted* [*alternatively*: *5* (*or 10*) *mm 0°* (*or 30°*) *laparoscopic through viewing trocar was advanced into the peritoneum under video visualization*].

For Hasson cannula: *The fascia was elevated and incised. Entry into the peritoneum was confirmed visually and no bowel was noted in the vicinity of the incision. Two figure-of-eight sutures of 2-0 Vicryl were placed and the Hasson cannula inserted under direct vision. The sutures were anchored around the cannula*. The abdomen was insufflated with carbon dioxide to a pressure of 12–15 mmHg. The patient tolerated insufflation well.

The laparoscope was inserted and the abdomen inspected. No injuries from initial trocar placement were noted. Two additional 5-mm trocars were then inserted in the following locations: subxiphoid to the right of the midline and right subcostal. The trocars were placed under video visualization, after instillation of local anesthetic.

Next, the laparoscope was switched to a 30° laparoscope and an intra-abdominal survey was completed. No other pathology was appreciated. A moderate amount of bilious fluid was suctioned and cultured. *A fourth trocar was placed under video visualization, in the right subcostal region at the anterior axillary line, and a liver retractor inserted*. The liver was gently elevated and the site of perforation identified on the *anterior wall of the first portion of the duodenum/anterior gastric wall*.

The table was placed in a head-up, left-rotated position. The ulcer was clearly identified and the perforation delineated by removing fibropurulent material with the suction irrigator. The perforation measured approximately _______ mm in maximum diameter.

The nasogastric tube was pulled back. *Three* interrupted sutures of were then placed across the perforation *but not tied/the perforation was closed with interrupted sutures of ______*.

Omentum was brought up and laid over the perforation. The previously placed sutures were tied in such a fashion as to pull the omentum snugly over the perforation. The closure was tested with air insufflation under saline and found to be intact.

If upper endoscopy performed: *the upper endoscope was passed through the mouth into the esophagus and stomach/duodenum. The ulcer was noted and biopsies/CLO test were/were not obtained. Insufflation test was performed and* (*describe findings*).

All four quadrants of the peritoneum were then irrigated with __ L of warm saline until clear. The saline was aspirated. Hemostasis was checked. *A closed suction drain was placed in the subhepatic space/adjacent to the perforation site and stitched in place with a 3-0 Nylon stitch*.

Secondary trocars were removed under direct vision. *No bleeding was noted/trocar site bleeding was controlled by electrocautery/suture placement*. The laparoscope was withdrawn and the umbilical trocar removed. All instruments were removed and pneumoperitoneum was allowed to egress. *All trocar sites greater than 5 mm were closed at the fascial layer with* ______. (Alternatively: Laparoscopic fascial closure device and transfascial suture passer were utilized to place ______ sutures of _______ in the fascial of the 10/11 port sites.) The skin incisions were lavaged with sterile saline and *closed with subcuticular sutures of* ______ *and steristrips/closed with cyanoacrylate glue/left open to encourage drainage. Sterile dressings were applied*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in satisfactory condition.

24 Proximal Gastric Vagotomy

Carol E.H. Scott-Conner

Indications

- Peptic ulcer disease refractory to medical management
- Noncompliance with medical management
- Adjunct to plication of perforated peptic ulcer in noncompliant patient

Essential Steps

1. Upper midline incision.
2. Abdominal exploration for unexpected findings.
3. Place the table in reverse Trendelenburg position.
4. Retract the left lobe of the liver upward (divide triangular ligament and reflect left lobe to the right if necessary).
5. Place fixed retractors.
6. Gently retract the stomach toward left lower quadrant.
7. Divide the peritoneum overlying the abdominal esophagus.
8. Extend the peritoneal incision to expose crura.
9. Gently encircle the esophagus with an index finger.
10. Separate each vagal trunk gently from the esophageal wall, pulling the vagal trunk toward the right and esophagus to the left.
11. Encircle each vagal trunk with a silastic loop.
12. Bring silastic loops out to the right of the esophagus.
13. Pass the left index and middle fingers through an avascular area of the gastrohepatic omentum and enter the lesser sac.
14. Identify crow's foot (terminal branches of the nerve of Latarjet).
15. Working from below upward, sequentially doubly clamp, divide, and ligate neurovascular bundles in the anterior leaflet of the gastrohepatic omentum, staying close to the gastric wall.
16. Continue dissection until the anterior vagus is reached.
17. Preserve this trunk (and its hepatic branches) by retracting it toward the patient's right with a silastic loop.
18. Begin a second pass through middle and posterior leaflets of the gastrohepatic ligament; start below, at the crow's foot, and work cephalad.
19. *A third pass may be needed if lesser omentum is very thick.*
20. Dissect the posterior aspect of the esophagus from the posterior vagus nerve to 7 cm above the esophagogastric junction.
21. Divide any tiny fibers resembling nerve tissue throughout the circumference of lower 5–7 cm of the esophagus.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_24

22. Imbricate the lesser curvature with interrupted 4-0 silk Lembert sutures.
23. Check hemostasis.
24. Close the abdomen.

Note This Variation

- None of significance

Complications

- Incomplete vagotomy
- Injury to the vagal trunks
- Injury to the spleen
- Necrosis of the lesser curvature of the stomach

Template Operative Dictation

Preoperative Diagnosis Peptic ulcer disease refractory to medical management

Procedure Proximal gastric vagotomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with peptic ulcer disease *refractory to/noncompliant with* medical therapy required proximal gastric vagotomy for management.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made from xiphoid to the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

The operating table was placed in reverse Trendelenburg position, and *the left lobe of the liver was retracted cephalad/the triangular ligament divided with electrocautery and the left lobe of the liver retracted to the right*. Fixed retractors were placed to expose the esophageal hiatus. The peritoneum overlying the esophagus was incised to expose the esophagus and left and right crura. The esophagus was gently encircled by blunt dissection and a Penrose drain passed behind it. Both vagal trunks were identified, gently dissected free of the esophagus, and retracted to the patient's right with silastic loops. The esophagus was retracted to the left by the Penrose drain.

An avascular portion of the lesser omentum was entered. The crow's foot termination of the anterior nerve of Latarjet was identified and the terminal branches preserved. Beginning just above these terminal branches (about 7 cm from the pylorus), the anterior leaflet of the lesser omentum was sequentially divided between clamps, and the neurovascular branches to the lesser curvature were secured with ties of 3-0 silk. Care was taken to avoid damage to the nerves of Latarjet or the lesser curvature of the stomach. This dissection progressed cephalad until the anterior vagus was encountered. The anterior vagus and its hepatic branches were preserved. The remaining lesser omentum, including the posterior leaflet, was sequentially divided in a similar fashion. *The criminal nerves of Grassi/branches from the posterior vagus nerve* to the gastric fundus were transected. At the conclusion of this dissection, the main vagal trunks were intact and separated from the distal 5–7 cm of the esophagus, and the distal esophagus was circumferentially cleaned of any apparent nerve fibers.

The lesser curvature of the stomach was imbricated with interrupted 3-0 silk Lembert sutures. The nasogastric tube was positioned. Hemostasis was checked.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ____ were placed*). The fascia was closed with *a running suture of ____/a Smead-Jones closure of interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ___/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

25 Truncal Vagotomy and Pyloroplasty

Carol E.H. Scott-Conner

Indications

- Refractory peptic ulcer disease
- As adjunct to oversewing of bleeding duodenal ulcer
- For closure of complex perforated duodenal ulcer

Essential Steps

1. Upper midline incision.
2. Abdominal exploration for unexpected findings.
3. *If bleeding*: *Place two 2-0 silk stay sutures on the pylorus*.
4. *Longitudinal incision across the pylorus*.
5. *Identify the bleeding vessel in the ulcer crater*.
6. *Suture ligate three points* (*superior*, *inferior*, *and medial*).
7. *Confirm hemostasis*.
8. *Pack pyloroplasty and change gloves*.
9. Place the table in reverse Trendelenburg position.
10. Retract the left lobe of the liver upward (divide triangular ligament and reflect the left lobe to right if necessary).
11. Place fixed retractors.
12. Gently retract the stomach toward the left lower quadrant.
13. Divide the peritoneum overlying the abdominal esophagus.
14. Extend this peritoneal incision to expose the crura.
15. Gently encircle the esophagus with the right index finger.
16. Pass a Penrose drain around the esophagus and apply downward traction.
17. Identify the two main vagal trunks by inspection and palpation.
18. Pass a right-angle clamp behind the anterior vagal trunk, and gently dissect from the esophagus for a distance of 1–1.5 cm.
19. Elevate the anterior vagal trunk; clip proximal and distal with hemostatic clips and excise the segment.
20. Send the excised segment for frozen section confirmation.
21. Roll the esophagus to expose the posterior vagal trunk.
22. Similarly, excise the posterior vagal trunk and submit separately for frozen section.
23. Carefully inspect and palpate the esophagus and paraesophageal tissues; excise and submit any possible nerve tissue.
24. Place packs in region of the hiatus.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_25

25. *If elective*: *Place two 2-0 silk stay sutures on the pylorus*.
26. *Longitudinal incision through the pylorus*.
27. *If for bleeding*: *Remove pack from the duodenum and verify hemostasis*.
28. Close pyloroplasty transversely in a single layer with interrupted 2-0 silk.
29. Place omentum over the pyloroplasty.
30. Remove packs from the hiatus and check hemostasis.
31. Close the abdomen in the usual fashion.

Note These Variations

- In a situation of active bleeding, first open the pyloroplasty and control the bleeding. Then perform vagotomy. Pyloroplasty incision is closed last to allow confirmation of hemostasis.
- In cases of perforated duodenal ulcer not amenable to simple plication, the pyloroplasty must be individually tailored (so that closure is performed through uninflamed tissue).
- In an elective situation, vagotomy is done first (because it is the clean part of the operation), then pyloroplasty.

Complications

- Injury to the esophagus
- Injury to the spleen
- Incomplete vagotomy
- Delayed gastric emptying
- Gastroesophageal reflux due to disruption of the hiatus
- Recurrent bleeding if inadequate suture ligature of the gastroduodenal artery

Template Operative Dictation

Preoperative Diagnosis *Refractory/bleeding* duodenal ulcer.

Procedure Vagotomy and pyloroplasty *with suture ligation of bleeding ulcer*.

Postoperative Diagnosis Same.

Indications This is ___-year-old *male/female* with *refractory ulcer disease/bleeding duodenal ulcer* requiring vagotomy and pyloroplasty *with suture ligation of bleeding ulcer as an emergency procedure*.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made from xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

If bleeding duodenal ulcer*: Two stay sutures of 2-0 silk were placed at the pylorus. A longitudinal incision was made across the pylorus and the duodenal bulb inspected. A posterior duodenal ulcer with active arterial bleeding was identified. Hemostasis was achieved with three sutures of 2-0 silk placed to control the gastroduodenal artery superiorly*, *inferiorly*, *and medially. All clot was suctioned and the duodenum packed lightly proximally and distally. Gloves were changed and attention was directed to the hiatus*.

The table was placed in reverse Trendelenburg position. *The left triangular ligament of the liver was incised*, *and the left liver lobe retracted toward the right/the left lobe of the liver was retracted upward*. Fixed retractors were placed to expose the hiatus. The stomach was gently retracted and the peritoneum overlying the abdominal esophagus was incised. The esophagus was gently mobilized and encircled with a Penrose drain. The anterior and posterior vagi were identified, dissected free from the esophagus, and doubly clipped, and a segment was excised and submitted for frozen section confirmation. Frozen section returned peripheral nerve. *Additional nerve fibers were identified and submitted separately*. At the conclusion of this dissection, all neural tissue had been divided and the esophagus was intact. A pack was placed in the region of the hiatus.

Attention was then turned to the region of the pylorus.

[Choose One]

If bleeding: *The duodenal ulcer crater was again inspected and hemostasis noted to be secure*.

If perforation: *Inspection of the perforation revealed it to be too large for plication. The edges were freshened and it was determined that pyloroplasty could be used for closure without tension*.

If elective: *Two stay sutures of 2-0 silk were placed at the pylorus. A longitudinal incision was made across the pylorus and the duodenal bulb inspected*. The pyloroplasty incision was closed in a transverse fashion with a single layer of interrupted 2-0 silk sutures. The closure was noted to be intact, with a patent lumen, at the conclusion of this. The nasogastric tube was positioned. Omentum was placed in the vicinity of the pyloroplasty. The pack was removed from the region of the hiatus and hemostasis confirmed.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ____ were placed*.) The fascia was closed with *a running suture of ____/a Smead-Jones closure of interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ___/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

26 Partial Gastrectomy with Billroth I Reconstruction

Roy R. Danks

Indications

- Gastric ulcer
- Prepyloric ulcer
- Recurrent ulcer of the stomach and duodenum (after vagotomy)
- Early gastric or antral carcinoma or other gastric malignancies (see Chap. 10)

Essential Steps

1. Upper midline incision.
2. Confirm pathology.
3. Identify probable points of division of the stomach on the greater and lesser curvature.
4. Create an opening in the gastrocolic omentum close to the gastric wall near the point of division.
5. Create a similar window in lesser omentum.
6. Serially clamp, divide, and ligate branches of the gastroepiploic vessels with 2-0 silk, progressing toward the duodenum.
7. Similarly divide lesser omentum, taking care to identify and protect the common bile duct.
8. Perform a Kocher maneuver.
9. Circumferentially dissect the duodenum, taking care to protect the common bile duct, gastroduodenal artery, and pancreas.
10. Place bowel clamps across the duodenum and divide it.
11. Divide the stomach with 90-mm linear stapler and remove the specimen.
12. Amputate the greater curvature tip of the gastric remnant.
13. Approximate the duodenum to gastric remnant.
14. Construct a two-layer anastomosis.
15. Check hemostasis.
16. Close the abdomen.

Note These Variations

- Stapled anastomosis is also possible.
- Early division of the stomach facilitates difficult duodenal dissection.
- Biopsy gastric ulcer (if not previously done) to exclude malignancy.

Complications

- Anastomotic leak
- Recurrent ulcer
- Injury to the common bile duct or pancreas

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_26

Template Operative Dictations

Preoperative Diagnosis Gastric ulcer

Procedure Partial gastrectomy with Billroth I reconstruction

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had a *nonhealing gastric ulcer despite* ___ *weeks of maximal medical therapy/other*. Partial gastrectomy was indicated.

The risks, benefits, indications, and alternatives were discussed with the patient/his or her durable power of attorney (DPOA) prior to the operation, and informed consent was obtained in writing.

Preoperative Antibiotic ____________ was administered prior to incision.

VTE Prophylaxis The patient was given *(low molecular weight heparin, unfractionated heparin)* subcutaneously preoperatively. Pneumatic compression devices were applied and functioning prior to induction of general anesthetic.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed.

An upper vertical midline incision was made. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct visualization with Metzenbaum scissors* (*Harmonic scalpel/electrocautery/LigaSure*).

A self-retaining retractor was then placed and the abdominal wall was retracted laterally, inferiorly, and superiorly. The small bowel and colon were then packed inferiorly with laparotomy pads and held in place with retractors. This afforded adequate exposure of the stomach and duodenum. The pancreas was then gently examined by palpation and determined to be *normal/abnormal* (*detail*). The gallbladder was palpated and found to *be normal/contain gallstones*.

The gastrocolic ligament was incised at the midpoint of the greater curvature of the stomach. This allowed good exposure of the omental bursa. Next, an opening was made in the lesser omentum and a Penrose drain was placed around the stomach for retraction. The dissection was continued along the greater curvature toward the duodenum. Gastroepiploic vessels were clamped, sharply divided, and ligated with *2-0 silk ties/LigaSure device/Harmonic scalpel*. Once the duodenum was reached, a Kocher maneuver was undertaken by sweeping the second limb of the duodenum from medial to lateral, sharply dividing the duplicated peritoneal reflection. Blunt and sharp dissection was used to free the duodenum until it was adequately mobilized.

The stomach was then retracted in a left cephalad direction to facilitate circumferential duodenal mobilization. This was accomplished by proceeding from the left, medial duodenal wall, posteriorly to the back wall, and laterally to the hepatoduodenal ligament. The gastroduodenal artery was identified and kept out of harm's way.

The dissection was continued along the lesser curvature of the stomach to the level of the third vein. Vessels were clamped, transected, and *tied with 2-0 silk ties/LigaSure device/Harmonic scalpel*. Stay sutures were placed on the lateral aspects of the duodenum. Bowel clamps were then applied across the duodenum, and it was sharply transected *with a #10 scalpel blade/with heavy scissors*. The stomach was transected by placing a TA90 stapling device across the proximal resection margin at a 45° angle to the lesser curvature and firing the stapler. The specimen was passed off the operative field.

A gastrotomy was then created by placing a clamp across the lower corner of the gastric remnant, at a width adequate to receive the duodenum, and removing the corner, sharply with *scissors/electrocautery/scalpel*. A posterior row of interrupted 3-0 silk Lembert sutures was placed, followed by an inner layer of running 4-0 Vicryl and an anterior row of interrupted 3-0 silk Lembert sutures. The anastomosis was palpably patent and intact at the conclusion of the procedure.

Hemostasis was checked. The nasogastric tube was noted to lie in a comfortable position within the gastric lumen. After removing all laparotomy pads, the abdominal cavity was lavaged with ____liters of warm, sterile saline. Irrigation was removed with suction. (*Optional*: *Multiple interrupted through-and-through retention sutures of ____ were placed*.) The fascia was closed with *a running/interrupted suture of* ____.

The subcutaneous layer was lavaged with _____ mL of warm, sterile saline solution.

The skin was closed with *skin staples/subcuticular sutures of ___/other*.

All sponge and instrument count was reported as correct at the completion of the operative procedure. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the *postanesthesia care unit/ICU* in stable condition.

27 Partial Gastrectomy with Billroth II Reconstruction

Roy R. Danks

Indications

- Peptic ulcer disease (gastric ulcer, duodenal ulcer)
- Failed Billroth I operation

Essential Steps

1. Upper midline incision.
2. Confirm pathology.
3. Identify probable points of division of the stomach on the greater and lesser curvature.
4. Create an opening in the gastrocolic omentum close to the gastric wall near the point of division.
5. Create a similar window in lesser omentum.
6. Serially clamp, divide, and ligate branches of the gastroepiploic vessels with 2-0 silk, progressing toward the duodenum. Vessels may also be divided with energy device (Harmonic scalpel or LigaSure).
7. Similarly divide lesser omentum, taking care to identify and protect the common bile duct.
8. Perform a Kocher maneuver.
9. Circumferentially dissect the duodenum, taking care to protect the common bile duct, gastroduodenal artery, and pancreas.
10. Pull the nasogastric tube back into the distal esophagus.
11. *Place bowel clamps across the duodenum/staple the duodenum with linear stapler and divide it.*
12. If *sutured duodenal stump closure*:
    - *Close the duodenal stump with an inner layer of 3-0 Vicryl placed as a running Connell suture, followed with an outer layer of interrupted 3-0 silk.*
13. *If sutured gastrojejunostomy*:
    - *Divide the stomach with bowel clamps across the greater curvature.*
    - *Divide the lesser curvature to within 3–4 cm of the esophagus with a linear stapler.*
14. *If stapled gastrojejunostomy*:
    - *Divide the stomach with a linear stapler from the chosen point on the greater curvature to within 3–4 cm of the esophagus on the lesser curvature. Trace* jejunum to the ligament of Treitz; identify mobile loop of jejunum close to the ligament of Treitz.
    - Pass jejunum antecolic/through window in transverse mesocolon and place adjacent to the gastric remnant.
15. *If sutured*:
    - *Create two-layered gastrojejunostomy, with the inner layer running 3-0 Vicryl and the outer layer interrupted 3-0 silk Lembert sutures.*
    - *Three-corner stitch at the angle of sorrows.*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_27

16. *If stapled*:
    - *Approximate posterior wall of the stomach and jejunum with two 3-0 silk sutures*.
    - *Create gastrotomy and jejunostomy and insert a linear cutting stapler*.
    - *Fire the stapler*.
    - *Check the staple line for hemostasis*.
    - *Close enterotomies with a linear stapler/in two layers with running 3-0 Vicryl and interrupted 3-0 silk*.
17. Check anastomosis for integrity and patency of both afferent and efferent limbs.
18. *If retrocolic*:
    - *Close the transverse mesocolon by suturing to the gastric remnant with interrupted 3-0 silk sutures*.
19. Position the nasogastric tube.
20. Bring omentum up to lie over the duodenal stump and gastrojejunostomy.
21. Check hemostasis.
22. Close abdomen.

Note These Variations

- Divide the stomach early if duodenal dissection is difficult.
- Extent of resection dictated by pathology.
- Stapled vs. sutured closure of the duodenal stump.
- Stapled vs. sutured gastrojejunostomy.
- Antecolic vs. retrocolic.
- Vagotomy.

Complications

- Anastomotic leak
- Injury to the common bile duct, pancreas, or spleen
- Recurrent ulcer or marginal ulcer
- Bile reflux gastritis
- Afferent limb syndrome
- Herniation through transverse mesocolon defect (retrocolic)

Template Operative Dictation

Preoperative Diagnosis *Gastric/duodenal* ulcer refractory to medical therapy

Procedure Subtotal gastrectomy with Billroth II reconstruction

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had a nonhealing gastric ulcer despite ___ weeks of maximal medical therapy. Partial gastrectomy was indicated.

The risks, benefits, indications, and alternatives were discussed with the patient/his or her durable power of attorney (DPOA) prior to the operation, and informed consent was obtained in writing.

Preoperative Antibiotic ____________ was administered prior to incision.

VTE Prophylaxis The patient was given (low molecular weight heparin, unfractionated heparin) subcutaneously preoperatively. Pneumatic compression devices were applied and functioning prior to induction of general anesthetic.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped (with ChloraPrep/Betadine/Duraprep) and draped in the usual sterile fashion. A vertical midline incision was made from xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors. Adhesions not involving viscera were divided with electrocautery/LigaSure/harmonic scalpel*.

A self-retaining retractor was then placed and the abdominal wall was retracted laterally, inferiorly, and superiorly. The small bowel and colon were then packed inferiorly with moist laparotomy pads and held in place with retractors. This afforded adequate exposure of the stomach and duodenum. The pancreas was then gently examined by palpation and determined to be *normal/abnormal* (*detail*). The gallbladder was palpated and found to *be normal/contain gallstones*.

The gastrocolic ligament was incised at the midpoint of the greater curvature of the stomach. This allowed good exposure of the omental bursa. Next, an opening was made in the lesser omentum and a Penrose drain was placed around the stomach for retraction. The dissection was continued along the greater curvature toward the duodenum. Gastroepiploic vessels were clamped, sharply divided, and ligated with 2-0 silk ties/divided with harmonic scalpel/LigaSure. Once the duodenum was reached, a Kocher maneuver was undertaken by sweeping the second limb of the duodenum from medial to lateral, sharply dividing the duplicated peritoneal reflection. Blunt and sharp dissection was used to free the duodenum until it was adequately mobilized.

The stomach was then retracted in a left cephalad direction to facilitate circumferential duodenal mobilization. This was accomplished by proceeding from the left, medial duodenal wall, posteriorly to the back wall, and laterally to the hepatoduodenal ligament. The gastroduodenal artery was identified and kept out of harm's way.

The dissection was continued along the lesser curvature of the stomach to within 3–4 cm of the esophagus. Vessels were clamped, transected, and tied with 2-0 silk sutures/divided with harmonic shears/LigaSure device.

[Choose One]

If stapled duodenal stump closure: *A linear stapler was then used to divide the duodenum just beyond the pylorus*.

If sutured duodenal stump closure: *The duodenum was divided just beyond the pylorus with bowel clamps. The duodenal stump was closed in two layers*: *an inner running layer of 3-0 Vicryl placed as a Connell suture and an outer layer of interrupted 3-0 silk Lembert sutures*.

The duodenal stump closure was inspected and found to be satisfactory.

If sutured gastrojejunostomy: *The stomach was then divided by placing bowel clamps at right angles across the greater curvature for a length of 4–5 cm* (*usually at the junction between the left and right gastroepiploic vessels*) *and sharply transected. A linear stapler was fired along toward the incisura of the lesser curvature to complete the resection*.

If stapled gastrojejunostomy: *The stomach was divided with a linear stapler placed across it from the chosen point of division on the greater curvature* (*usually at the junction between the left and right gastroepiploic vessels*) *to the incisura on the lesser curvature*.

The specimen was removed. The ligament of Treitz was palpated and a mobile loop of jejunum as close as possible to the ligament of Treitz was identified. It was passed in an *antecolic fashion/through a window in the transverse mesocolon* and brought to lie comfortably adjacent to the gastric remnant.

If sutured gastrojejunostomy: *A two-layered sutured gastrojejunostomy was then constructed with an inner layer of running 3-0 Vicryl and an outer layer of interrupted 3-0 silk Lembert sutures. A three-point suture was placed at the angle of sorrows*.

If stapled gastrojejunostomy: *The jejunum was approximated to the posterior wall of the stomach with two sutures of 3-0 silk. A gastrotomy and a jejunostomy were then made and the linear cutting stapler inserted and fired. The staple line was inspected for hemostasis. The enterotomies were closed with a linear stapler/in two layers using 3-0 Vicryl and 3-0 silk*.

The anastomosis was checked for integrity and patency of both the afferent and efferent limbs. It was noted to lie comfortably without tension or torsion in the left upper quadrant. *The transverse mesocolon was approximated to the gastric remnant with interrupted 3-0 silk sutures to prevent herniation*.

Hemostasis was checked. The nasogastric tube was positioned. Omentum was brought up and made to lie over the duodenal stump and gastrojejunostomy site.

(*Optional*: *The abdominal cavity was lavaged with ___ liters of sterile saline solution. As much of the irrigant as possible was removed with suction. Laparotomy pad and instrument counts were completed and reported as correct*).

(*Optional*: *Multiple interrupted through-and-through retention sutures of ___ were placed.*) The fascia was closed *with a running suture of ___/a Smead-Jones closure of interrupted ___*.

The skin was closed with *skin staples/subcuticular sutures of ___/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

28 Laparoscopic Distal Gastrectomy with Billroth II Reconstruction

Stephanie Wood and Andrew J. Duffy

Indications

- Distal gastric mass requiring resection, for which a more radical procedure is not indicated
- Gastrointestinal stromal tumors
- Selected cases of gastric neuroendocrine tumors – type 3 gastric neuroendocrine tumor or any distal gastric neuroendocrine tumor greater than 2 cm in size
- Peptic ulcer disease with medically refractory GI bleed
- Chronic peptic ulcer disease with gastric outlet obstruction
- Other causes of gastric outlet obstruction

Essential Steps

1. Position the patient in a supine, reverse Trendelenburg position.
2. Access peritoneal cavity (Veress, Hasson, Optiview).
3. Achieve 15 mmHg pneumoperitoneum; place ports.
4. Perform diagnostic laparoscopy to rule out metastatic disease.
5. Incise the gastrocolic ligament to mobilize the greater curvature of the stomach to the level of transection.
6. Divide the right gastroepiploic artery.
7. Incise the pars flaccida.
8. Divide the right gastric vessels.
9. Circumferentially dissect and transect the duodenum just distal to the pylorus.
10. Divide the antrum.
11. Place the specimen in a laparoscopic specimen bag for subsequent retrieval.
12. Trace jejunum from the ligament of Treitz; identify mobile loop of jejunum close to the ligament of Treitz.
13. Orient jejunal loop in an antecolic, retrogastric position to create an isoperistaltic anastomosis.
14. Create gastrojejunal anastomosis.
15. Retrieve specimen and close the extraction site.

Note These Variations

- Access to abdomen (Veress, Hasson, Optiview)
- Creation of anastomosis (hand-sewn, stapled, hybrid, Endo Stitch)
- Vagotomy (for peptic ulcer disease) – rarely performed
- Intraoperative endoscopy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_28

Complications

- Gastric perforation/injury
- Anastomotic leak
- Anastomotic stricture
- Duodenal stump leak
- Failure to empty
- Dumping syndrome
- Afferent/efferent limb syndrome
- Bile reflux gastritis

Template Operative Dictation

Preoperative Diagnosis *Distal gastric mass/chronic peptic ulcer disease/gastric outlet obstruction/other*

Procedure Laparoscopic distal gastrectomy with Billroth II reconstruction, upper endoscopy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who presented *with distal gastric neoplasm/peptic ulcer disease/medically refractory GI bleed/gastric outlet obstruction/other*. Laparoscopic distal gastrectomy with Billroth II reconstruction was indicated.

Description of Procedure The patient was brought into the operating room and placed in supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia with endotracheal intubation was induced. Preoperative antibiotics were administered. [*Specify lines/tubes*, etc. (i.e., *Foley catheter*, *OG/NG*, *SCDs*, etc.)] were placed and all pressure points appropriately padded. The abdomen was prepped and draped in the usual sterile fashion.

A *5/12* mm supraumbilical incision was made. Using a *Veress needle/Hasson* or *Optiview trocar*, the peritoneal cavity was accessed and the abdomen insufflated to a pressure of 15 mmHg with CO^2. A *5/10* mm 30° laparoscope was introduced. The abdomen was inspected for signs of *Veress needle/trocar placement injury* and none was seen. *The abdominal cavity was inspected and no evidence of metastatic disease was noted*. A subxiphoid 5 mm Nathanson liver retractor was placed to elevate the left lobe of the liver.

The following ports were placed under direct vision: a left lateral 5 mm port, a midclavicular left upper quadrant 12 mm port, and a right upper quadrant 5 mm port.

[Optional]:

An upper endoscopy was performed.

The location of the distal gastric mass/peptic ulcer disease was confirmed with external landmarks noted; the stomach was decompressed and the endoscope withdrawn.

Antrectomy was performed first. The gastrocolic ligament was taken down distally toward the duodenum and proximally toward the junction between the right and left gastroepiploic vessel. The right gastroepiploic vessels were transected. The stomach was elevated and the avascular gastropancreatic folds were taken down. The pars flaccida was opened, providing access into the lesser sac. Using the LigaSure device, the right gastric vessels were divided close to their origin. The pylorus and duodenal bulb were circumferentially dissected. Just distal to the pylorus, the duodenum was transected with a single firing of a *45/60* mm *purple/other Endo GIA stapler*.

The antrum of the stomach was then divided using multiple firings of the 60 mm purple/other Endo GIA stapler. The line of transection starts from the junction between the left and right gastroepiploic vessels and heads toward the incisura of the lesser curvature. The specimen was placed into a specimen retrieval bag and left temporarily in the abdominal cavity.

Next, the Billroth II reconstruction was performed. The transverse colon was elevated and the ligament of Treitz was identified, confirmed by identification of the inferior mesenteric vein. The bowel was run distally for about 30 cm until the optimal mesenteric length was obtained.

This loop of bowel was placed adjacent to the remnant stomach in an antecolic, isoperistaltic fashion. Four 0-Vicryl sutures were placed to approximate the small bowel to the stomach and serve as a posterior layer. Using the *Sonicision*™

device/other energy device, a gastrotomy and enterotomy were made. A side-to-side stapled anastomosis was created using *the Endo GIA™ 60 purple stapler*. The common enterotomy was then closed in two layers using the *Endo Stitch™* device. The Peterson defect was closed with a 2-0 Vicryl/silk purse-string suture.

[Optional: if checking for anastomotic leak, choose one]

If upper endoscopy is performed: *The upper endoscope was passed into the stomach and the gastrojejunal anastomosis inspected. The gastrojejunostomy was widely patent. A leak test was performed and no leak was identified. The stomach was decompressed and the intra-abdominal fluid suctioned*.

If insufflation is performed without upper endoscopy: *An oral Ewald tube/orogastric tube was placed into the stomach. A leak test was performed by insufflating the stomach with air while simultaneously flooding the operative field with normal saline and clamping the proximal and distal jejunal limbs. No leak was identified*.

All ports were removed, and the abdomen deflated. The 12 mm port site was extended and the specimen extracted. The fascia was closed *with a running/interrupted suture of* ___. The wound was irrigated and all skin incisions were closed with a *subcuticular 4-0 Monocryl suture/skin staplers*.

All counts were confirmed prior to closure. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transported to PACU in a stable condition.

Laparoscopic Partial Gastrectomy with Roux-en-Y Gastrojejunostomy Reconstruction

29

Kurt E. Roberts and Jennifer L. Salluzzo

Indications

- Distal gastric mass requiring resection, for which a more radical procedure is not indicated
- Gastrointestinal stromal tumors
- Selected cases of gastric neuroendocrine tumors, type 3 gastric neuroendocrine tumor, or any distal gastric neuroendocrine tumor greater than 2 cm in size
- Peptic ulcer disease with medically refractory GI bleed
- Chronic peptic ulcer disease with gastric outlet obstruction
- Other causes of gastric outlet obstruction

Essential Steps

1. Decompress the stomach with an orogastric tube.
2. Access the peritoneal cavity (Veress, Hasson, Optiview) and place ports and liver retractor.
3. Incise the gastrocolic ligament to mobilize the greater curvature of the stomach to the level of transection.
4. Divide the right gastroepiploic artery.
5. Incise the lesser omentum.
6. Divide the right gastric artery.
7. Mobilize the first portion of the duodenum.
8. Transect the duodenum.
9. Divide the posterior attachments of the stomach.
10. Transect the stomach.
11. Place specimen in an Endo Catch bag.
12. Divide omentum into two halves, up to the level of the mid-transverse colon.
13. Identify the ligament of Treitz and transect jejunum 40 cm distal to ligament of Treitz.
14. Create two-layered GJ anastomosis.
15. Create jejuno-jejunal anastomosis with a 60 cm Roux limb.
16. Close jejuno-jejunal mesenteric defect and Petersen's defect.
17. *Upper endoscopy*, *leak test.*
18. Remove specimen. Close extraction and trocar sites.

Note These Variations

- Access to abdomen (Veress, Hasson, Optiview)
- Creation of anastomosis (stapled, hand-sewn, hybrid, Endo Stitch)

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_29

- Vagotomy (for peptic ulcer disease), rarely performed
- Intraoperative endoscopy

Complications

- Gastric perforation/injury
- Anastomotic leak
- Anastomotic stricture
- Duodenal stump leak
- Failure to empty
- Dumping syndrome
- Internal hernia

Template Operative Dictation

Preoperative Diagnosis *Distal gastric mass/chronic peptic ulcer disease/gastric outlet obstruction/other*

Procedure Laparoscopic partial gastrectomy with Roux-en-Y reconstruction

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who presented *with distal gastric neoplasm/peptic ulcer disease/medically refractory GI bleed/gastric outlet obstruction/other*. Laparoscopic distal gastrectomy with Roux-en-Y reconstruction was indicated.

Description of Procedure The patient was taken to the operating room and placed in a supine position with both arms out. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Lower extremity compression boots were placed on the patient. The patient received weight-based antibiotic prophylaxis. General endotracheal anesthesia was induced. The patient's abdomen was prepped and draped in a sterile fashion.

A 12 mm skin incision supraumbilical incision just off to the left of midline was made. A *Veress needle/open Hasson*, *Optiview trocar* was used to access the peritoneal cavity. Pneumoperitoneum was established up to 15 mmHg. The abdomen was inspected. No injuries were identified. The following ports were placed under direct vision: a 5 mm left upper quadrant midclavicular port, a 5 mm left midabdominal port, a RUQ 5 mm port, and a 5 mm subxiphoid incision were made for the liver retractor. The left lobe of the liver was retracted superiorly.

The gastrocolic ligament was taken down distally toward the duodenum and proximally toward the junction between the right and left gastroepiploic vessel. The stomach was elevated and the avascular gastropancreatic folds were taken down. The pars flaccida was opened, providing access into the lesser sac. Using the LigaSure device, the right gastric vessels were divided close to their origin. The pylorus and duodenal bulb were circumferentially dissected. Just distal to the pylorus, the duodenum was transected with a single firing of a *45/60* mm *purple/other Endo GIA stapler*.

The antrum of the stomach was then divided using multiple firings of the 60 mm purple/other Endo GIA stapler. The line of transection starts from the junction between the left and right gastroepiploic vessels and heads toward the incisura of the lesser curvature. The specimen was placed into a specimen retrieval bag and left temporarily in the abdominal cavity.

Attention was turned toward the creation of the Roux-en-Y gastrojejunostomy. The greater omentum was bisected in the middle. The ligament of Treitz was identified by elevating the transverse colon. Approximately 30–40 cm distal to the ligament of Treitz, an Endo GIA stapler was used to transect the jejunum. A vascular load Endo GIA stapler was used to divide the mesentery of the small bowel to offset tension on the gastrojejunal anastomosis.

The Roux limb was placed adjacent to the remnant stomach in an antecolic, isoperistaltic fashion. Four 0-Vicryl sutures were placed to approximate the Roux limb to the stomach and serve as a posterior layer. Using the *Sonicision™ device/other energy device*, a gastrotomy and enterotomy were made. A side-to-side stapled anastomosis was created using t*he Endo GIA™ 60 purple stapler*. The common enterotomy was then closed in two layers using the *Endo Stitch™* device.

The Roux limb was measured to a 60 cm length. The previously transected proximal jejunum was then aligned in an isoperistaltic fashion with the distal Roux limb. The two limbs of the small bowel were secured to each other using two interrupted 2-0 Polysorb stay sutures placed in a seromuscular, antimesenteric fashion. Enterotomies were created in the proximal jejunum and Roux limb using the *Sonicision/energy device*. A 45/60 mm purple load Endo GIA stapler was used to create a side-to-side anastomosis. The common enterotomy was closed with another firing of the 60 mm purple load Endo GIA stapler. The jejuno-jejunal mesenteric defect was closed using interrupted 2-0 Polysorb/silk sutures. Similarly, the Petersen's defect was closed using interrupted 2-0 Polysorb/silk sutures.

[Optional: if checking for anastomotic leak, choose one:]

If upper endoscopy is performed: *The upper endoscope was passed into the stomach and the gastrojejunal anastomosis inspected. The gastrojejunostomy was widely patent. A leak test was performed and no leak was identified. The stomach was decompressed and the intra-abdominal fluid suctioned*.

If insufflation is performed without upper endoscopy: *An oral Ewald tube/orogastric tube was placed into the stomach. A leak test was performed by insufflating the stomach with air while simultaneously flooding the operative field with normal saline and clamping the proximal and distal jejunal limbs. No leak was identified*.

All ports were removed, and the abdomen deflated. The 12 mm port site was extended and the specimen extracted. The fascia was closed *with a running/interrupted suture of* ___. The wound was irrigated and all skin incisions were closed with a *subcuticular 4-0 Monocryl suture/skin staplers*. All counts were confirmed prior to closure. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transported to PACU in a stable condition.

Subtotal Gastrectomy with D2 Nodal Dissection, Roux-en-Y Reconstruction for Cancer

30

Jessica Maxwell and Hisakazu Hoshi

Indication

- Carcinoma of the distal stomach

Essential Steps

1. Make an upper midline incision.
2. Explore the abdomen. Confirm pathology and stage.
3. Separate the greater omentum from the transverse colon.
4. Infrapyloric nodal dissection and ligation of the right gastroepiploic vessels.
5. Suprapyloric nodal dissection and ligation of the right gastric vessels.
6. Divide the duodenum.
7. Dissect nodes along the common hepatic artery.
8. Dissect nodes around the celiac axis and the proximal splenic artery.
9. Ligate the left gastric artery at the celiac axis.
10. Dissect nodes along the lesser curvature toward GE junction.
11. Ligate the left gastroepiploic vessels.
12. Dissect nodes along the greater curvature.
13. Pull the nasogastric tube back into the distal esophagus.
14. Divide stomach at least 3 cm from the tumor for differentiated carcinoma or 5 cm for poorly differentiated carcinoma.
15. Trace jejunum to the ligament of Treitz; identify a mobile loop of the jejunum close to the ligament of Treitz.
16. Divide loop of the jejunum with a linear stapler.
17. Pass the distal jejunum antecolic/retrocolic for Roux-en-Y reconstruction and place adjacent to the gastric remnant.
18. Create gastrojejunal anastomosis.
19. Create a stapled jejunojejunostomy.
20. Check hemostasis.
21. Position nasogastric tube.
22. Close the abdomen without drainage.

Note These Variations

- Stapled or sutured duodenal stump closure
- Stapled or sutured gastrojejunostomy
- Billroth I or Billroth II reconstruction
- En bloc resection of contiguous structures

Complications

- Recurrence
- Anastomotic leak

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_30

- Injury to the common bile duct, pancreas, or spleen
- Bile reflux gastritis (rare in Roux-en-Y reconstruction)
- Afferent limb syndrome
- Herniation through transverse mesocolon defect (retrocolic)

Template Operative Dictation

Preoperative Diagnosis Adenocarcinoma of the stomach (T_, N_, M_ stage __)

Procedure Distal gastrectomy with D2 nodal dissection, Roux-en-Y reconstruction

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed symptoms of *early satiety/gastrointestinal bleeding/epigastric pain* and on evaluation was found to have adenocarcinoma of the distal stomach. Distal gastrectomy with D2 nodal dissection was indicated for treatment.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation.* Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from the xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors.* No liver metastases or peritoneal involvement was seen. Wash cytology was obtained in the upper abdomen. The tumor was *limited to the stomach / found in* (*detail locations*). The stomach was mobile and the decision was made to proceed with distal gastrectomy.

The spleen was gently elevated from the diaphragm using abdominal laparotomy pads. The greater omentum was dissected from the transverse colon first, by starting in the avascular plane near the splenic flexure. The dissection was advanced toward the hepatic flexure and advanced along the anterior leaf of the transverse mesocolon into the lesser sac toward the head of the pancreas until the point at which the accessory right colic vein inserts into the right gastroepiploic vein. The right gastroepiploic vein was ligated just proximal to the insertion of the accessory right colic vein with 3-0 silk ligatures. The right gastroepiploic artery was identified, ligated with 3-0 silk ligatures, and reinforced with a silk stick tie. All lymphatic tissue in subpyloric area was separated from the duodenal wall toward the pylorus.

Next, the peritoneum was incised on the left side of the hepatoduodenal ligament and the origin of the right gastric artery was exposed. The artery was ligated with 2-0 silk ties and divided. All of the nodal tissue in the suprapyloric area was separated from the duodenum and included in the specimen. The pylorus was identified. The duodenum was then transected 1 cm distal to the pylorus with a GIA stapler blue load. The staple line was over-sewed with 3-0 silk Lembert stitches. The stomach was reflected in a cephalad manner, which exposed the head of the pancreas, the common hepatic artery, and the origin of the celiac axis. The nodal tissue adjacent to the upper border of the pancreas along the common hepatic artery was dissected using a combination of sharp and blunt methods. The lesser omentum was then divided toward the GE junction with electrocautery just proximal to its attachment with the inferior border of the liver. *No replaced / accessory left hepatic artery was noted or replaced / accessory left hepatic artery was noted and preserved.* The retroperitoneal dissection was advanced along the right crus of the diaphragm to the esophageal hiatus. Nodal tissue covering the proximal splenic artery was dissected toward the origin of the left gastric artery. The left gastric vein and the left gastric artery were identified. The left gastric vein was ligated with 3-0 silk sutures. The left gastric artery was then ligated with silk sutures and further reinforced with a silk stick tie.

If a replaced or accessory left hepatic artery is identified: *The origin of left gastric artery was completely cleared with soft tissue up to the origin of the replaced / accessory left hepatic artery, and the distal portion of left gastric artery was ligated and divided.*

Dissection was advanced along the anterior surface of the aorta to esophageal hiatus leaving all the soft tissue to the stomach side.

The lesion within the stomach was palpated in the antrum. A *3 / 5* cm margin was measured from the proximal extent of the lesion for a line of transection. Along the lesser curvature of the stomach, soft tissue was dissected away from the stomach wall by ligating the terminal branches of the left gastric arteries toward GE junction.

Attention was next turned to the greater curvature of the stomach. The origin of the left gastroepiploic artery from the splenic artery was identified, isolated, ligated with silk suture, and reinforced with a 3-0 silk stick tie. The short gastric arteries were preserved. Dissection of the nodes along the greater curvature of the stomach, gastroepiploic artery, and greater omentum was carried out by ligating the terminal branches of the left gastroepiploic artery on the wall of the stomach with a combination of blunt dissection, silk ligatures, and Harmonic scalpel toward the pylorus to the level of the planned line of transection.

If sutured gastrojejunostomy: *With a Kocher clamp on the specimen side and a gastric clamp on the remnant side*, *the stomach was divided sharply half way across its width from the greater curvature side. On the lesser curvature side*, *the stomach was divided with a TA stapler slightly angled back toward the GE junction. This was over-sewn with 3-0 silk Lembert stitches*.

If stapled gastrojejunostomy: *The stomach was divided with a linear stapler 3 / 5 cm from the proximal aspect of the tumor on the greater curvature to a point within 3–4 cm of the esophagus on the lesser curvature*.

The stomach, greater omentum, and nodal stations as described above were then passed off the table to pathology. The stomach was everted on the back table to identify the tumor and to ensure adequate margins of resection.

A Roux-en-Y reconstruction was performed. A segment of jejunum approximately 20 cm downstream from the ligament of Treitz was selected. A window in the mesentery was created and the bowel loop was divided with a linear stapler. The distal part of the intestine was then brought up in *front of / through the mesenteric defect behind* the transverse colon to the gastric remnant.

[Choose One]

If hand-sewn Roux-en-Y reconstruction**:** A two-layered sutured gastrojejunostomy was constructed with an inner layer of running 3-0 absorbable suture and an outer layer of interrupted 3-0 silk Lembert sutures. A three-point suture was placed at the angle of sorrows. The anastomosis was checked for patency and appeared widely patent without any areas concerning for leakage.

If stapled Roux-en-Y reconstruction: *The jejunum was approximated to the posterior wall of the stomach with interrupted 3-0 silk sutures. A gastrotomy and a jejunotomy were made and the linear cutting stapler inserted and fired. The staple line was inspected for hemostasis. The enterotomies were closed with a linear stapler / in two layers*.

A jejunojejunal anastomosis was created between the pancreatobiliary end of the jejunum and a segment approximately 45 cm down from the gastrojejunostomy. This was done in a side-to-side fashion. Tacking stitches of 3-0 silk were placed. An enterotomies were made in both jejunal limbs and the GIA stapler was fired. No bleeding was seen from staple line. The enterotomies were then closed with a TA stapler and oversewn with 3-0 silk Lembert stitches.

After ensuring adequate hemostasis, the fascia was closed with *a running suture of ____*. The skin was closed with *skin staples / subcuticular sutures of ____/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in a stable condition.

Total Gastrectomy with D2 Nodal Dissection, Roux-en-Y Reconstruction, and Feeding Tube Jejunostomy

31

Jessica Maxwell and Hisakazu Hoshi

Indication

- Carcinoma of the stomach

Essential Steps

1. Make an upper midline incision.
2. Explore the abdomen and confirm pathology and stage.
3. Separate the greater omentum from the transverse colon.
4. Infrapyloric nodal dissection and ligation of the right gastroepiploic vessels.
5. Suprapyloric nodal dissection and ligation of the right gastric vessels.
6. Divide the duodenum.
7. Dissect nodes along the common hepatic artery.
8. Dissect nodes around the celiac axis and the splenic artery.
9. Ligate left gastric artery at the celiac axis.
10. Ligate short gastric vessels and divide the gastrosplenic ligament.
11. Dissect nodes around the distal esophagus.
12. Transect esophagus and remove specimen.
13. Identify the ligament of Treitz and identify a loop of upper jejunum.
14. Create Roux-en-Y limb.
15. Roux-en-Y esophagojejunostomy.
16. *Feeding jejunostomy*.
17. Closed suction drains in vicinity of the hiatus.
18. Position the nasogastric tube.
19. Check hemostasis.
20. Close the abdomen.

Note These Variations

- Stapled or sutured duodenal stump closure
- Antecolic or retrocolic passage of Roux-en-Y jejunal limb
- Stapled or sutured esophagojejunal anastomosis
- Creation of jejunal pouch
- Feeding tube jejunostomy
- Drain

Complications

- Injury to the replaced left or accessory left hepatic artery
- Anastomotic leak
- Injury to the esophagus

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_31

- Duodenal stump leak
- Small bowel obstruction caused by feeding jejunostomy
- Pancreatitis or pancreatic fistula

Template Operative Dictation

Preoperative Diagnosis Adenocarcinoma of the stomach (T_, N_, M_ stage __)

Procedure Total gastrectomy with D2 nodal dissection, Roux-en-Y reconstruction, and *feeding tube jejunostomy*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed symptoms of *early satiety/gastrointestinal bleeding/epigastric pain* and on evaluation was found to have gastric adenocarcinoma. A total gastrectomy was indicated for treatment. *A feeding jejunostomy was placed for enteral nutrition*.

Description of Procedure An epidural catheter was placed by anesthesia prior to the start of the operation. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from the xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. No liver metastases or peritoneal involvement was seen. Wash cytology was obtained in the upper abdomen. The tumor was *limited to the stomach / found in* (*detail locations*). The stomach was mobile and the decision was made to proceed with total gastrectomy.

The spleen was gently elevated from the diaphragm using abdominal laparotomy pads. The greater omentum was dissected from the transverse colon first, by starting in the avascular plane near the splenic flexure. The dissection was advanced toward the hepatic flexure and advanced along the anterior leaf of the transverse mesocolon into the lesser sac toward the head of the pancreas until the point at which the accessory right colic vein inserts into the right gastroepiploic vein. The right gastroepiploic vein was ligated just proximal to the insertion of the accessory right colic vein with 3-0 silk ligatures. The right gastroepiploic artery was identified, ligated with 3-0 silk ligatures, and reinforced with a silk stick tie. All lymphatic tissue in subpyloric area was separated from the duodenal wall toward the pylorus.

Next, the peritoneum was incised on the left side of the hepatoduodenal ligament and the origin of the right gastric artery was exposed. The artery was ligated with 2-0 silk ties and divided. All of the nodal tissue in the suprapyloric area was separated from the duodenum and included in the specimen. The pylorus was identified. The duodenum was then transected 1 cm distal to the pylorus with a GIA stapler blue load. The staple line was over-sewed with 3-0 silk Lembert stitches. The stomach was reflected in a cephalad manner, which exposed the head of the pancreas, the common hepatic artery, and the origin of the celiac axis. The nodal tissue adjacent to the upper border of the pancreas along the common hepatic artery was dissected using a combination of sharp and blunt methods. The lesser omentum was then divided toward the GE junction with electrocautery just proximal to its attachment with the inferior border of the liver. *No replaced / accessory left hepatic artery was noted* or *replaced / accessory left hepatic artery was noted and preserved*. The retroperitoneal dissection was advanced along the right crus of the diaphragm to the esophageal hiatus. Nodal tissue covering the splenic artery was dissected from the splenic hilum toward the origin of the left gastric artery. *The posterior gastric artery was identified, dissected, ligated, and divided*. The left gastric vein and the left gastric artery were identified. The left gastric vein was ligated with 3-0 silk sutures. The left gastric artery was then ligated with silk sutures and further reinforced with a silk stick tie.

If a replaced or accessory left hepatic artery is identified: *The origin of the left gastric artery was completely cleared of soft tissue up to the origin of the replaced / accessory left hepatic artery, and the distal portion of left gastric artery was ligated and divided*. Dissection was advanced along the anterior surface of the aorta to the esophageal hiatus leaving all the soft tissue to the stomach side.

Attention was turned to the greater curvature of the stomach. The origin of the left gastroepiploic artery from the splenic artery was identified, ligated with silk suture, and reinforced with a silk stick tie. The short gastric arteries were serially ligated at the hilum of the spleen. The entire fundus was mobilized from the retroperitoneum toward the esophagus.

Retractors were placed on the left lateral lobe of the liver and attention was directed to the esophageal hiatus. An incision was made in the peritoneum overlying the abdominal esophagus. The esophagus was gently mobilized with sharp and blunt dissection and encircled with a Penrose drain. The anterior and posterior vagus nerves were identified, ligated, and divided. A clamp was applied just proximal to the GE junction and a purse string suture was placed. The anterior wall of the esophagus was opened *and a __ mm circular stapler anvil was placed within the esophagus*. The purse string suture was tied around the esophagus and the posterior wall of the esophagus was divided. The stomach and nodal tissue were removed en bloc.

The ligament of Treitz was identified and the small bowel was transected approximately 20 cm distal to it with the linear cutting stapler. An arcade in the small bowel mesentery was ligated and transected to allow for further mobilization of the small bowel. The distal limb of this jejunum was brought up to the esophagus *in an antecolic / through a window in the transverse mesocolon in a retrocolic* fashion and brought to lie comfortably without tension or torsion adjacent to the esophagus.

The circular stapler was then introduced into the open end of the jejunum and the spike driven out through the antimesenteric border approximately ___ cm from the end. The stapler was assembled and fired. Intact donuts were retrieved. The open end of jejunum was then closed with a linear stapler.

If sutured: *Single layer esophagojejunostomy was created with interrupted 3-0 absorbable sutures*.

The anastomosis was inspected and found to be intact. An NG tube was guided through the anastomosis and placed distally.

The Roux-en-Y jejunojejunostomy was then constructed 45 cm distal to the esophagojejunostomy.

If stapled: *The two limbs of jejunum were approximated with 3-0 silk sutures. Enterotomies were made and the stapler was introduced and fired. The staple line was checked for hemostasis and the enterotomies closed with a linear stapler / in two sutured layers.*

If sutured: *A hand-sewn two-layered end-to-side anastomosis was made between the jejunal limbs using running 3-0 Vicryl and Interrupted silk*. The anastomosis was checked for integrity and found to be widely patent in all three directions.

If feeding jejunostomy constructed: *A purse string suture was placed within the jejunum 20 cm distal to the jejunojejunal anastomosis. An enterotomy was made at the center of the purse string stitch. A ___ French red Robinson catheter was placed within the lumen of the jejunum, and the purse string suture was tightened. 3-0 silk Lembert sutures were placed to create a Witzel tunnel and bury the jejunostomy tube without compromising the lumen. Next, a stab incision was made to the left of the midline incision. The red rubber catheter was grasped and brought out through the stab incision. The jejunum was sutured to the anterior abdominal wall with four-quadrant sutures through the anterior abdominal wall and seromuscular bites on the jejunum. These were securely tied, affixing the jejunum and jejunostomy tube up to the anterior abdominal wall. The* *exit site of the tube was sutured with 3-0 nylon sutures and the jejunostomy feeding tube was secured in place*.

Hemostasis was checked. *One closed suction drain was placed in the vicinity of the hiatus and brought out through a stab wound*. The fascia was closed with *a running suture of* ____. The skin was closed with *skin staples* / *subcuticular sutures of* ____ / *other*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Part III

General Surgery: Bariatric

32 Vertical Banded Gastroplasty

Carol E.H. Scott-Conner

Indication

- Morbid obesity

Essential Steps

1. General anesthesia: Avoid postoperative epidural analgesia to avoid masking clinical assessment of possible gastric leak.
2. Upper midline incision.
3. Reverse Trendelenburg position.
4. Note the location of the pylorus (prepyloric veins of Mayo).
5. Identify and divide the falciform ligament.
6. Identify the gastrohepatic ligament (be aware that the right hepatic artery sometimes arises from the superior mesenteric artery).
7. Anesthesia passes 32-French Ewald tube down into the stomach.
8. Incise the peritoneum over the esophagus and mobilize it.
9. Encircle the esophagus with a Penrose drain.
10. Enter the lesser sac approximately 6 cm inferior to the gastroesophageal junction and over the pancreas lateral to the lesser curvature vessels.
11. Mark a point 3 cm from the lesser curve and 6 cm from the angle of His, where a circular stapled defect will be created.
12. Create a circular defect with a circular stapling device, centered at the marked point.
13. Place a Penrose drain through the circular defect and around the lesser curvature.
14. Pass a red rubber catheter through the circular defect and bring it out over the angle of His to guide a stapler.
15. Connect the circular stapling defect with the left side of gastroesophageal junction with a TA 90-D stapler (Autosuture Corp.); do not fire the stapler yet or divide the stomach.
16. Remove the 32-French Ewald tube.
17. Measure the pouch volume (it should be <20 mL at 60-cm water pressure).
18. Fire the TA 90-D stapler.
19. Place a 7 × 1.5-cm piece of Marlex mesh around the pouch outlet, and suture in place with three serially placed 3-0 prolene sutures to approximate the overlapped ends.
20. Cover Marlex mesh with omentum.
21. Check hemostasis.
22. Close the abdomen.

Complications

- Early
  – Staple line leak
  – Injury to the vagus nerves

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_32

  - Injury to the right hepatic artery
  - Injury to the esophagus
- Late
  - Staple line dehiscence with gastro-gastric fistula formation
  - Progressive gastric outlet obstruction from the neo-pylorus as a result of stenosis from the mesh

Template Operative Dictation

Preoperative Diagnosis Morbid obesity.

Procedure Vertical banded gastroplasty.

Postoperative Diagnosis Same.

Indications This ___-year-old *male/female* underwent a thorough evaluation for morbid obesity (BMI ___) and had failed medical management.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from xiphoid to the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised. Preperitoneal fat was dissected from the peritoneum and subsequent access was gained into the peritoneal cavity. A wound protector was inserted and wound retractors were applied using an Omni. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors.* The falciform ligament was divided and ligated with 2-0 silk.

Attention was turned to the stomach and the gastrohepatic ligament was divided, gaining access to the lesser sac. The anterior plane between the esophagus and the crus of the diaphragm was opened by gently inserting two fingers superiorly to disrupt the phrenoesophageal ligament. The lower end of the esophagus, including the posterior vagus nerve, was encircled with a finger, and a Penrose drain was passed around it.

The nasogastric tube was removed and a 32-French *Ewald tube* was passed from the mouth by the anesthesiologist and placed in the stomach. The lesser omentum was opened adjacent to the stomach at a point approximately 6 cm inferior to the gastroesophageal junction. A Penrose drain was passed through this opening. Three centimeters from the lesser curve and 6 cm from the angle of His, a point was marked on the anterior wall of the stomach. A 5-mm trocar was passed through the anterior and posterior walls of the stomach at this point. A grasper was passed through this and used to position the anvil of a 28-mm EEA stapler within this region of the stomach.

The Ewald tube was mobilized so it would lie along the lesser curvature of the stomach, and the EEA stapling device was used to create a circular stapled defect at the site. Two intact donuts were obtained. The second Penrose drain was then passed through this defect. By blunt finger dissection, a tunnel was then created behind the stomach connecting the lesser sac to the gastroesophageal junction on the left side. A red rubber catheter was passed from the left gastroesophageal junction along the posterior aspect of the stomach and through the circular stapled defect. A TA 90-D stapler was inserted into the flanged end of the red rubber catheter and passed superiorly using this catheter as a lead. The stapler was closed and the two Penrose drains were tightened to occlude the inlet and outlet and allow measurement of the gastric pouch. Saline was instilled by anesthesia into the Ewald tube to confirm that the pouch measured <20 mL at 60-cm water pressure. The Ewald tube was pulled back in the esophagus and the TA stapler was then fired, connecting the circular stapling defect to the left side of the gastroesophageal junction without dividing the stomach.

A 7 × 1.5-cm piece of Marlex mesh was placed around the pouch outlet and sutured in place with three serially placed 3-0 prolene sutures to approximate the overlapped ends.

The omentum was brought up and made to lie comfortably over the mesh. It was affixed in place with interrupted sutures of 3-0 silk. All Penrose drains were removed and the upper abdomen was filled with normal saline. Air was instilled into the Ewald tube by anesthesiology. No leaks were identified. The saline was aspirated from the abdomen. Hemostasis was achieved.

The abdominal wall and fascia were reapproximated using a running suture of #1 looped PDS. The skin was closed with *skin staples/subcuticular sutures* of ___.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the postanesthesia care unit in satisfactory condition.

33 Laparoscopic Adjustable Gastric Banding for Obesity

Mohammad A. Hojeij, Ghassan A. Shamseddine, and Bassem Y. Safadi

Indication

- Morbid obesity with body mass index (BMI) greater or equal to 40 kg/m^2.
- Morbid obesity with BMI greater than 35 kg/m^2 with serious comorbidities.
- Select cases of obesity (BMI 30–34.9 kg/m^2) with serious comorbidities.
- The patient should have tried but failed supervised medical weight loss program and should have had a multidisciplinary assessment in a bariatric surgical program preoperatively.

Essential Steps

1. The procedure is done via four or five laparoscopic ports placed in the upper abdomen.
2. We prefer to use an optical trocar to facilitate initial port placement in these patients.
3. Place the first port, which will be used for the laparoscope, high – around 15 cm below the xiphoid process to ensure.
4. Pass the band through a retrogastric tunnel that is created by blunt dissection connecting these two points:
   - The angle of His on the left
   - A window created through the pars flaccida just anterior to the right crus of the diaphragm at the inferior edge of the lesser omentum
5. Wrap the gastric band around the upper part of the stomach in such a manner as to lie below the esophagogastric (EG) junction and partition the stomach into a small 15 cc. proximal gastric pouch separate from the rest of the stomach.
6. Calibrate the pouch using a balloon-tipped orogastric tube that is placed in the stomach and pulled back toward the EG junction. With experience this step becomes unnecessary.
7. Lock the band into position.
8. Secure the band posteriorly by intact retroperitoneal gastroesophageal attachments and anteriorly by plicating the fundus around the band to the upper gastric pouch.
9. Tunnel the tubing to exit through the abdominal wall at an oblique angle and then to the subcutaneous pocket that will house the band reservoir.
10. Test the band for leakage with methylene blue.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_33

Note These Variations

- Hiatal hernias if detected should be repaired by approximating the crura prior to band passage.
- The technique of band placement has transitioned from a peri-gastric to a “pars flaccida” approach because of less risk of slippage and erosion.

Complications

- Bleeding
- Esophageal perforation
- Gastric perforation
- Band slippage
- Pulmonary embolus

Operative Dictation

Preoperative Diagnosis Morbid obesity.

Procedure Laparoscopic adjustable gastric band placement.

Postoperative Diagnosis Same.

Indications *BMI above 40 kg/m^2/BMI above 30 kg/m^2 with serious comorbidities*.

Description of Procedure The patient was placed in the supine position with the legs in stirrups. Time-outs were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. The patient received *heparin 5,000 units subcutaneous/others* and *1 g cefazolin/others* prior to induction. The abdomen was prepped and draped in the usual sterile fashion.

A 10-mm incision was made 15 cm below the xyphoid process to the left of midline. A 10-mm optical port was placed under direct vision without complications. The peritoneal cavity was insufflated to a pressure of 14 mmHg. The patient was placed in the reverse Trendelenburg position. The liver was noted to have fatty infiltration and the left lateral segment of the liver was large. A 5-mm port was inserted via a subxiphoid incision, and a grasper was used to effectively retract the liver and expose the esophagogastric junction. Three additional ports were placed under direct vision, one 5 mm in the right upper quadrant, a 15-mm port left subcostal at the midclavicular line, and a 5-mm port at the anterior axillary line in left upper quadrant.

The peritoneum at the level of angle of His was incised, and the plane between the stomach and the diaphragm was bluntly dissected to expose the left crus of the diaphragm. Then the pars flaccida was opened. The right crus of the diaphragm was identified, and the peritoneum overlying the right crus was opened at the inferior edge of the lesser omentum. With blunt dissection, a forceps was passed behind the stomach toward the angle of His without any resistance. Then the band with tubing attached was introduced through the 15-mm port. The tubing was grasped with the forceps and passed around the stomach. The tubing was gently pulled to allow the band to pass circumferentially around the stomach leaving a proximal gastric pouch with an estimated volume of 15 ml. The tubing was then passed through the band buckle and the band was locked in place. An anterior fundoplication was done bringing the fundus to the upper pouch of the stomach with two interrupted prolene sutures. Once this part was done, the tubing was exteriorized from the subxiphoid incision. The 15-mm port was removed and the tubing was passed through a subcutaneous tunnel to the 15-mm port incision. A subcutaneous pocket for the reservoir was created by blunt dissection of the fat above the fascia. The band reservoir was then connected to the tubing and fixed to the fascia with nonabsorbable sutures. Laparoscopic re-exploration was done to make sure the tubing was not kinked. We injected the band reservoir with saline and methylene blue to make sure there was no leakage in the band system. Once that was done, the remaining ports were removed. The skin was closed with absorbable sutures. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was extubated and transferred to the recovery room in stable condition. The instrument and sponge counts were reported to be correct.

Open Roux-en-Y Gastric Bypass

34

Carol E.H. Scott-Conner

Indication

- Severe obesity (body mass index of 40 kg/m^2 or above without comorbidities or body mass index of 35 kg/m^2 or above for those with comorbidities) refractory to dietary changes and medical treatment
- Inability to perform laparoscopic bariatric procedure

Essential Steps

1. Sequential compression stocking and administer subcutaneous fractionated low-molecular-weight heparin.
2. General anesthesia.
3. Administer antibiotic prophylaxis.
4. Upper midline incision.
5. Reverse Trendelenburg position.
6. Explore the abdomen.
7. Assess the gallbladder.
8. Mobilize the distal esophagus and gastroesophageal junction.
9. Create a proximal gastric pouch of 15–30 mL.
10. Divide jejunum 50 cm distal to the ligament of Treitz.
11. Create a window in the transverse mesocolon anterolateral to the ligament of Treitz that is large enough to enable the retrocolic passage of distal jejunum (Roux limb) to lie adjacent to the gastric pouch.
12. Create a side-to-side anastomosis between the proximal gastric pouch and the Roux limb.
13. Test for leak.
14. *Manually guide the nasogastric tube through the gastrojejunostomy*.
15. Create a stapled jejunojejunostomy 45 cm along the Roux limb.
16. Close all mesenteric defects with running 3–0 vicryl.
17. Close the transverse mesocolon defect.
18. Check for hemostasis.
19. Close fascia with running #1 looped PDS.
20. Close skin.

Note These Variations

- Antecolic vs retrocolic gastrojejunostomy.
- Concurrent cholecystectomy.
- Jejunojejunostomy may be made 150 cm (rather than 45–60 cm) distal to the gastrojejunostomy in patients whose BMI is >50 kg/m^2.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_34

Complications

- Anastomotic leak
- Injury to the vagus nerves, esophagus, or spleen

Template Operative Dictation

Preoperative Diagnosis Severe obesity.

Procedure Roux-en-Y gastric bypass.

Postoperative Diagnosis Same.

Indications This ___-year-old *male/female* has severe obesity with BMI of ___ kg/m^2 that is refractory to dietary changes and medical management.

Description of Procedure The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and orogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

A vertical midline incision was made from the xiphoid to the umbilicus. This was deepened through the subcutaneous tissue. The linea alba was identified and incised. Preperitoneal fat was dissected from the peritoneum and access was gained into the peritoneal cavity. A wound protector was inserted and abdominal wall retractors were placed. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. The gallbladder was *normal/abnormal* (*list any additional abnormalities noted*). The falciform ligament was divided and ligated with 2-0 silk.

The liver was reflected superiorly. The lesser sac was entered by bluntly dissecting the lesser omentum overlying the caudate lobe of the liver. The incision was extended toward the gastroesophageal junction and the distal esophagus was gently mobilized. It was then encircled with a Penrose drain. With downward traction on the Penrose drain, the phrenoesophageal ligament was taken down, and the distal esophagus fully mobilized.

After the gastroesophageal junction was clearly defined, the Penrose drain was lifted anteriorly and a finger was passed through the lesser sac posterior to the stomach. The nasogastric tube was removed. Starting from the *first/second branches* of the left gastric artery, the stomach was serially transected using multiple loads of __ stapler to create a gastric pouch that measured ___ mL.

The ligament of Treitz was then identified, and the jejunum transected 45–50 cm distal to the ligament of Treitz using a linear cutting stapler. A window was made in the transverse mesocolon and the Roux limb was passed through it in a retrocolic fashion, reaching the proximal gastric pouch without tension. A side-to-side anastomosis was then created between the proximal gastric pouch and the Roux limb with an outer layer of interrupted 3-0 silk and an inner layer of continuous 3-0 PDS sutures. A leak test was performed, showing *no air leak/other findings*.

The Roux limb was then traced *45 cm/150 cm/other lengths* distally, and a side-to-side stapled jejunojejunostomy was created.

The nasogastric tube was then replaced, *and the tip was manually guided through the gastrojejunostomy just beyond the suture line*. The transverse mesocolon and jejunojejunostomy mesenteric defects were then closed with __ sutures.

Hemostasis was checked. The fascia was closed using running #1 looped PDS sutures and the skin edges were re-approximated with *staples/a running subcuticular suture of* ___. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Yi-Horng Lee, MD, in the previous edition.

Laparoscopic Antecolic Roux-en-Y Gastric Bypass

35

Mohammad K. Jamal

Indications

- Morbid obesity refractory to dietary changes and medical treatment.
- Current NIH guidelines suggest these qualifications for surgical weight loss procedures:
  - BMI >35 kg/m^2 with obesity-related comorbidities
  - BMI >40 kg/m^2 without any medical conditions

Essential Steps

1. Supine position, with appropriate tubes (Foley catheter and OG tube) placed and prophylactic antibiotics and subcutaneous heparin given preoperatively.
2. Carefully pad all pressure points and place a padded foot board on the operating table.
3. Create a 15-mmHg pneumoperitoneum using Veress needle (upper abdominal quadrant insertion preferred).
4. Place trocars in the following locations: 12-mm port in the left paraumbilical location for the 10-mm laparoscope, 12-mm port in the right midclavicular line, a 5-mm port in the lateral subcostal location, and two 5-mm ports in the left midclavicular and left subcostal position. The ports should resemble a "smiley face configuration."
5. Perform a diagnostic laparoscopy to verify that no iatrogenic injury has occurred during Veress or port entry.
6. Retract greater omentum and transverse colon superiorly to expose and identify the ligament of Treitz.
7. Divide the jejunum with a linear cutting endoscopic stapler (stapler height 2.5 mm, length 60 mm) approximately 30 cm from the ligament of Treitz.
8. Divide the jejunal mesentery with two applications of a linear cutting endoscopic stapler (stapler height 2.0 mm, length 45 mm) loaded with staple line reinforcement.
9. Mark the distal cut end of small bowel with a silk stitch.
10. Measure the Roux limb 75–100 cm distally and align the two limbs in a side-to-side fashion using absorbable suture.
11. Make enterotomies in both limbs with the ultrasonic shears.
12. Insert the linear cutting endoscopic stapler (stapler height 2.0 mm, length 45 mm), approximate, and fire it to create the enteroenterostomy.
13. Check hemostasis at the staple line.
14. Staple the common enterotomy site closed with another firing of the linear cutting

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_35

stapler (stapler height 2.5 mm, length 60 mm) after aligning with suture.

15. Place an anti-obstruction "Brolin stitch" to prevent twisting of the Roux limb between the biliopancreatic and the Roux limb.
16. Close the jejunal mesenteric defect with a running nonabsorbable stitch.
17. Divide the greater omentum underneath the falciform ligament to allow the antecolic Roux limb to reach the supracolic compartment.
18. Suture the proximal end of the Roux limb to the greater curvature of the stomach in a hockey-stick configuration.
19. Place the patient in steep reverse Trendelenburg position, and ask the anesthesiologist to remove all tubes from the esophagus and stomach.
20. Elevate the left lateral segment of the liver with a 5-mm Nathanson liver retractor placed in the subxiphoid location to expose the hiatus.
21. Retract the stomach and omentum inferiorly.
22. If a hiatal hernia is found, it should be repaired at this time.
23. Create a window into the lesser sac at a point adjacent to the gastric wall high on the lesser curvature of the stomach – corresponding to the third or fourth "crow's foot" (neurovascular bundles on the lesser curve).
24. Insert an endoscopic linear stapler (stapler height 2.5 mm, length 60 mm) to divide the lesser curvature vessels below the left gastric artery.
25. Apply and fire the stapler three to four times to staple and create the gastric pouch using linear cutting stapler (stapler height 3.5 mm, length 60 mm). Pouch size should not be more than 30–60 ml.
26. Align the Roux limb and the gastric pouch side by side.
27. Suture the back wall of the anastomosis with a running nonabsorbable suture from an appropriately marked site on the staple line to the lesser curvature in a tension-free fashion.
28. Make enterotomies in the proximal gastric pouch and the Roux limb with the ultrasonic shears.
29. Use the endoscopic cutting linear stapler (stapler height 3.5 mm, length 45 mm) to make a measured 2.5-cm anastomosis.
30. Check hemostasis.
31. Pass an Ewald tube orally into the gastric pouch under direct visualization.
32. Close the common enterotomy in two layers – absorbable suture for the first layer and nonabsorbable imbricating outer layer.
33. Clamp the distal Roux limb with a bowel clamp.
34. With the Ewald tube in the gastric pouch, test the anastomosis with air insufflation under saline.
35. Once tested and no leaks are found, remove the Ewald tube.
36. Place a closed suction drain just posterior to the gastrojejunostomy anastomosis.
37. Desufflate the abdomen.
38. Close all large port sites and skin.

Note This Variation

- Size and exact locations of trocars vary with size of instruments used and individual patient physique.

Complications

- Anastomotic leak
- Injury to the esophagus or spleen
- Torsion of the Roux limb
- Pulmonary embolism

Template Operative Dictation

Preoperative Diagnosis Morbid obesity with comorbidities.

Operation Performed Laparoscopic Roux-en-Y gastric bypass, antecolic, 75-cm roux loop, 30-cm biliopancreatic limb.

Postoperative Diagnosis Same.

Indications This patient was diagnosed with morbid obesity with a BMI of ___ and significant comorbidities including ___. The patient was counseled extensively in the bariatric outpatient clinic and after a thorough explanation of the risks and benefits of surgery (including death from complications, bowel leak, infection such as peritonitis and/or sepsis, internal hernia, bleeding, need for blood transfusion, bowel obstruction, organ failure, pulmonary embolus, deep venous thrombosis, wound infection, incisional hernia, skin breakdown, marginal ulceration, stomal stenosis, and others entailed on the consent form) and after a compliant diet and exercise program, the patient was scheduled for an elective laparoscopic Roux-en-Y gastric bypass.

Description of Operation Following informed consent, the patient was taken to the operating room and placed on the operating table in the supine position. The patient had previously received prophylactic antibiotics and subcutaneous heparin for DVT prophylaxis in the pre-op holding area. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

After induction of general endotracheal anesthesia by the anesthesiologist, the patient underwent placement of sequential compression devices, Foley catheter, and orogastric tube. The patient was adequately padded at all pressure points and placed on a footboard to prevent slippage from the OR table during extremes of position during surgery. The left arm was extended on an arm board and the right arm was tucked in. The surgical field was prepped and draped in the usual sterile fashion.

Using a Veress needle in the left upper quadrant, a carbon dioxide pneumoperitoneum up to a pressure of 15 mmHg was obtained after retracting the anterior abdominal wall upward. A 12-mm laparoscopic port was placed in the right upper quadrant, and then using a 45°, 10-mm scope, other ports were placed under direct visualization as follows – two 5-mm left upper quadrant, a 5-mm right upper quadrant, and another 12-mm umbilical port for the surgeon and assistant.

The organs were inspected for injury during entry and none was seen. The transverse colon and greater omentum were reflected toward the supracolic compartment and the ligament of Treitz was identified. The jejunum was measured 30 cm from the ligament of Treitz and transected at this point using a linear cutting stapler (stapler height 2.5 mm, length 45 mm), whereas the small bowel mesentery was divided to the root using two firings of the linear cutting stapler (stapler height 2.5 mm, length 45 mm) loaded with staple line reinforcement. The distal cut end of the bowel was identified with a suture. From this point, 75 cm of small bowel was measured, and the proximal cut end of jejunum was anastomozed at the 75-cm site using a side-to-side stapled anastomosis using a linear cutting stapler (stapler height 2.5 mm, length 45 mm), and the common enterotomy was closed with another firing of the linear cutting stapler (stapler height 2.5 mm, length 60 mm). An anti-obstruction Brolins silk stitch was applied and the mesenteric defect was closed with a continuous running nonabsorbable suture. A crotch silk stitch was also applied to stabilize the anastomosis. Hemostasis was found to be satisfactory and there was no evidence of leakage at the completed jejunojejunostomy site. The Roux limb was then placed underneath the transverse mesocolon for identification and later anastomosis to the gastric pouch.

The greater omentum was then divided into two halves along the midline starting at the antimesenteric border of the transverse colon and extending up to the free edge of the greater curvature of the stomach. Between the two halves of the greater omentum, the distal cut end of jejunum was brought up in an antecolic fashion into the supracolic compartment and temporarily sutured to the greater curvature of the stomach to prevent slippage into the pelvis. Care was taken to prevent twisting of the mesentery while bringing the Roux limb toward the supracolic compartment.

Attention was then turned to the gastric portion of the operation. The patient was placed into steep reverse Trendelenburg position, and the anesthesiologist was asked to empty the stomach and then remove ALL tubes (including the orogastric tube and the esophageal temperature probe) from the patient's GI tract. A liver retractor was applied to retract the left lobe of the liver anteriorly and expose the angle of His. The lesser omentum was transected near the lesser curve using a linear cutting stapler (stapler height 2.5 mm, length 60 mm) loaded with staple line reinforcement, and then the stomach was transected using several firings of the linear cutting stapler (stapler height 3.5 mm, length 60 mm) to create a small proximal gastric pouch.

Hemostasis was found to be excellent and then a side-to-side gastrojejunostomy was performed in four layers. The first layer is a continuous hand-sewn layer using nonabsorbable suture. The stapled gastrojejunostomy was created using a linear cutting stapler (stapler height 3.5 mm, length 45 mm), and the gastrotomy and enterotomy were closed with a hand-sewn continuous suture. The fourth layer is an anterior hand-sewn layer using a continuous nonabsorbable suture. The anastomosis was checked for leaks under saline after turning the patient back into the supine position, clamping the distal jejunum with a bowel clamp and insufflating air through an oral Ewald tube that was placed into the Roux limb. No leaks were identified at the gastrojejunostomy anastomosis. The Ewald tube and the bowel clamp were removed, and a 10-mm closed suction drain was placed posterior to the gastrojejunostomy and brought out through the right lateral-most port site and anchored onto the skin using a 3-0 nylon suture. All ports were removed under direct visualization ensuring hemostasis.

The skin for all port sites was approximated using 4-0 absorbable subcuticular sutures followed by application of Steri-Strips. *This was followed by an injection of a total of 50 cc of local anesthetic* (*including 25 cc of 1% lidocaine containing 1:100,000 epinephrine mixed with 25 cc of 0.25% Marcaine containing 1:100,000 epinephrine*) *at the port sites*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then extubated and transferred to the recovery room in a stable condition.

Laparoscopic Sleeve Gastrectomy

36

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Indications

- Morbid obesity with body mass index greater than 40 kg/m^2.
- Morbid obesity with BMI greater than 35 kg/m^2 with serious comorbidities.
- Select cases of obesity (BMI 30–34.9 kg/m^2) with serious metabolic disease.
- Super obesity (BMI >50 kg/m^2) as a first stage of the duodenal switch.
- Patients should have been evaluated in a multidisciplinary bariatric surgical program and deemed appropriate for such surgical intervention.

Essential Steps

1. Place the patient in the supine position; split-leg position is optional.
2. Reverse Trendelenburg positioning helps expose the esophagogastric (EG) junction.
3. Initial port placement is through the umbilicus. In some "super" obese patients, placing an optical port under direct vision may be easier than using an open approach. In such patients the initial port placement is about 20 cm below the xiphoid process to the left side of the midline.
4. Place two other ports in the left upper quadrant of the abdomen and one in the right upper quadrant. The operation can be performed with three ports. Additional ports may be needed for difficult cases.
5. Retract the left lateral segment of the liver.
6. Identify the pylorus.
7. Identify the anterior vagal branches along the lesser curvature and crow's feet.
8. Start sealing and dividing all the vessels along the greater curvature of the stomach from a point around 2–6 cm proximal to the pylorus and all the way to the angle of His.
9. Lift the stomach and divide all posterior attachments to the pancreas.
10. Expose the EG junction well to ensure there are no missed hiatal hernias. Excising the EG junction fat pad aids in the exposure.
11. Ask the anesthesiologist to place an orogastric tube or bougie (34–42 Fr) into the esophagus and lying along the lesser curve to the antrum.
12. Alongside the tube, staple and divide the stomach in a vertical fashion aiming to the angle of His. Approximately 60–120 ml of gastric volume should remain.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_36

13. We recommend firing the first stapler from the right-sided port and the rest from the umbilical port.
14. Use appropriate thickness cartridges as the stomach is thickest in the antrum and decreases in thickness as you proceed toward the cardia.
15. Align these staple lines parallel. Avoid crossed staple lines and avoid twisting. Avoid narrowing the sleeved stomach at the incisura angularis.
16. The last stapler fire at the angle of His is parallel to the esophagus. Avoid leaving a "dog ear," and keep <1 cm of the stomach at this level.
17. Hemostasis at the staple line is improved with staple line reinforcement, oversewing, or clips.
18. Extract the stomach in a bag.
19. Test the "sleeved" stomach by filling it with methylene blue or by intraoperative endoscopy.
20. Close the fascia at the gastric extraction with nonabsorbable sutures.

Note These Variations

- Hiatal hernias can be repaired simultaneous with the sleeve gastrectomy.
- An alternate approach is to perform the stapling and division of the stomach first followed by gastric resection.

Complications

- Bleeding
- Staple line leak with resultant abscess or fistula
- Pulmonary embolism
- Gastroesophageal reflux

Operative Dictation

Preoperative Diagnosis Morbid obesity

Procedure Laparoscopic sleeve gastrectomy

Postoperative Diagnosis Same

Indications This ____-year-old *female/male* had morbid obesity with *BMI above 40 kg/m²/BMI above 35 kg/m² with significant comorbidities* and failure of medical weight loss.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. The patient received 5,000 units of heparin subcutaneously prior to induction. The abdomen was prepped and draped in the usual sterile fashion. A 20-mm incision was made through the umbilicus and the fascia was exposed. Under direct vision a 15-mm port was placed and CO2 pneumoperitoneum at 15 mmHg was established. Then under direct vision, two 12-mm trocars were inserted in the left upper quadrant along the midclavicular and anterior axillary lines. A 12-mm port was placed in the right upper quadrant at the midclavicular line just above the umbilical level.

The operating table was placed in reverse Trendelenburg position, and the left lobe of the liver was retracted cephalad using a fixed retractor "Nathanson" through a 5-mm subxiphoid incision to expose the esophageal hiatus.

Using an energy device (LigaSure®, Harmonic Scalpel®, or Ultrasonic Shears®), the lipoma of the gastroesophageal junction was excised and the peritoneum overlying the cardia was incised, and the plane between the cardia and left crus of the diaphragm was bluntly opened to expose the left diaphragmatic crus. Then the pylorus was identified, and a point 2–6 cm proximal to the pylorus along the greater curvature of the stomach was marked with cautery. Then all the vessels along the greater curvature and all the short gastric vessels were sealed and divided completely freeing up the greater curvature and the fundus of the stomach. The stomach was lifted up and all posterior attachments to the pancreas were divided sharply. Then a 40-Fr orogastric tube was placed by the anesthesiologist and oriented toward the antrum snug along the lesser curvature. Alongside the tube the stomach was stapled and divided sequentially in a vertical fashion heading toward the angle of His. We used a total of six cartridges 60 mm in length with 4.8-mm staple height. The staple line was reinforced with a running 2-0 PDS serosa-serosa imbricating sutures. Intraoperative endoscopy revealed no areas of stenosis and no leak along the staple line. The stomach was placed in a plastic bag and was extracted from the umbilical port which was widened a bit. Then the ports and liver retractor were removed under vision. The abdomen was deflated. The fascia at the umbilical port site was closed with three interrupted nonabsorbable sutures. The wounds were closed with 4-0 monocryl continuous subcuticular sutures. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and left the operating room in good condition.

Part IV

General Surgery: Small Bowel

37 Simple Excision of Duodenal Diverticulum

Roy R. Danks

Indication

- Complications of the duodenal diverticulum, which is not in close proximity to the head of the pancreas or ampulla of Vater, including bleeding, obstruction of the common bile duct, perforation, and diverticulitis

Essential Steps

1. Upper midline incision.
2. Wide Kocher maneuver.
3. Confirm that the diverticulum is distant from the ampulla of Vater and pancreas.
4. Place a *bowel clamp/linear stapler* across base.
5. Reconfirm that the ampulla of Vater is not in the vicinity.
6. *Fire the stapler and* remove the diverticulum.
7. *If sutured*: *Close the duodenum in two layers*.
8. *Perform any needed biliary tract surgery*.
9. Check hemostasis.
10. Place omentum over the staple line.
11. Close the abdomen.

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Note These Variations

- Convert to transduodenal excision if the diverticulum is in proximity to the ampulla of Vater, embedded in the pancreas, or if anatomy is in doubt.
- *Stapled/sutured* closure.
- Gallstones and/or common duct stones may coexist, requiring cholecystectomy and/or common bile duct exploration.

Complications

- Injury to the common duct, pancreas, or ampulla of Vater
- Pancreatitis
- Leak from duodenal staple line

Template Operative Dictation

Preoperative Diagnosis Duodenal diverticulum with *bleeding/obstruction/perforation/inflammation*

Procedure Simple excision of the duodenal diverticulum (*list any additional biliary tract procedures*)

Postoperative Diagnosis Same

Indications This ____-year-old *male/female* developed *gastrointestinal bleeding/obstruction/*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_37

perforation/inflammation and on workup was found to have a duodenal diverticulum. Excision was required for management.

The risks, benefits, indications, and alternatives were discussed with the patient/his or her durable power of attorney (DPOA) prior to the operation, and informed consent was obtained in writing.

Preoperative Antibiotic ____________ was administered prior to incision.

VTE Prophylaxis The patient was given (low-molecular-weight heparin, unfractionated heparin) subcutaneously preoperatively. Pneumatic compression devices were applied and functioning prior to induction of general anesthetic.

Description of Procedure An epidural catheter was placed by anesthesia prior to the start of the operation. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made from xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors/divided with harmonic shears/divided with LigaSure device*.

A self-retaining retractor was then placed and the abdominal wall was retracted laterally, inferiorly, and superiorly. The small bowel and colon were then packed inferiorly with wet laparotomy pads and held in place with retractors. This afforded adequate exposure of the stomach and duodenum. The pancreas was then gently examined by palpation. The gallbladder was palpated and *gallstones/no gallstones* were noted. A duodenal diverticulum located approximately ____ cm from the palpated ampulla of Vater was noted. *There was no pancreatic involvement*, *nor were there signs of perforation/was there surrounding inflammation*.

A wide Kocher maneuver was undertaken by sweeping the second limb of the duodenum from medial to lateral, sharply dividing the peritoneal reflection. Blunt and sharp dissection was used to free the duodenum until it was fully mobilized.

The diverticulum was identified and completely isolated. Small branches of the pancreaticoduodenal artery were clamped, cut, and ligated with 4-0 silk ties/divided with harmonic shears/divided with LigaSure device to allow complete exposure of the diverticulum. The diverticulum was completely isolated. A *small bowel clamp/linear stapler* was applied across the base of the diverticulum. The position of the *clamp/stapler* relative to the ampulla was confirmed by palpation before the *diverticulum was sharply removed/stapler was fired and the diverticulum removed* and passed off the operative field.

If sutured: *The resulting defect was then closed in two layers – an inner layer of running 3-0 Vicryl placed as a Connell suture and an outer layer of interrupted 3-0 silk Lembert sutures*. At the conclusion, the duodenum was intact with a patent lumen, and the common bile duct, ampulla, and pancreas appeared normal to inspection and palpation.

Detail any additional biliary tract surgery performed.

The abdomen was thoroughly irrigated with warm, sterile saline solution, suctioned until clear, and the self-retaining retractor and all the sponges were removed. Hemostasis was checked and omentum was brought up and made to lie over the operative field.

(*If significant phlegmon or abscess was found*, *one may consider the placement of a closed suction drain*; *therefore, I would add the following*: *Due to the presence of abscess at the site of diverticular perforation*, *a* (*drain type*) *was placed near to the excised duodenum and brought out through a stab incision in the* ______ (*location*), *secured with a skin suture of* ______ *and placed to* (*closed bulb suction*, *gravity*, *etc.*).

(*Optional*: *Multiple interrupted through-and-through retention sutures of* ____ *were placed*.) The fascia was closed with *a running suture of* ____/*a Smead-Jones closure of interrupted* ____.

Subcutaneous tissues were lavaged with ____ *ml of sterile saline solution*.

The skin was closed with *skin staples*/*subcuticular sutures of* ____/*other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

38 Transduodenal Excision of Duodenal Diverticulum

Roy R. Danks

Indications

- Complications of the duodenal diverticula in close proximity to the ampulla or embedded in the head of the pancreas include the following: bleeding, obstruction of the common bile duct or duodenum, perforation, and diverticulitis.

Essential Steps

1. Upper midline incision.
2. Extensive Kocher maneuver.
3. Longitudinal duodenotomy opposite the site of the diverticulum.
4. Identify and protect the ampulla of Vater.
5. *Cannulate the ampulla and perform a cholangiogram if necessary*.
6. Evaginate the diverticulum.
7. Place a clamp across the base and excise.
8. Close mucosa with a full-thickness running suture of 3-0 Vicryl.
9. Reassess the ampulla of Vater.
10. Close the duodenotomy transversely (if possible) in two layers.
11. *Perform any needed biliary tract surgery*.
12. Check hemostasis.
13. Place omentum over the duodenotomy and into the operative field.
14. Close the abdomen.

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Note These Variations

- Cannulation of the ampulla and cholangiography may be needed in difficult cases.
- Gallstones and/or common bile duct stones may coexist, requiring cholecystectomy and/or common bile duct exploration.

Complications

- Injury to the common bile duct, pancreas, or ampulla of Vater
- Pancreatitis
- Leak from the duodenal suture line

Template Operative Dictation

Preoperative Diagnosis Duodenal diverticulum with *bleeding/obstruction/perforation/inflammation*

Procedure Transduodenal excision of the duodenal diverticulum *with operative cholangiogram* (*list any additional biliary tract procedures*)

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_38

Postoperative Diagnosis Same

Indications This ____-year-old *male/female* developed *gastrointestinal bleeding/obstruction/perforation/inflammation* and on workup was found to have a duodenal diverticulum. Excision was required for management.

The risks, benefits, indications, and alternatives were discussed with the patient/his or her durable power of attorney (DPOA) prior to the operation, and informed consent was obtained in writing.

Preoperative Antibiotic ____________ was administered prior to incision.

VTE Prophylaxis The patient was given *(low molecular weight heparin, unfractionated heparin)* subcutaneously preoperatively. Pneumatic compression devices were applied and functioning prior to induction of general anesthetic.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made from xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors/cautery/harmonic scalpel/LigaSure*.

A self-retaining retractor was then placed and the abdominal wall was retracted laterally, inferiorly, and superiorly. The small bowel and colon were then packed inferiorly with laparotomy pads and held in place with retractors. This afforded adequate exposure of the stomach and duodenum. The pancreas was then gently examined by palpation. The gallbladder was palpated and *gallstones/no gallstones* were noted. A periampullary diverticulum was identified. *There was no pancreatic involvement/there were signs of perforation/there was surrounding inflammation*.

A wide Kocher maneuver was undertaken by sweeping the second limb of the duodenum from medial to lateral, sharply dividing the peritoneal reflection. Blunt and sharp dissection was used to free the duodenum until it was fully mobilized.

The diverticulum was identified and completely isolated. It was noted to be in close relation to the head of the pancreas, *but did not directly involve the pancreas/and appeared embedded in the pancreas*. A longitudinal anterior duodenotomy was created with electrocautery at a point opposite the diverticulum. The orifice of the diverticulum was identified. A curved hemostat was placed into the diverticulum and the sac grasped and invaginated into the duodenum. The ampulla of Vater was identified and *was distant from/in close proximity to* the invaginated specimen.

If cannulation of ampulla and/or cholangiogram: *Because of the close relationship of the ampulla and diverticulum, the orifice of the ampulla was identified and gently cannulated with a ____ tube. Cholangiograms were obtained/a stent was left in the ampulla to protect it during the subsequent dissection.*

A small bowel clamp was then applied across the base of the diverticulum and the diverticulum was cut away sharply with a #15 scalpel blade. The specimen was removed from the operative field. The mucosa was then re-approximated with a running full-thickness suture of 3-0 Vicryl. At the conclusion of this portion of the procedure, the *ampulla was again visually inspected/cholangiogram* (*using flat-plate single-shot technique/using video C-arm fluoroscopy*) *was repeated* and the common bile duct noted to be intact with free flow of contrast in a retrograde fashion, into the hepatic radicals.

The duodenotomy was then closed *transversely/longitudinally* with an inner running layer of 3-0 Vicryl placed as a Connell suture. This was followed by an outer seromuscular layer of interrupted 3-0 silk Lembert sutures. At the conclusion of the procedure, the duodenum was noted to be intact, with a widely patent lumen. The ampulla, common bile duct, and pancreas appeared uninjured.

Detail any additional biliary tract surgery performed.

The abdomen was thoroughly irrigated with warm, sterile saline solution, suctioned until clear, and the self-retaining retractor and all sponges removed. Hemostasis was checked.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ____ were placed.*) The fascia was closed with *a running/interrupted suture of* ___.

The subcutaneous layer was lavaged with ____ ml of warm, sterile saline solution.

The skin was closed with *skin staples/subcuticular sutures of ____/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

39 Open Feeding Jejunostomy

Carol E.H. Scott-Conner

Indications

- Need for prolonged enteral support when gastrostomy or feeding tube not feasible
- Frequently done as adjunct to complex upper abdominal procedures

Essential Steps

1. Short midline incision.
2. Identify the ligament of Treitz.
3. Trace distally to the mobile loop of the proximal jejunum.
4. Pass a tube through the abdominal wall at the desired site.
5. Purse-string suture on the antimesenteric border of the jejunum.
6. Insert a tube and manually pass it distally as far as possible.
7. Tie a purse-string suture.
8. Create a Witzel tunnel with interrupted 3-0 silk Lembert sutures.
9. Tack the jejunum to the abdominal wall at the catheter entrance site.
10. Check for torsion and tension.
11. Close the abdomen.
12. Secure the catheter to the abdominal wall.

Note This Variation

- Needle catheter jejunostomy is sometimes used when need is temporary.

Complications

- Insertion into the ileum rather than jejunum
- Obstruction of the lumen by Witzel tunnel and catheter
- Torsion of the bowel
- Leakage of succus into the abdomen
- Tube dislodgement

Template Operative Dictation

Preoperative Diagnosis *Head and neck malignancy/other* with need for prolonged enteral nutrition

Procedure Feeding jejunostomy

Postoperative Diagnosis Same

Indications This ____-year-old *male/female* required prolonged enteral nutrition because of *head and neck malignancy/other* and was unable

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_39

to tolerate other routes of access due to ____. Feeding jejunostomy was chosen as the route of nutritional support.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

A short midline incision was made and deepened through the subcutaneous tissues. Hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

The ligament of Treitz was identified. A loop of proximal jejunum was delivered into the wound. It was confirmed to be sufficiently mobile to reach the chosen site without tension.

[Choose One:]

If standard jejunostomy**:** *A purse-string suture of 3-0 silk was placed on the antimesenteric border of the bowel at 20 cm from the ligament of Treitz, and an incision was made with electrocautery in the intestinal wall in the center of the purse-string suture. A 14-French feeding tube/other was passed through the anterior abdominal wall and inserted into the lumen of the jejunum and advanced distally. The purse-string suture was secured in place.*

If needle catheter jejunostomy**:** *A small incision was made at the proposed skin entry site. The needle catheter kit was used to enter the jejunum at a suitable point on the antimesenteric border approximately 20 cm from the ligament of Treitz. The catheter was passed and advanced distally into the jejunum. The catheter was confirmed to lie within the lumen by free injection of saline. A purse-string suture of 3-0 silk was placed around the site where the catheter entered the jejunum.*

A Witzel tunnel was then constructed with 3-0 silk Lembert sutures in such a manner as to completely cover the entry site into the jejunum and to extend proximally, completely covering the catheter, for approximately 5 cm. The jejunum was noted to have a patent lumen at the conclusion of this procedure.

The jejunum was then tacked to the anterior abdominal wall at the catheter entrance site with several 3-0 silk sutures in such a manner as to prevent torsion. The catheter was secured to the skin with a 3-0 nylon suture.

Hemostasis was checked and omentum was brought adjacent to the surgical field. The fascia was closed with *a running suture of ____/interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ____/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Laparoscopic Feeding Jejunostomy

40

James P. De Andrade and Jessica K. Smith

Indication

1. Long-term contraindication to oral feeding with contraindication to gastrostomy
2. Enteral adjunct in a patient unable to maintain nutrition with oral intake

Essential Steps

1. Review applicable existing cross-sectional imaging that may guide site of entry into the abdomen.
2. Enter the abdomen using a Veress needle/Optiview trocar/open Hasson technique. Veress placement is at Palmer's point. Hasson is periumbilical. Insufflate the abdomen.
3. Place additional ports.
4. Retract the colon and omentum superiorly.
5. Identify a mobile portion of jejunum approximately 15 cm distal to the ligament of Treitz.
6. Place a purse-string 2-0 silk suture in the antimesenteric side of the jejunum. Make an enterotomy within the purse string.
7. Make a small, full-thickness incision in the left lateral abdominal wall.
8. Pass a 16–18 Fr red rubber catheter through incision in abdominal wall and through the enterotomy distally, securing it with the purse-string stitch.
9. Fix the jejunum to the abdominal wall in four corners around the jejunostomy.
10. Further fix the jejunum 4 cm distally to the abdominal wall to reduce the possibility of jejunal torsion.
11. Inject normal saline through red rubber catheter while under laparoscopic visualization to ensure no leakage and that fluid passes easily into distal jejunum.
12. Check hemostasis.
13. Deflate the abdomen and remove ports.
14. Secure the red rubber jejunostomy tube to the skin with a 3-0 nylon suture.

Note These Variations

1. A dedicated feeding jejunostomy kit may be used instead of a red rubber catheter.
2. May be performed as an open procedure.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_40

Complications

1. Early tube dislodgement and resulting abdominal sepsis
2. Tube dysfunction or clogging
3. Jejunal torsion or perforation
4. Small bowel obstruction

Template Operative Dictation

Preoperative Diagnosis *Contraindication to oral intake/need for supplemental enteral nutrition*

Procedure Laparoscopic feeding jejunostomy

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with need for surgical enteral nutritional access due to (*underlying condition*). Feeding jejunostomy was indicated.

Description of Procedure The risks, benefits, and alternatives to surgery were discussed with the patient, and written informed consent was obtained. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position, and general endotracheal anesthesia was induced. Preoperative antibiotics and an orogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A stab incision in the *left upper quadrant at Palmer's point/other location* was made and a *Veress needle/Optiview trocar/open Hasson technique* was utilized to gain access to the peritoneal cavity. After inflating the abdomen with CO_2 to a pressure of 15 mmHg, a port was placed and a laparoscope was inserted. The abdominal viscera were inspected, and no injury to the underlying contents was noted. The following ports were then placed: *a 5/12-mm right lower quadrant port and a 5/12-mm right upper quadrant port/describe other location*.

The omentum and colon were retracted superiorly using a grasper. The ligament of Treitz was identified and traced approximately 15 cm distally. A mobile portion of jejunum that reached the abdominal wall was selected. A 2-0 silk suture was used to create a purse string around a 1-cm area at the antimesenteric portion of the jejunum. Using *electrocautery*, a small enterotomy was created within the purse-string suture.

A 1-cm incision was made in the skin at the left lateral abdomen. This was deepened down into the peritoneum using electrocautery. A *16/18 Fr* red rubber catheter was inserted into the abdomen through this incision and inserted through the enterotomy going distally. The previously placed purse-string suture was tightened around the red rubber catheter.

2-0 silk intracorporeal sutures were used to fix the jejunum in four corners around the jejunostomy to the abdominal wall. Two additional 2-0 silk sutures were placed 4 cm distal to this to further fix the jejunum to the abdominal wall to decrease the risk of bowel torsion. __ mL of normal saline was then injected through the jejunostomy, ensuring easy flow into the distal jejunum and no leakage into the peritoneum.

Hemostasis was assured, ports were removed, and the abdomen was deflated. *The fascia at the 12-mm port site was closed with a __ Vicryl suture/others. Local anesthesia of ___ was infiltrated into the subcutaneous tissues*. The skin incisions were closed with a running 4-0 monocryl suture. *Adhesive skin glue was/benzoin and steri-strips were* applied over the incisions. The jejunostomy tube was secured to the skin with a 3-0 nylon suture.

The patient tolerated the procedure well, and there were no immediate complications noted. All needle and sponge accounts were reported as correct. General anesthesia was reversed, and the patient was extubated. A debriefing checklist was completed to share information critical to postoperative care of the patient. *He/she* was taken to the recovery room in stable condition.

Open Adhesiolysis for Small Bowel Obstruction

41

Carol E.H. Scott-Conner

Indications

- Small bowel obstruction
- Adjunct to other surgical procedures (previously operated abdomen)

Essential Steps

1. Midline incision.
2. Enter the abdomen above or below the old scar if possible.
3. Apply traction to adherent loops and divide the adhesions sharply under direct vision.
4. Identify point(s) of obstruction.
5. Ascertain viability of the bowel.
6. Run the small bowel.
7. Confirm absence of additional areas of obstruction, injuries, or compromised bowel.
8. Repair deserosalized areas or inadvertent enterotomies.
9. Check hemostasis.
10. Close the abdomen.

Note This Variation

- Repair of enterotomies

Complications

- Recurrent obstruction
- Enterocutaneous fistula

Template Operative Dictation

Preoperative Diagnosis Small bowel obstruction

Procedure Exploratory laparotomy and enterolysis

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *male/female* with history of *appendectomy/hysterectomy/other abdominal procedure*, who presented ____ *days ago with picture consistent with partial small bowel obstruction that progressed to complete bowel obstruction unresponsive to conservative measures/complete bowel obstruction/bowel*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_41

obstruction with tenderness and clinical deterioration/other.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from *above the previous laparotomy incision down to its most inferior extent/xiphoid to just below the umbilicus/other*. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised *in a region above the old incision/in the upper abdomen/other* and the peritoneal cavity entered with care.

Upon entering the abdominal cavity, there are extensive adhesions of omentum and bowel *to the underside of the old incision/more prominent in* (*specify location*). Omentum and loops of bowel were carefully dissected from the underside of the abdominal wall using sharp dissection with Metzenbaum scissors. Careful exploration of the abdomen was then performed (*detail findings*).

The small bowel was run from the ligament of Treitz to the ileocecal valve. The bowel was noted to be dilated proximally and collapsed distally with a zone of transition (*describe location*). *An adhesive band was noted/multiple adhesions were noted* to be obstructing the distal small bowel. All adhesions were divided sharply and all small bowel loops carefully separated. The entire small bowel was then inspected for viability and the absence of any additional obstructing bands. *A small patch/patches of deserosalized bowel was/were imbricated with 3-0 silk Lembert sutures/3-0 Vicryl sutures. An inadvertent enterotomy was repaired/enterotomies were repaired in two layers with 3-0 Vicryl and 3-0 silk. Small bowel content was milked proximally to be aspirated by the nasogastric tube and distally into the colon*, *again confirming patency and integrity throughout its entire length*. The abdominal cavity was copiously washed with saline and hemostasis was obtained.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ____were placed*.) The fascia was closed with *a running suture of ____/a Smead-Jones closure of interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ____/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

42 Laparoscopic Enterolysis for Small Bowel Obstruction

Mohamad H. Alaeddine,
Ghassan A. Shamseddine, and Bassem Y. Safadi

Indications

- Acute small bowel obstruction with moderate bowel dilation and expectation of limited adhesions based on previous surgical history (e.g., appendectomy, tubal ligation, C-section, etc.)
- Subacute or recurrent intestinal obstruction with a well-defined transition zone on preoperative imaging
- Suspicion of internal hernia after laparoscopic bariatric surgery (particularly laparoscopic Roux-y-gastric bypass)

Essential Steps

1. Position the patient supine with both arms to the side.
2. Enter the abdomen away from the previous incisions using open Hasson technique.
3. Insert all trocars under direct laparoscopic vision away from location of suspected pathology.
4. Manipulate the table position (e.g., Trendelenburg position) to serve exposure.
5. Lyse adhesions to the anterior abdominal with sharp dissection. Minimize use of energy sources.
6. Retract the omentum cephalad along with the transverse colon and mesocolon.
7. Handle the bowel gently, and use intestinal graspers.
8. Run the small intestine from the ligament of Treitz or the ileocecal area. If the bowels are edematous and dilated, it is safer to start distally.
9. Dissect all adhesions sharply.
10. After laparoscopic antecolic gastric bypass procedures, inspect two potential defects for internal hernias, that is, Petersen's defect and the mesenteric defect at the jejunojejunostomy.
11. After laparoscopic retrocolic gastric bypass, inspect the mesocolic window as well.
12. Internal hernia can develop after other laparoscopic operations such as colonic or small bowel resection and biliopancreatic diversion.

Note These Variations

- Dense diffuse adhesions with massive bowel distention should prompt the surgeon to convert to open early to avoid intestinal injury.
- Small intestinal obstructions in the setting of large incisional hernias are best approached

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_42

open since the defects need to be repaired as well.

Complications

- Bleeding
- Intestinal injury
- Recurrent bowel obstruction

Operative Dictation

Preoperative Diagnosis Small bowel obstruction

Procedure Laparoscopic adhesiolysis and release of small bowel obstruction

Postoperative Diagnosis Same

Indications A ___ -year-old *male/female* patient with a remote history *open appendectomy/C-section/hysterectomy/other* has clinical and radiographic features of partial small bowel obstruction. *He/she* failed to improve with nasogastric decompression. A clear transition point at the level of distal small bowel was seen on CT imaging in *the right iliac fossa/pelvis/other location*.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion. A urinary catheter was placed in the urinary bladder using sterile technique.

A 10-mm trocar was inserted under direct vision using open Hasson technique and the abdomen was inflated with CO_2 till 14 mmHg. Then under direct laparoscopic vision, two 5-mm trocars were inserted in the left upper and left lower quadrants. Immediately upon exploration we noted loops of bowel that were dilated and others that were decompressed. There were *adhesions between omentum/loops of small intestines adherent to the anterior abdominal wall at the previous appendectomy site in the right lower quadrant/other*. The adhesions to abdominal wall were sharply incised carefully releasing the omentum and intestines from the abdominal wall. There was no evidence of any incisional hernia. Once the adhesions to the abdominal wall were released, it became clear that the transition point was at the level of distal ileum and was due to a fibrous adhesive band. There was no ischemia or necrosis of the bowel. The adhesive band was sharply incised totally releasing the obstruction. Other than that there were no significant adhesions.

The small bowel was then examined from the ileocecal valve to the ligament of Treitz. We added a 5-mm port in the right upper quadrant to help retract the transverse colon cephalad to aid in the exposure.

At this stage, we were satisfied that the obstruction was resolved. The trocars were removed under vision. The abdomen was deflated. The fascia defect at the 10-mm trocar was closed with an absorbable suture. The incisions were closed with 4-0 monocryl subcuticular sutures. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and left the operating room in good condition.

Small Bowel Resection

43

Carol E.H. Scott-Conner

Indications

- Ischemia
- Tumor
- Trauma
- Stricture
- Obstruction

Essential Steps

1. Make a midline incision.
2. Explore the abdomen.
3. Mobilize the bowel to be resected (lyse adhesions if necessary).
4. Create a window in the mesentery at the resection edges in the avascular area.
5. Divide the mesentery.
6. Clamp/staple and divide the bowel.
7. Remove the specimen (*mark proximal/distal ends*).
8. *Stapled anastomosis*:
    - *Create enterotomy at stapled ends for anastomosis*.
    - *Approximate enterotomies*.
    - *Fire linear cutting stapler*.
    - *Inspect lumen for bleeding*.
    - *Close enterotomies* (*staple/suture*).
    - (*Or sutured anastomosis*).
9. Check the anastomosis for patency and integrity.
10. Close the mesenteric defect.
11. Check hemostasis.
12. Make sure sponge needle and instrument count is correct.
13. Close the abdomen.

Note These Variations

- Extent of resection and length of the remaining bowel (if extensive)
- Stapled vs. sutured anastomosis

Complications

- Anastomotic leak
- Intra-abdominal abscess
- Enterocutaneous fistula
- Obstruction
- Malabsorption/short gut syndrome
- Hernia

Template Operative Dictation

Preoperative Diagnosis *Intestinal ischemia/tumor/trauma/other*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_43

Procedure Exploratory laparotomy with small bowel resection

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *man/woman* with signs and symptoms of (*list*) and a preoperative diagnosis of (*detail*). Small bowel resection indicated for management of *ischemia/tumor/trauma/other*.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and orogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. After a time-out was performed, a vertical midline incision was made from xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored (*list any abnormal findings*). *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

[Choose One:]

If ischemia: The segment of nonviable small bowel was ____ cm long and *began ____ cm from the ligament of Treitz/ended ____ cm from the ileocecal valve*. The margins were determined to be viable by arterial Doppler.

If tumor or trauma: The *region of the tumor/perforation or stricture* was identified and the extent of resection determined so as to *achieve an adequate margin and allow resection of a fan-shaped portion of mesentery with accompanying lymph nodes/allow anastomosis to be performed in a region of normal bowel*.

A window was created by using a curved hemostat to separate the mesentery from the bowel at each resection margin. The mesentery was scored and serially divided with hemostats, and the vessels were then ligated with 3-0 silk ties.

If stapled anastomosis: The bowel was divided with a cutting linear stapler at each resection margin and passed off the table as a specimen (*label proximal and distal margins for ischemia or tumor*). The antimesenteric angles of the proximal and distal segments were then approximated with two sutures of 3-0 silk placed approximately 5 cm apart. Enterotomies were made at the antimesenteric borders and the cutting linear stapler inserted and fired. The lumen was inspected for hemostasis. The enterotomies were closed with *a single firing of a linear stapler/in two layers with 3-0 Vicryl and 3-0 silk*.

If sutured anastomosis: A pair of noncrushing bowel clamps were placed on the bowel at each resection margin. The small bowel was then transected between clamps with a #10 scalpel and passed off the table as a specimen (*label proximal and distal ends for tumor or ischemia*). The small bowel was then brought together approximating the ends. A two-layer anastomosis was created with an inner layer of running 3-0 Vicryl and an outer layer of interrupted 3-0 silk Lembert sutures completely imbricating the inner layer.

The anastomosis was then inspected for patency and integrity. The mesenteric defect was closed with a running 3-0 Vicryl suture. The abdomen was irrigated with 2 L of saline. *The remaining small bowel appeared viable*. The resection site was ____ cm from the *ileocecal valve/ligament of Treitz*, and the patient had ____ cm of small bowel remaining.

After the sponge needle and instrument count was correct (*optional*: *multiple interrupted through-and-through retention sutures of ____ were placed*.) The fascia was closed with *a running suture of ____/a Smead-Jones closure of* *interrupted* ____. The skin was closed with *skin staples/subcuticular sutures of* ____/*other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Ross Bengtson, MD, in the previous edition.

44 Laparoscopic Small Bowel Resection

Walid Faraj, Hussein Nassar, and Ahmad Zaghal

Indications

- Small intestinal neoplasm
- Resection of nonviable bowel in the context of intestinal obstruction
- Ischemic small bowel
- Stricture

Essential Steps

1. Foley catheter, nasogastric tube insertion.
2. Induce pneumoperitoneum (Veress needle or Hassan cannula).
3. Place trocars – supraumbilical 10 mm for laparoscope – then one in each midclavicular line, left and right, approximately 6–7 cm from umbilicus (also 10 mm), taking due consideration of location of old scars to avoid adhesions.
4. Explore the abdomen.
5. Lyse any adhesions.
6. Identify segment to resect.
7. Create a window in the mesentery at the resection margins.
8. Divide the mesentery.
9. Deliver the resected segment.
10. Restore bowel continuity.
11. Close the mesenteric defect.
12. Check hemostasis.
13. Close wounds.

Note These Variations

- Extent of resection
- Stapled or sutured anastomosis
- Placement of incision to deliver bowel
- Use of second-look operation for intestinal ischemia
  - Anastomosis may be delayed until second operation in this case.
- Length of the remaining bowel

Complications

- Anastomotic leak
- Intra-abdominal abscess
- Wound infection
- Enterocutaneous fistula
- Intestinal obstruction
- Short bowel syndrome
- Bleeding
- Internal hernia
- Incisional hernia at trocar site

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_44

Template Operative Dictation

Preoperative Diagnosis *Intestinal tumor/ischemia/other*

Procedure Exploratory laparoscopy, with *lysis of adhesions and* laparoscopic small bowel resection

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* presented with signs and symptoms of ___, work up confirmed the diagnosis of___, and the decision was to proceed with laparoscopic segmental small bowel resection.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed supine on the operating table, anesthesia placed appropriate lines and induced and intubated the patient without complications, and preoperative antibiotics were given. Foley catheter and nasogastric tube were inserted, and the patient's anterior abdomen was prepped and draped in the usual sterile fashion. A time-out was completed verifying correct patient, procedure, site, positioning, and implant(s) and/or special equipment prior to beginning this procedure.

A supraumbilical 10 mm trocar was inserted under direct vision, *using Hasson technique, or a Veress needle was used to insufflate the abdomen and a 10 mm trocar was placed in the supraumbilical location*. Abdominal exploration revealed *no incidental findings/the following incidental findings* (*detail*). This was followed by insertion of two trocars, one on the left and the other on the right side, at the midclavicular line 6–7 cm from the umbilicus, 10 mm each, respectively.

Adhesions were lysed sharply under direct vision.

[Choose One:]

If ischemia: *The segment of nonviable small bowel was ___ cm long*, *___ from the ligament of Treitz. An arterial Doppler probe was used to determine arterial mesenteric pulsation to aid the laparoscopic inspection*.

The bowel was found to be gangrenous, *and the decision was to proceed with laparoscopic small bowel resection with anastomosis/second-look operation with delayed reconstruction*, *after extensive normal saline irrigation of the abdomen*.

If tumor/stricture: *The region of the tumor/stricture was identified*, *and the resection planned to get enough surgical margins and include the nodal basin* via *a wide resection margin in the mesentery*.

A window was created at the junction points between the mesentery and the borders of bowel resection; a V-shaped portion of the mesentery suspending the bowel segment was scored using electrocautery, then LigaSure was used to divide the mesentery, and then the resection borders of the selected bowel segment were cut using a cutting linear stapler.

A separate incision was made in the left lower quadrant, and the specimen was placed in a laparoscopic specimen bag and delivered through this incision.

Then attention was drawn toward restoring the continuity of the bowel.

The antimesenteric angles of the proximal and distal margins were then approximated using stay silk sutures, enterotomies were made using electrocautery at the antimesenteric borders, and the cutting linear Endo GIA was inserted and fired. Lumen was then inspected for bleeding points.

The enterotomies were then closed with *Endo GIA/using two layers of 3-0 Vicryl or PDS sutures*.

The mesenteric defect was then closed using running suture of 3-0 PDS.

Abdomen was irrigated extensively with normal saline.

The remaining of the bowel looked viable.

Hemostasis secured.

Trocar sites were then closed in layers, with O/PDS for the fascia and 4/0 Monocryl continuous subcuticular sutures for the skin.

The left lower abdominal incision was also closed in layers, 0/PDS interrupted sutures for the fascia and 3-0 nylon interrupted sutures for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Resection of Meckel's Diverticulum

45

James P. De Andrade and Peter Nau

Indications

1. Bleeding
2. Inflammation
3. Volvulus
4. Intussusception
5. Littre's hernia
6. Incidental finding during laparotomy

Essential Steps

1. Review patient information and imaging studies to ensure proper indications.
2. Mobilization of the diverticulum and adjacent ileum.
3. Ligate the mesentery of the diverticulum near the ileal mesentery.
4. Transect the Meckel's with a stapling device or using a clamp-and-sew method.
5. Evaluate the transection margin for integrity and to confirm adequate lumen diameter.
6. Check hemostasis. Irrigate abdomen.
7. Perform sponge, needle, and instrument count.
8. Close in the usual fashion.

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Note These Variations

1. Simple diverticulectomy as described here vs. small bowel resection of underlying ileal segment with its adjoining Meckel's diverticulum
2. Stapled versus sutured diverticulectomy
3. Laparoscopic approach

Complications

1. Staple line or suture line breakdown
2. Enterocutaneous fistula
3. Abscess
4. Small bowel obstruction

Template Operative Dictation

Preoperative Diagnosis *Bleeding/peritonitis/small bowel obstruction/other*

Procedure Resection of Meckel's diverticulum

Postoperative Diagnosis Same

Indication The patient is a ___-year-old *male/female* with *bleeding/peritonitis/small bowel obstruction/other. He/she* was brought to the operating room for surgical exploration.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_45

Description of Procedure The risks, benefits, and alternatives to surgery were discussed with the patient preoperatively, and written informed consent was obtained. The patient was brought to the operating room and laid supine. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and an orogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from caudal to the xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues with electrocautery. The peritoneum was entered sharply so as not to injure the underlying viscera. The abdomen was explored, revealing a Meckel's diverticulum approximately ___ cm from the ileocecal valve. *If incidental Meckel's diverticulectomy, dictate primary procedure here*.

The Meckel's diverticulum was mobilized by lysis of surrounding adhesions. The mesodiverticulum was gently dissected with a curved hemostat in an avascular plane at its takeoff from the ileal mesentery. The freed mesodiverticulum was then clamped proximally and distally, transected, and ligated with a 3-0 silk.

A linear cutting stapler with a bowel staple load was fired across the base of the diverticulum. Attention was paid to stapler positioning so as to avoid compromise of the underlying lumenal diameter. The specimen was sent to pathology for permanent section. **Or** *two noncrushing bowel clamps were placed transversely across the base of the diverticulum at its takeoff from the ileum. The diverticulum was transected sharply between clamps and sent to pathology for permanent section. The enterotomy was the closed in two layers*: *an inner layer of running 3-0 Vicryl and an outer layer of interrupted 3-0 silk Lembert sutures. The remaining bowel clamp was removed*. The integrity of the *staple line/suture line* was confirmed and the lumen of the underlying ileum was patent.

Hemostasis was checked and the abdomen was irrigated with normal saline. The omentum was placed over the operative site. Sponge, needle, and instrument counts were reported as correct. The fascia was closed with a running, absorbable monofilament suture. The skin edges were reapproximated and sterile dressings applied. A debriefing checklist was completed to share information critical to postoperative care of the patient. General anesthesia was reversed, and the patient was taken to the recovery room in stable condition. The patient tolerated the procedure well, and there were no immediate complications noted.

Acknowledgment This chapter was contributed by Ross Bengtson, M.D. in the previous edition.

Part V

General Surgery: Colorectal

Lower Endoscopy: Colonoscopy and Flexible or Rigid Sigmoidoscopy

46

Ryan Conway and Yehudith Assouline-Dayan

Indications

- Colorectal cancer screening
- Cancer and polyp surveillance
- Infectious or inflammatory colitis
- Surveillance for dysplasia or carcinoma in patients with ulcerative colitis
- Investigation of unexplained diarrhea
- Lower gastrointestinal bleeding
- Colonic pseudo-obstruction decompression
- Sigmoid colonic volvulus

Contraindication

- Severe comorbidities and inability to tolerate conscious sedation
- Recent gastrointestinal anastomoses (relative)
- Inflammation of gastrointestinal tract, such as diverticulitis (relative)
- Mechanical bowel preparation is contraindicated in the presence of bowel obstruction

Essential Steps

1. Bowel prep.
2. Check endoscopy tower, endoscope, light source, suction, and irrigation equipment to assure proper function.
3. Position patient in left lateral decubitus position with knees bent.
4. Administer procedural sedation using agents.
5. Perform digital rectal examination to assess for masses.
6. Lubricate endoscope thoroughly with water-soluble lubricant.
7. Gently insert endoscope through the anus.
8. Judiciously insufflate air to visualize lumen, using the minimum amount of air necessary to navigate the endoscope through the rectum and colon to the cecum as identified by landmarks including the appendicle orifice and ileocecal valve:
   - To minimize the risk of perforation, advance endoscope only when the lumen is clearly visualized.
   - The terminal ileum can be intubated and inspected to evaluate terminal ileum if clinically indicated.
9. After navigating to the cecum, slowly withdraw the endoscope by systematically inspecting the mucosa for abnormalities.
10. To biopsy a mass or polyp, advance a biopsy forceps or snare through the working port of the endoscope and grasp the specimen of tissue for biopsy. Electrocautery may be used to achieve hemostasis.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_46

11. Prior to removing the endoscope, retroflex the endoscope to visualize the rectum looking for abnormalities.
12. Remove excess insufflated air upon removal of the endoscope prior to terminating the procedure.

Note These Variations

- Anoscopy
  - Position in lateral decubitus, prone, or lithotomy positions.
  - Insert a lubricated anoscope with the obturator in place until the flanges rest on the perianal skin.
  - Remove the obturator, and while withdrawing the anoscope, examine the anal mucosa in a systematic manner. Repeat the procedure as needed to ensure full inspection of the anal canal.
- Rigid Sigmoidoscopy
  - Assemble sigmoidoscope by placing the obturator through the scope; check the light source and insufflation bulb.
  - Gently insert the sigmoidoscope through the anus to 5 cm, remove the obturator, and judiciously insufflate air to visualize the lumen. Air will leak during the procedure, and intermittent insufflation will be necessary.
  - Advance the sigmoidoscope under direct vision to 15 cm and withdraw slowing to inspect mucosa for abnormalities.

Complications

- Bleeding from biopsy or polypectomy site(s)
- Colonic or rectal perforation
- Inadequate therapeutic intervention
- Missed diagnostic abnormality
- Post-polypectomy syndrome
- Mechanical bowel preparation-associated complication (electrolyte imbalances)
- Sedation-related complications
- Splenic capsular tear/splenic rupture (rare)
- Disinfectant-induced colitis (uncommon)
- Death (rare)

Template Operative Dictation

Preoperative Diagnosis *Screening colonoscopy/rectal bleeding/other*

Procedure *Screening/diagnostic* colonoscopy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* presented with *rectal bleeding/lower abdominal and pelvic trauma/screening colonoscopy*.

Description of Procedure Written consent was obtained prior to the procedure. The patient was brought to the *OR/endoscopy suite*. Based on the pre-procedure assessment, including review of the patient's medical history, medications, allergies, and appropriate physical exam, the patient was deemed to be an appropriate candidate for conscious sedation. Prior to proceeding, the patient's name, date of birth, and procedure to be undertaken were verified at the time-out. The patient was then placed in the left lateral decubitus position, and adequate sedation was achieved with the use of *fentanyl and midazolam/Demerol/propofol/others*. A digital rectal exam was performed. No lesions were noted. An adult *Olympus colonoscope* (CF-*H180AL*)/*other* was placed in the rectum and advanced to the cecum as identified by landmarks including the appendix orifice and the ileocecal valve. The terminal ileum was intubated and appeared endoscopically normal. The prep was *poor/fair/good/excellent*.

Note Excellent: minimal solid stool and only small amounts of clear fluid requiring suction Good: no or minimal solid stool with large amount of clear fluid requiring suction

Fair: collection of semisolid debris that are cleared with difficulty

Poor: solid or semisolid debris that cannot be effectively that cannot be effectively cleared

The colonoscope was then slowly withdrawn, examining for any mucosal abnormalities. The cecum and ascending, transverse, descending, and sigmoid colon were visualized adequately. No mucosal lesions, polyps, or diverticula were noted.

If biopsies were taken: A *suspicious lesion/polyp/other* was noted in the ______. A *biopsy forceps/snare/other* was advanced through the working port of the colonoscope. The *suspicious lesion/polyp/other* was grasped and *biopsied/partially removed/completely removed* with *biopsy forceps/cold snare or hot snare*. The biopsy was sent to pathology for permanent processing. *Electrocautery was used to achieve hemostasis*.

If tattoo was performed: An injection needle was advance through the working channel of the endoscope. __ *cc of India ink/indigo carmine/others* diluted with normal saline was injected into __ *quadrants* around the biopsied site.

Retroflexion was performed in the rectum. No external or internal hemorrhoids were visible. Excess air was removed, the colonoscope withdrawn, and the procedure terminated. Total withdrawal time (cecum to anus) was ____ minutes. Photographs *were/were not* taken and placed into the patient's chart if applicable. The patient was assessed and was in satisfactory condition at the termination of the procedure and transferred to the recovery area.

Complications: The patient tolerated the procedure well and *no complications were noted/complications were noted as* _____.

47 Open Appendectomy

Edward Cho and Samy Maklad

Indications

- Acute appendicitis
- Interval appendectomy after treatment of appendiceal abscess/phlegmon
- Benign tumor of the appendix

Essential Steps

1. Make right lower quadrant incision over McBurney's point or the point of maximum tenderness that was marked prior to the anesthesia induction (*rarely*, *the incision is made in the lower midline or right paramedian*).
2. Divide each muscular and aponeurotic layer parallel to fibers to achieve a muscle-splitting incision.
3. Enter the peritoneum and note any discoloration or malodor of the peritoneal fluid. If present, send the peritoneal fluid for gram stain and culture.
4. Expose the cecum, pulling it into the wound and elevating it with a moist pad.
5. *Divide the lateral peritoneal attachments of the cecum* (*may be required for better exposure*).
6. Deliver the appendix into the wound.
7. If the appendix appears normal, check the terminal ileum and pelvis. Check for any fluid in the right paracolic gutter which may arise from another pathology such as perforated peptic ulcer (*convert to laparotomy if necessary*).
8. Carefully divide and ligate the appendiceal mesentery at the base of the appendix.
9. Crush the stump of the appendix with a clamp; then, move the clamp distally 1 cm on the appendix.
10. Ligate the proximal edge of the crushed appendix.
11. Take a *purse-string suture/z-stitch* in the wall of the cecum at the base of the appendix.
12. Transect the appendix above the ligature and remove it.
13. Invaginate the stump and tie the *purse-string suture/z-stitch*.
14. Place omentum over the site.
15. Aspirate any purulent material, cautiously irrigate, and gently suction.
16. *Incise and drain if a well-formed abscess cavity is encountered. Remove all fibrinous material lining the abscess cavity and send for culture*.
17. Check hemostasis.
18. Close the incision in three layers: peritoneum and transversalis fascia and internal and then external oblique.
19. *Close the subcutaneous tissue and skin/pack the wound open*.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_47

Note These Variations

- Choice of incision
- Incision of the peritoneum to mobilize the cecum
- Location of the appendix
- Method of stump inversion
- Degree of purulence, whether drain used

Complications

- Pelvic abscess
- Stump leak
- Missed pathology (e.g., perforated ulcer)
- Small bowel obstruction

Template Operative Dictation

Preoperative Diagnosis Acute appendicitis

Procedure Appendectomy

Postoperative Diagnosis *Same/mesenteric adenitis/Crohn's disease/pelvic inflammatory disease/mucocele/mucinous adenocarcinoma/other*

Indications *Acute appendicitis*: This ___-year-old *male/female* presented with right lower quadrant pain of ___ duration, fever, and elevated WBC count. *Computed tomography scan/ultrasound/physical examination* was consistent with acute appendicitis. The decision was made to proceed with open appendectomy.

Interval appendectomy: This ___-year-old *male/female* had an appendiceal abscess treated by percutaneous drainage and antibiotics ___ weeks earlier and now presents for interval appendectomy. The decision was made to proceed with an open appendectomy.

Description of Procedure The patient was placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. The abdomen was prepped and draped in the usual sterile fashion.

An incision was made in a natural skin line centered *over McBurney's point/over the palpable mass in the right lower quadrant/over the point of maximum tenderness*. Subcutaneous tissues were divided until the aponeurosis of the external oblique was encountered. This was opened in a direction parallel to its fibers, extending medially toward the rectus sheath and laterally to the iliac crest. The underlying internal oblique aponeurosis was exposed. The transversus abdominis was then encountered and similarly split. The transversalis fascia was entered. The peritoneum was lifted with forceps and entered, while being careful not to injure the bowel below. *Turbid fluid was encountered and cultured*. Moist pads were placed to protect the edges of the wound. The cecum was identified and pulled into the wound and held in place using a moist pad. *The appendix came into view/the lateral peritoneal attachment of the cecum was incised to mobilize the cecum and appendix*. The appendix was noted to be *free/retrocecal and inflamed/gangrenous/perforated/normal*. [*If normal*: *The terminal ileum was then run for ___ ft and found to be normal/inflamed. Pelvic viscera were inspected and found to be ___. A presumptive diagnosis of Crohn's disease/mesenteric adenitis/inflamed Meckel's diverticulum/pelvic inflammatory disease was made*. (*Include details of other procedures performed.*) *The decision was made to proceed with appendectomy*.]

The mesentery of the appendix was divided between clamps and ligated with 3-0 silk. The base of the appendix was crushed with a clamp. The clamp was then advanced and clamped distally 1 cm, toward the tip of the appendix. The appendix was ligated at the proximal edge of the crushed portion with a 0 chromic ligature. A *purse-string suture/z-stitch* was taken in the wall of the cecum. The appendix was held upward and cut distal to the ligature and removed. The stump was (*cauterized and*) then invaginated into the cecum using forceps, and the *purse-string suture/z-stitch* was tied in such a manner as to completely invert and cover the stump. Hemostasis was checked. Omentum was placed on the site of the operation.

No other pathologies were noted/an abscess was encountered and a swab was sent for gram stain and culture. The abscess was well formed; *its entire lining of fibrinous material was removed and sent to the lab for culture*. All purulent material was aspirated, and the field was gently irrigated with normal saline. *A closed suction drain was placed in the abscess cavity*. The incision was closed in layers in the following fashion: the peritoneum and transversalis fascia were closed with a running suture of ___. The opening in the rectus sheath and the internal oblique was then closed with a *running/interrupted* suture of ___. The external oblique was closed with interrupted ___. *Subcutaneous tissues and skin were closed with ___/the wound was packed open with fine mesh gauze*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in satisfactory condition.

Acknowledgment This chapter was contributed by Lori Soni, M.D. in the previous edition.

Laparoscopic Appendectomy

48

Edward Cho and Samy Maklad

Indications

- Acute appendicitis
- Interval appendectomy after the treatment of appendiceal abscess/phlegmon
- Benign tumor of the appendix

Essential Steps

1. Tuck the left arm.
2. Put monitors on the right side of the patient so that the surgeon can work from the left side.
3. Place orogastric tube and Foley catheter to decompress the stomach and bladder.
4. Gain access to the abdomen via Veress needle or Hassan technique at the umbilicus.
5. Inspect the abdomen.
6. Place a 5-mm trocar above the pubic symphysis followed by a 5- or 10-mm trocar at the left lower quadrant.
7. Position the table in a slight Trendelenburg position with the table rotated right side up.
8. Identify the appendix and cecum.
9. Grasp the appendix with Babcock forceps and elevate to expose the base of the appendix.
10. Develop a window between the base of the appendix and the mesoappendix.
11. Transect the appendix and mesoappendix at the base.
    - *If stapled*:
      – *Endoscopic linear cutting stapler across the base of the appendix*
      – *Endoscopic linear cutting stapler with a vascular cartridge across the mesoappendix*
    - *If pre-tied endoloop*:
      – *Serially divide the mesentery with clips/cautery/ultrasonic shears*.
      – *Doubly ligate the base of the appendix with pre-tied endoloop*.
      – *Transect with endoscopic shears*.
12. Place the appendix into an endoscopic retrieval pouch and remove through the left lower quadrant port site (or the umbilical port site, if using Hassan trocar).
13. Cauterize the base of mesoappendix as needed for hemostasis.
14. Irrigate and assure hemostasis.
15. *Place closed suction drain if well-formed abscess cavity encountered*.
16. Close.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_48

Note These Variations

- Veress needle or Hassan trocar.
- Stapler or pre-tied endoloop.
- Location of the appendix (retrocecal) and pathology.
- If retrocecal, mobilize the cecum.
- Drain if well-formed abscess encountered.

Complications

- Stump leak.
- Dropped/lost fecalith or appendix.
- Bowel, bladder, or vascular injury from placement of Veress needle/trocar.

Template Operative Dictation

Preoperative Diagnosis Acute appendicitis

Procedure Laparoscopic appendectomy

Postoperative Diagnosis *Same/mesenteric adenitis/Crohn's disease/pelvic inflammatory disease/other*

Indications *Acute appendicitis*: This ___-year-old *male/female* presented with a right lower quadrant pain of ___ duration, fever, and elevated WBC. *Computed tomography scan/ultrasound/physical examination* was consistent with an acute appendicitis. The decision was made to proceed with a laparoscopic, possibly open, appendectomy.

Interval appendectomy: This ___-year-old *male/female* had an appendiceal abscess treated by percutaneous drainage and antibiotics ___ weeks earlier and now presents for interval appendectomy. The decision was made to proceed with a laparoscopic, possibly open, appendectomy.

Description of Procedure The patient was placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Foley catheter and orogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

An incision was made in a natural skin line above the umbilicus.

[Choose One:]

If Veress needle technique: *The fascia was elevated and the Veress needle inserted. Proper position was confirmed by aspiration and saline meniscus test. The abdomen was insufflated with carbon dioxide to a pressure of 15 mmHg. The patient tolerated the insufflation well. A 5-mm optical trocar was then inserted.*

If Hassan technique: *The fascia was elevated and incised. Entry into the peritoneum was confirmed visually and no bowel was noted in the vicinity of the incision. Two figure-of-eight stay sutures of 2-0 Vicryl were placed in the fascia and 12-mm Hassan trocar was inserted. The Hassan trocar was anchored using the stay sutures. The abdomen was insufflated with carbon dioxide to a pressure of 15 mmHg. The patient tolerated the insufflation well.*

The laparoscope was inserted, and the abdomen was inspected. No injuries from the initial trocar placement were noted. *Turbid fluid/purulent fluid was noted in the right lower quadrant*. Under direct visualization, a 5-mm trocar was inserted above the symphysis pubis and below the hairline. Next, *a 10-mm trocar/5-mm trocar* was inserted in the left lower quadrant lateral to the rectus muscle. Care was taken to avoid injuring the bladder or inferior epigastric vessels. The table was placed in a Trendelenburg position rotated with the right side up.

The cecum was manipulated with a grasper and the appendix was identified. The appendix was then grasped with a Babcock forceps and elevated exposing the base of the appendix.

If retrocecal: *The appendix was not seen. The lateral peritoneal attachment of the cecum was incised, and the cecum was mobilized until a retrocecal appendix was visualized.*

The appendix was noted to be *normal/inflame d/gangrenous/perforated*. A window was developed in the mesoappendix at a point between the base of the appendix and the cecum.

[Choose One:] ***If stapled***: *An endoscopic linear cutting stapler was then used to divide and staple the base of the appendix. The stapler was reloaded with a vascular cartridge and, then, was used to similarly divide the mesoappendix*.

If ligated: *The mesentery was serially divided with clips/cautery/ultrasonic shears. A pre-tied endoloop was then passed over the appendix and snugged tight at the base. A second endoloop was similarly placed distal to the first. The appendix was divided in between the two endoloops using an endoscopic shear*.

The appendix was placed into an endoscopic retrieval bag and removed via *the 10-mm port site*.

The appendiceal stump was then irrigated and hemostasis was assured. Fluid was suctioned from the right lower quadrant and pelvis. The terminal ileum was run for ___ft *and found to be normal/inflamed. No other pathology was identified/Meckel's diverticulum was identified*.

A closed suction drain was placed in the abscess cavity and withdrawn through the ___ trocar site.

Secondary trocars were removed under direct vision. *No bleeding was noted/trocar-site bleeding was controlled by electrocautery/suture placement*. The laparoscope was withdrawn, and the umbilical trocar was removed. The pneumoperitoneum was evacuated. All trocar sites greater than 5 mm were closed with ___. The skin was closed with subcuticular sutures of ___ and *Steri-Strips/surgical glue*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D. in the previous edition.

Right Hemicolectomy

49

John Armstrong and John C. Byrn

Indications

- Malignancy
- Ischemia
- Perforation
- Right-sided diverticular disease
- Bleeding from the right colon
- Cecal volvulus

Essential Steps

1. Midline incision.
2. *Explore the abdomen for metastatic disease* (*liver and peritoneum*, *ovaries in female*).
3. Incise the line of Toldt and mobilize the colon toward midline.
4. Identify and protect both ureters and the duodenum.
5. Divide the colon proximally and distally.
6. Ligate the mesenteric vessels.
7. Remove the specimen (tag proximal and distal ends).
8. Perform anastomosis.
9. Check the anastomosis for patency and integrity.
10. Close the abdomen.

Note These Variations

- Stapled or sutured anastomosis
- Choice of stapler and suture
- Ligation of the main trunk vs. right branch of the middle colic artery
- Presence/extent of metastatic disease

Complications

- Injury to the ureter
- Injury to the duodenum
- Anastomotic leak

Template Operative Dictation

Preoperative Diagnosis *Carcinoma/ischemia/perforation/diverticular disease/bleeding of the right colon*

Procedure Right hemicolectomy with primary anastomosis

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_49

Postoperative Diagnosis Same (*enumerate any metastatic disease found*)

Indications This ____-year-old *male/female* with *abdominal pain/bleeding/obstructive symptoms/recurrent bouts of diverticulitis* was found to have *carcinoma/ischemia/perforation/diverticular disease/bleeding* involving the right colon. *Elective/emergency* resection was indicated.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Sequential pneumatic compression devices were placed on the lower extremities. Preoperative antibiotics were given. A Foley catheter and nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered.

The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors. A mass was palpated in the ascending colon. The liver*, *omentum*, *peritoneum*, *and ovaries* (*if present*) *were inspected for the evidence of metastatic disease. Metastatic disease was noted ____/no metastatic disease was noted*.

The small bowel was inspected and retracted to the left using a moist gauze and self-retaining retractor. Using electrocautery, the colon was freed from its peritoneal attachments along the avascular line of Toldt from the cecum to the hepatic flexure. Additional lateral peritoneal coverings were incised to further mobilize the colon. The dissection was extended across the ileocolic junction and terminal ileum was mobilized. The right ureter was identified and protected, as were the duodenum, right kidney, and gonadal vessels. The hepatic flexure was carefully mobilized by dividing the peritoneum in the hepatorenal fossa.

Points of transection were selected proximally and distally (*specify locations*). The bowel was divided with the linear cutting stapler. The peritoneum overlying the mesentery was then scored with electrocautery, and the ileocolic artery was identified, double ligated with 2-0 silk sutures, and transected. The *right branch/main trunk* of the middle colic and right colic arteries was similarly identified and ligated. The remaining mesentery and all associated nodal tissue was divided and swept down with the specimen. The specimen was removed, proximal and distal ends tagged, and sent to pathology. Hemostasis was checked in the operative field. The two ends of bowel were checked and found to be viable, with excellent blood supply.

If stapled anastomosis: *The proximal and distal segments were brought into apposition and found to lie comfortably next to each other without tension. Two stay sutures of 3-0 silk were placed to approximate the antimesenteric borders of the bowel segments. Enterotomies were made on the antimesenteric corner of the staple line on the ileum and transverse colon and the linear cutting stapler inserted and fired. Hemostasis was checked on the staple line. The enterotomies were then closed with a linear stapler/a two-layer sutured closure of running 3-0 Vicryl and interrupted 3-0 silk Lembert sutures*.

If sutured: *The fat was gently cleared from the terminal 2–3 mm of the bowel ends. The ileum and transverse colon ends of bowel were brought into apposition and found to lie comfortably without excessive tension. A Cheatle slit was made in the antimesenteric border of the ileum to equalize the caliber of the two pieces of bowel. A two-layer hand-sewn end-to-end anastomosis was then constructed using an outer layer of interrupted 3-0 silk Lembert sutures and an inner running layer of 3-0 Vicryl*.

The anastomosis was checked and found to be intact and widely patent. The mesenteric defect was closed with interrupted 3-0 Vicryl. The abdominal cavity was then copiously irrigated and hemostasis was checked.

The fascia was closed with *a running suture of ____/a Smead-Jones closure of interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of____/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Simon Roh, M.D. in the previous edition.

Laparoscopic Right Hemicolectomy

50

Faek R. Jamali

Indications

- Right-sided colonic polyps or malignancy
- Appendiceal neoplasms (carcinoids >2 cm or with positive nodes; mucinous neoplasm)
- Resection of specific benign conditions of the ascending and transverse colon (arteriovenous malformations, diverticular disease, and ischemic strictures)
- Cecal volvulus
- Severe appendicitis with involvement of the cecum in the inflammatory process
- Right colonic involvement in inflammatory bowel disease (primarily Crohn's disease)

Essential Steps

1. Lithotomy
2. Foley catheter insertion
3. Establish laparoscopic access, place five trocars, and perform laparoscopic exploration of abdominal cavity.
    - 10 or 12 mm trocar in umbilicus
    - 12 mm trocar suprapubic
    - 5 mm trocar in RLQ and 5 mm trocar in LLQ
    - 5 mm trocar in upper midline
4. Position the patient in anti-Trendelenburg with the right side up to obtain appropriate exposure.
5. Place the cecum on traction to identify the ileocolic vessels. Incise the peritoneum overlying the junction of the ileocolic vessels with the SMA.
6. Dissect and control the ileocolic vessels and perform associated lymphadenectomy (for malignancy).
7. Dissect the plane anterior to the Toldt fascia. Identify and protect the duodenum and head of pancreas.
8. If indicated by extent of needed resection, dissect and divide the right colic and right branch of the middle colic vessels.
9. Complete mesenteric dissection of transverse colon by opening into lesser sac and dividing the mesentery of the colon up to the colonic wall at the selected point of distal transection.
10. Complete retroperitoneal dissection of all attachments of ascending colon. Identify and protect the ureter and gonadal vessels.
11. Mobilize ascending colon and hepatic flexure along white line of Toldt meeting the retroperitoneal mobilization.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_50

12. *For an extracorporeal anastomosis*:
    - Create a midline periumbilical 5-cm incision and place a wound protector.
    - Deliver the specimen.
    - Complete the proximal and distal mesenteric and bowel dissection extracorporeally with GIA staplers.
    - Perform a standard side-to-side stapled anastomosis extracorporeally, avoiding any twists, and close the mesenteric defect.
    - Reintroduce the bowel into abdominal cavity perform a final laparoscopic exploration after closure of the access site using 2-0 PDS suture.
    - Close all 10-mm trocar sites at the level of the fascia and closure of all skin defects.
13. *For an intracorporeal anastomosis*:
    - Divide the mesentery of the small bowel followed by division of terminal ileum and transverse colon using an energy device and linear stapler.
    - Perform an intracorporeal side-to-side anastomosis using linear stapler, followed by closure of common enterotomy and mesenteric defect.
    - Place the specimen into an extraction bag and deliver it via a properly placed small incision.
    - Close extraction site in layers using 2-0 PDS suture
    - Close all 10-mm trocar sites at the level of the fascia and close all skin defects.

Note These Variations

- Intracorporeal versus extracorporeal anastomosis.
- A hand-assist technique may be used. In the hand-assist technique, a small incision is strategically placed at the beginning of the operation, and a specific hand-assist device is used to allow the introduction of the non-dominant hand of the surgeon into the abdominal cavity to assist with the operation. The site is typically chosen so as the non-dominant hand does not interfere with a camera; the site can also be used for the extraction of the specimen and for the performance of the extracorporeal anastomosis. In the hand-assist technique, the access incision is usually placed either in the midline (periumbilically) or in the right upper quadrant. The surgeon's hand is used to retract the small bowel, elevate the colon, and facilitate laparoscopic dissection.

Complications

- Access-related complications (bowel injury, vascular injury, and retroperitoneal injury)
- Transection of the ureter
- Perforation of the duodenum or stomach
- Small bowel enterotomy
- Anastomotic leak

Template Operative Dictation

Preoperative Diagnosis List specific pathology indicating surgery (*see indications above*), e.g., *malignant neoplasm of ascending colon*.

Procedure Laparoscopic right hemicolectomy.

Postoperative Diagnosis List specific intraoperative findings, e.g., *malignant neoplasm of ascending colon*.

Indications This ___-year-old *male/female* patient presented with ____ and on workup was found to have______. *If malignancy*: *staging workup was completed and showed*_____. *He/she* is now presenting for elective laparoscopic right hemicolectomy. The procedure, indication, alternatives, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Details of Operation The patient was brought to the operating room and placed on the operating table. Time-outs were performed using both pre-induction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, *he/she* was placed in the lithotomy position. Intravenous antibiotic and subcutaneous heparin were administered. A Foley catheter was inserted. All extremities were well padded. The abdomen was shaved and prepped in the usual sterile fashion

[Choose One:]

A Veress needle was introduced into the abdominal cavity and pneumoperitoneum was achieved and a 10 mm optical trocar was inserted.

An open approach was used to access the peritoneal cavity. Using the S retractors, the subcutaneous tissue was dissected all the way down to the fascia. The fascia was grasped between two Kocher clamp and opened using the 11 blade vertically. The peritoneum was then incised and the trocar placed under direct vision.

An additional 12-mm trocar was then placed under direct vision in the midline in the suprapubic taking care to avoid injury to the bladder. Two additional 5-mm trocars were placed, one in the left anterior axillary line and the other one at the level of the midclavicular of the line to the right of the abdominal cavity below the umbilicus. *An additional 5-mm trocar was placed in the subxiphoid area to allow for the assistant to retract the transverse colon upward.* The patient was then positioned in 30° reverse Trendelenburg position with the patient's right side up to allow for small bowel to drop clear of the operative field. The 10-mm scope was introduced from the suprapubic port at the initial part of the procedure. The cecum was grasped with the left hand of the operating surgeon and lifted up to tent the ileocolic artery. The dissection was then started at the base of the ileocolic artery where it joined the superior mesenteric artery. The peritoneum overlying the takeoff of the ileocolic artery was opened using *electrocautery/an appropriate energy device*. This opening of the peritoneum was carried all the way up to the base of the transverse mesocolon. With the ileocolic artery retracted by traction on the cecum, gentle dissection was used to identify its takeoff from the superior mesenteric artery. The ileocolic artery and vein were then dissected and divided using *laparoscopic vascular stapler/energy device/clip*. The divided vessels were then elevated and dissection proceeded in the retroperitoneal plane using a traction countertraction technique with gentle sweeping and visualization of the duodenum. The duodenum and its attachments were swept downward. The C loop of the duodenum and the head of the pancreas were fully visualized, dissected, and preserved. Dissection then continued on the right side of the superior mesenteric artery leading to the identification of the right colic artery and vein which were then gently dissected and divided *using laparoscopic vascular stapler/energy device/clip*. Finally, the mesentery of the transverse colon at the point that is selected for distal transection is divided using an energy device. A window is created in the avascular plane into the lesser sac.

For extended right hemicolectomy: *the middle colic vessels were also dissected by opening the peritoneum overlying them and dissecting them at the takeoff from the superior mesenteric artery. The middle colic vessels were then divided followed by complete division of the mesentery of the transverse colon to the right of the middle colic vessels.*

The lateral attachments of the ascending colon were then divided including mobilization of the retroperitoneal attachments of the terminal ileum. This mobilization was carried out until the posterior plane of dissection that was started from the medial approach was encountered, completing the liberation of the ascending colon and its hepatic flexure. The omentum attached to resected portions of the colon was divided and resected with the specimen.

If extracorporeal anastomosis: *A grasper was placed on the ascending colon and an access incision made by enlarging the umbilical trocar site to a total length of about 4–5 cm. A wound protector was then placed into the peritoneal cavity to prevent port site implantation as well as minimize* *the risk of wound infection. The ascending and transverse colon were then delivered and extracted. The small bowel and colon were then divided extracorporeally using a GIA device. The mesenteric dissection was completed as needed on the small bowel and colonic sides. The specimen was removed. The two ends of the ileum and transverse colon were then aligned, ensuring that the mesentery was not twisted, and a stapled side-to-side anastomosis was created using a linear stapler. The mesenteric defect was then closed with 4-0 PDS sutures and the bowel reintroduced into the peritoneal cavity. The extraction site was closed by placing the cap on the wound protector or by closing the fascia using 2-0 PDS for the fascia using a 4:1 suture length to incisional length ratio and 5 mm bites. The peritoneum was again insufflated, and the anastomosis, alignment of the bowel, and hemostasis were checked.*

If intracorporeal anastomosis: *The specimen was placed on the right side of the abdominal cavity. The terminal ileum and the transverse colon were approximated with a single 3-0 PDS suture. Enterotomies were made and the 60-mm linear stapler was used to construct a stapled side-to-side anastomosis. The common enterotomy was closed using 3-0 PDS suture. The rent in the mesentery was also approximated with 3-0 PDS suture. The specimen was then placed in and Endo Catch bag and extracted from an appropriately placed incision (right lower quadrant muscle splitting or Pfannenstiel). Following extraction of the specimen, the fascia of the extraction site was closed using 2-0 PDS for the fascia using a 4:1 suture length to incisional length ratio and 5 mm bites.*

The trocars were removed under direct vision and any fascial defects larger than 10 mm closed with a 0 PDS suture. The skin was closed with 4-0 PDS sutures in a running fashion, and a dry sterile dressing was applied. The sponge and instrument count was correct, blood loss was minimal, and there were no complications. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Left Hemicolectomy

51

Allison W. Lorenzen and Irena Gribovskaja-Rupp

Indications

- Cancer
- Diverticular disease
- Sigmoid volvulus
- Ischemic colitis

Essential Steps

1. Lower midline incision.
2. *Explore the abdomen for metastatic disease if operating for malignancy or indeterminate* (*liver and peritoneum and ovaries in female*).
3. Incise the line of Toldt and mobilize the colon lateral to medial.
4. Identify and protect both ureters.
5. Mobilize the splenic flexure along the avascular plane.
6. Ligate the mesenteric vessels.
7. Divide the colon proximally and distally.
8. Remove the specimen (tag proximal and distal ends).
9. Anastomose the colon.
10. Check the anastomosis for patency and integrity.
11. Close the abdomen.

Note These Variations

- Stapled or sutured anastomosis
- Size/type of stapler and type of sutures
- High ligation of inferior mesenteric artery
- *Presence/extent of metastatic disease*

Complications

- Injury to the ureter
- Injury to the spleen
- Injury to small bowel
- Anastomotic leak
- Mesenteric bleed

Template Operative Dictation

Preoperative Diagnosis *Carcinoma of the descending colon/diverticular disease/sigmoid volvulus*

Procedure Left hemicolectomy with primary anastomosis (coloproctostomy)

Postoperative Diagnosis Same (*describe any metastatic disease found*)

Indications This ____-year-old *male/female* with a history of *abdominal pain/bleeding/obstructive symptoms/recurrent bouts of diverticulitis* was

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_51

found to have *carcinoma of the descending colon/diverticular disease/sigmoid volvulus*. Elective resection was indicated.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter, orogastric tube, and sequential pneumatic compression devices were placed. *Ureteral stents were placed by urology*. The abdomen was prepped and draped in the usual sterile fashion.

A lower midline incision was made. The incision was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The patient was repositioned in a slight Trendelenburg position. The abdomen was explored. *Adhesions were lysed sharply. A mass/diverticula was palpated in the descending colon. The liver, omentum, peritoneum, and ovaries (if present) were inspected for the evidence of metastatic disease. Metastatic disease was noted ____/no metastatic disease was noted. Frozen section biopsy was sent and returned positive/negative for metastatic disease*.

A self-retaining retractor was placed, the small bowel was packed away with a moist towel, and the descending colon was reflected medially. Using electrocautery/Metzenbaum scissors, the colon was freed from its lateral peritoneal attachments along the line of Toldt from the splenic flexure down to the rectosigmoid junction. Both ureters were identified and protected.

Attention was then turned to mobilization of the splenic flexure. The splenocolic ligament and the pancreaticocolic ligaments were divided. The distal transverse colon was dissected from the stomach by freeing the greater omentum.

The mesentery was then divided with the energy device/clamps and suture ligature after confirming adequate bowel length to reach the pelvis and adequate margins (if oncologic resection). The peritoneum on the medial aspect of the mesentery was scored with electrocautery, and the vessels were serially clamped, divided, and ligated/taken with energy device. Points of transection were selected proximally and distally (*specify locations*). In doing so, the inferior mesenteric artery/sigmoid branches were identified and double ligated with sutures. The location of the left ureter was confirmed prior to dividing the IMA/sigmoid branches. The proximal bowel was then divided with the linear cutting stapler/between a straight Dennis clamp on the staying side and Kocher clamp on specimen side. The rectosigmoid junction was mobilized and the areolar tissues in the presacral plane were sharply divided with electrocautery down to the level of the sacral promontory. The rectosigmoid junction was identified by the splaying of the teniae at the level of the sacral promontory. The bowel was transected at that level using a linear cutting stapler/pelvic cutting stapler. The specimen was removed and the proximal and distal ends tagged prior to sending to pathology. The operative field was examined, and hemostasis was assured prior to proceeding with the anastomosis.

[Choose One:]

If stapled anastomosis: *Attention was turned to performing a coloproctostomy with the EEA stapler. The two ends of the bowel were checked and found to be viable, with excellent blood supply. The proximally transected colon was brought down and the staple line was sharply excised and edges were grasped with Allis clamps. The diameter of EEA to be used was measured with EEA sizers (EEA 28 or 29 is most commonly used) A purse-string suture was placed around the proximal end of the colon using 0 Prolene. The anvil was inserted and the purse-string was tied down snugly. The EEA stapler was passed* via *the anus so that it abutted the rectal staple line. The spike was deployed through the rectum immediately anterior/posterior to the rectal staple line, and the EEA stapler was matched with the anvil. The stapler was closed and fired. Following removal of the stapler, two intact donut* *anastomoses were visualized. A leak test was performed with flexible/rigid proctoscopy and was found to be negative*.

If sutured: *Attention was turned to performing a hand sewn anastomosis. The two ends of the bowel were checked and found to be viable*, *with excellent blood supply. The fat was gently cleared from the terminal 2–3 mm of each of the bowel ends. The two ends were brought into apposition and found to lie comfortably without excessive tension. A two-layer hand-sewn end-to-end anastomosis was then constructed using an outer layer of interrupted 3-0 silk Lembert sutures and an inner running layer of 3-0 Vicryl sutures. The anastomosis was checked and found to be intact and widely patent. Leak test was performed with rigid/flexible proctosigmoidoscopy and found to be negative*.

Following completion of the anastomosis, the abdominal cavity was then irrigated and hemostasis was confirmed.

(*Optional*: *A 10 Fr JP drain was placed through a stab incision in the LLQ and left in pelvis near the anastomosis*.)

The fascia was closed with *a running suture of ____/a closure of interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of____/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Simon Roh, M.D. and John Byrn, M.D. in the previous edition.

52 Laparoscopic Left Hemicolectomy

Faek R. Jamali

Indications

- Left colon cancer or polyps
- Resection of specific benign conditions of the descending and sigmoid colon (arteriovenous malformations, diverticular disease and its complications, localized inflammatory bowel disease, ischemic strictures, and sigmoid volvulus)

Essential Steps

1. Lithotomy position, right arm tucked.
2. Foley catheter insertion.
3. Establish laparoscopic access, place five trocars, and perform laparoscopic exploration of the abdominal cavity.
   - 10 mm trocar in umbilicus
   - 12 mm trocar in the right lower quadrant
   - 3×5 mm trocars. One trocar on each side of the umbilicus and one suprapubic trocar
4. Position the patient in Trendelenburg position with left side up to obtain appropriate exposure.
5. Place the sigmoid colon under traction and incise the peritoneum overlying the promontory. Continue incision till ligament of Treitz. Perform medial-to-lateral dissection in the avascular plane. Identify and preserve the left ureter and gonadal vessels.
6. Elevate left colon mesentery. Identify, dissect, and divide the IMA using a vascular stapler, an energy source, or clips and perform lymphadenectomy.
7. Complete medial-to-lateral dissection in the plane anterior to the Toldt fascia all the way to the splenic flexure of the colon. Identify and preserve the hypogastric nerve bundles.
8. Identify and divide inferior mesenteric vein (IMV).
9. Complete the lateral mobilization of the left colon along the white line to Toldt meeting the medial dissection to achieve complete mobilization of the left colon.
10. Take down the splenic flexure, if indicated by tumor location (medial to lateral or lateral to medial or combination).
11. Select point of distal transection, usually at the level of the promontory. At this point, dissect and divide the mesorectum (division of superior hemorrhoidal vessels) using an energy device.
12. Transect the left colon distally at the selected level with Endo GIA stapler.
13. Perform a Pfannenstiel (or left lower quadrant) access incision and place a wound protector.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_52

14. Deliver the specimen. Choose point of proximal transection and transect the colon proximally. Ensure adequate perfusion of transected colon (visible bright red blood from transection/staple line).
15. Introduce anvil of 28 mm EEA stapler into proximal colon in an end-to-end or end-to-side manner.
    - If end to end, perform a purse-string suture with 2-0 Prolene.
    - If end to side, bring the anvil out on the antimesenteric aspect of the proximal colon and staple distal end with linear stapler. Place purse-string suture with 2-0 Prolene at the site of exit of the anvil from the colon.
16. Reinsert the colon and anvil back into the peritoneal cavity. Close the access by placing the cap on the wound protector or closing incision in layers.
17. Check the orientation of the colon to avoid any twist.
18. Perform a stapled EEA anastomosis.
19. Check for two complete donuts and test the anastomosis by transanally insufflating the pouch with the pelvis submerged with saline solution.
20. Remove trocars under direct vision and close all fascial defects >10 mm.

Note This Variation

- A hand-assist technique may be used. In the hand-assist technique, a small incision is strategically placed at the beginning of the operation, and a specific hand-assist device is used to allow the introduction of the nondominant hand of the surgeon into the abdominal cavity to assist with the operation. The site is typically chosen so as the nondominant hand does not interfere with the camera. The site can also be used for the extraction of the specimen and for the performance of the extracorporeal anastomosis. In the hand-assist technique, the access incision is usually placed either in the midline (periumbilically) or in the left lower quadrant. The surgeon's hand is used to retract the small bowel, elevate the colon, and facilitate laparoscopic dissection.

Complications

- Access-related complications (bowel injury, vascular injury, and retroperitoneal injury)
- Transection of the ureter
- Perforation of the duodenum or stomach
- Laceration of the spleen
- Small bowel enterotomy
- Transection of the hypogastric nerve trunk
- Anastomotic leak

Template Operative Dictation

Preoperative Diagnosis List specific pathology indicating surgery (*see indications above*), e.g., *malignant neoplasm of the descending colon*.

Procedure Laparoscopic left hemicolectomy.

Postoperative Diagnosis List specific intraoperative findings, e.g., *malignant neoplasm of the descending colon*.

Indications This ___-year-old *male/female* patient was found to have *list specific preoperative diagnosis*. Preoperative and staging workup was completed and showed ____. *He/she* is now presenting for elective laparoscopic left hemicolectomy. The procedure, indication, alternatives, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Details of Operation The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, *he/she* was placed in the lithotomy position with the left arm tucked.

Intravenous antibiotic and subcutaneous heparin were administered. A Foley catheter was inserted. All extremities were well padded. The perineum was prepped in usual sterile fashion. The abdomen was shaved and prepped in the usual sterile fashion

[Choose One:]

A Veress needle was introduced into the abdominal cavity, and pneumoperitoneum was achieved and a 10 mm optical trocar was inserted.

An open approach was used to access the peritoneal cavity. Using the S retractors, the subcutaneous tissue was dissected all the way down to the fascia. The fascia was grasped between two Kocher clamp and opened using the 11 blade vertically. The peritoneum was then incised and the trocar placed under direct vision.

An additional 12-mm trocar was then placed under direct vision in the right lower quadrant and two additional 5-mm trocars, one on the right anterior axillary line at the level of umbilicus and another on the left anterior axillary line at the level of the umbilicus. A 5-mm trocar was placed in the suprapubic area to allow the assistant to retract the sigmoid colon.

The patient was then positioned in 30° Trendelenburg and with the patient's left side up to allow for small bowel to drop out of the operative field. The sigmoid was grasped with the assistant's hand lifted up to tent the IMA. The dissection was then started by incising the peritoneum at the level of the promontory all the way up to the ligament of Treitz. A medial-to-lateral dissection was performed to identify the left ureter and create a window between the artery and the retroperitoneum. The hypogastric plexus of nerves was identified at the level of the pelvic brim and preserved. The left ureter was identified and protected from harm's way for the entirety of the operation. The IMA was then dissected near its origin from the aorta and divided using *laparoscopic vascular stapler/energy device/clip*. The dissection was then continued in the avascular plane anterior to the Toldt fascia cephalad to the level of the ligament of Treitz and inferior border of the pancreas. The left colon was mobilized from a lateral to medial approach by incising the lateral attachments at the white line of Toldt. This dissection was carried on until it met with the medial-to-lateral dissection that had already been done. The dissection was also carried out upward to the level of the splenic flexure.

If splenic flexure mobilized*: The mobilization of the splenic flexure was performed to allow sufficient length of colon to perform a tension-free anastomosis. The patient was placed in reverse Trendelenburg position. The splenic flexure was taken down by dividing the splenocolic ligament, lifting the omentum off the distal transverse colon and joining the dissection with the mobilized descending colon laterally. Completion of the splenic flexure mobilization is then done medially by dividing the attachments of the mesentery of the transverse colon to the inferior border of the tail of the pancreas.*

The patient is repositioned in Trendelenburg. The point of distal transection is selected. The mesentery of the colon at that level was dissected with *energy device* including division of the superior hemorrhoidal vessels. The colon at that level was transected with an Endo GIA 60-mm stapling device with 3.8-mm staples. Similarly, the point of proximal transection is selected, and the mesentery is divided up to the colonic wall at that level using an *energy device*. An access incision was then made in the *Pfannenstiel manner in the suprapubic area/left lower quadrant* via *a muscle-splitting incision*. A wound protector was inserted and the specimen delivered through this access incision. The colon was transected proximally. Adequate blood supply to the anastomosis is verified by visualization of bright red blood coming from the transection site/staple line.

Preparation for the anastomosis was carried out. The anvil of 28 mm EEA stapler was introduced into the proximal colon:

[Choose One:]

- If end to end: A purse-string suture with 2-0 Prolene was performed and tightened over the anvil.
- If end to side, a colotomy is made distal to the selected transection site. The anvil of the 28 mm EEA device is then introduced into the proximal colon. The colon is then transected

at the selected site using a linear stapler. The anvil of the EEA is then brought out on the antimesenteric aspect of the descending colon a few centimeters proximal to the staple line. A 2-0 Prolene purse-string suture is used to reinforce the exit site of the anvil.

The colon and the anvil were then reintroduced back into the peritoneal cavity. The access incision was closed by placing the cap on the wound protector (or by closing the incision in layers with 3-0 Vicryl for the peritoneal layer and 2-0 PDS for the fascia using a 4:1 suture length to incisional length ratio and 5 mm bites. Reinsufflation of the abdominal cavity was carried out. The EEA stapler was then introduced into the anus following gentle dilatation and appropriate lubrication. It was guided under direct vision up to the level of the distal staple line on the rectal stump. The spike of the EEA device was then deployed to pierce the rectal stump, the anvil was then attached to this spike, and the EEA device is closed and fired to perform a stapled end-to-end anastomosis. The doughnuts produced by the EEA stapler were checked to ensure that they were complete. Furthermore, an air leak test was carried out by insufflating air gently into the rectum, while the anastomosis was bathed underwater. A clamp was placed on the proximal colon to prevent its distention. Once the anastomosis was properly tested, the patient was repositioned back in the normal anatomical position. The trocars were removed under direct vision and any fascial defects larger than 10 mm closed with 0 PDS suture on a J needle. The skin was closed with 4-0 PDS sutures in a running fashion and a dry sterile dressing is applied. The sponge and instrument count were correct, blood loss was minimal, and there were no complications. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

53 Low Anterior Resection

Irena Gribovskaja-Rupp

Indications

- Diseases of the rectosigmoid colon (diverticulosis, diverticulitis, rectosigmoid cancer)
- Carcinoma of the rectum (higher than 5 cm from the anal verge)

Essential Steps

1. Low lithotomy position with stirrups, buttocks positioned at the edge of the table.
2. Lower midline incision.
3. Explore the abdomen for metastatic disease (palpate and examine the liver and peritoneum and ovaries in female).
4. Incise the white line of Toldt to free the colon from peritoneal attachment.
5. Identify and preserve both ureters.
6. Mobilize the splenic flexure.
7. High ligation of inferior mesenteric vessels (IMA) at the takeoff from aorta for cases involving malignancy.
8. Transect the sigmoid colon.
9. Mesorectal dissection of the rectum (posterior plane first, then lateral, then anterior).
10. Verify adequate margin (palpate rectum, rigid proctoscopy to visualize tumor).
11. Transect specimen in the pelvis with a stapling device; verify adequate margin.
12. Construct stapled anastomosis.
13. Check the anastomosis for patency and integrity.
14. Bring out loop ileostomy for mid- and low rectal anastomoses.
15. Abdominal closure, ileostomy maturation.

Note These Variations

- Note and document any metastatic disease; biopsy any suspicious areas.
- Stapled anastomosis is the gold standard. Sutured anastomosis (coloanal) is a rescue technique or in case of stapler difficulty. Sewn anastomosis an alternative for sigmoid lesions with anastomoses at the top of the rectum (no pelvic dissection).
- Size of stapler/type of suture.
- Construct diverting loop ileostomy for all colorectal anastomoses less than 7 cm from anal verge.

Complications

- Injury to the ureters or bladder
- Injury to the spleen, small bowel

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_53

- presacral bleeding (in case of mesorectal dissection)
- Anastomotic leak
- High-output ileostomy

Template Operative Dictation

Preoperative Diagnosis Carcinoma of the rectum

Procedure Low anterior resection with primary anastomosis

Postoperative Diagnosis Same (*enumerate any metastatic disease found*).

Indications This ____-year-old *male/female* with *abdominal pain/bleeding/obstructive symptoms* was found to have carcinoma of the rectum located ____ cm from the anal verge. Workup with *computed tomography scan of the chest*, *abdomen, and pelvis* revealed *no evidence of metastatic disease/other*. MRI of the pelvis/endorectal ultrasound was performed. The tumor was staged T_N_M_. Patient *underwent neoadjuvant chemoradiation/did not undergo neoadjuvant chemoradiation*. Elective resection was indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, positioning, special equipment, and additional critical information prior to beginning the procedure. *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in low lithotomy position with buttocks at the edge of the table, and general endotracheal anesthesia and heparin was induced. Preoperative antibiotics and heparin were given. A Foley catheter and orogastric tube were placed. All pressure points were appropriately padded. Abdomen was prepped and draped in the usual sterile fashion.

A lower midline incision was made from above the umbilicus to the pubic symphysis. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered sharply. A wound protector was placed. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors. A mass was palpated in the distal colon/rectum* (*note any tattoos seen*). The liver, omentum, peritoneum, *and ovaries* (*if present*) were inspected for the evidence of metastatic disease. *Metastatic disease was noted ____/no metastatic disease was noted. Biopsies were taken and sent for frozen section* (*if applicable*).

The small bowel was inspected and retracted to the right using a rolled moist towel. *Self-retaining retractor was used* (*if applicable*). Using electrocautery, the colon was freed from its peritoneal attachments along the white line of Toldt proximally from the splenic flexure and distally to the pelvic inlet. Left ureter was identified and protected. Omentum was freed from the transverse colon and the splenic flexure was mobilized along the avascular plane.

With the descending colon and splenic flexure mobilized lateral to medial, the dissection turned to mesenteric examination. IMA was palpated above the sacral promontory, and a window was made in the avascular plane on both sides of it and connected bluntly. Takeoff of left colic artery was identified. Left and right ureter and gonadal vessels were visualized and protected. The IMA was taken low using *a double 0 Vicryl ligature/double seal with a LigaSure device*. A point was chosen in the descending colon (*rectal cancer*)/at least 5 cm proximal to the tumor (*colon cancer*), and the colon was transected using *a linear cutting stapling device/bowel clamp and a scalpel*.

The mesorectum was then mobilized posteriorly using sharp dissection. Care was taken to avoid presacral vessels by staying in the posterior avascular plane next to mesorectal fat. The lateral rectal stalks were divided with electrocautery using traction and counter traction. Wylie renal vein retractors and St. Mark's retractors were used to expose pelvic planes. Anteriorly the plane between the *vagina and rectum/prostate and rectum* (Denonvilliers fascia) was incised and the mesorectal plane mobilized anteriorly, being careful to avoid *seminal vesicles/bladder/vagina*. The lesion was palpable and the rectum was carefully elevated until an adequate distal margin was noted. This was confirmed with *digital rectal exam/rigid sigmoidoscopy*. At this point, a mesenteric defect was made at the level of distal rectal transection, careful not to violate the rectal wall. A stapling device was placed in the pelvis and closed on the rectum, careful to visualize left ureter and obtain adequate margin on the tumor.

[Choose One:]

If stapled: *Specimen was removed and opened on the back table to ensure adequate distal margin. The distal margin appeared adequate. The proximal colon was carefully inspected, noted to reach easily into the pelvis and to have an excellent blood supply. Mesenteric fat was cleared from the distal centimeter of proximal bowel. The field was isolated with laparotomy pads and the proximal bowel opened*. (*Typically, a 28 or 29 mm end-to-end stapler is used without sizing*.) *A purse-string suture of 2-0 prolene was placed, the anvil was inserted, and the purse-string suture was tied to ensure snug fit around the anvil*. (*All diverticuli were included in to the proximal anastomotic doughnut by sewing them to the base and incorporating them into the purse-string*.) *The circular stapler was introduced through the anus and guided under direct vision along the rectal stump. The spike was opened immediately anterior/posterior to the midportion of the staple line. The proximal bowel with anvil in place was engaged with the spike. Correct mesenteric orientation of the proximal colon was verified prior to closing the stapler. Stapler was then closed and fired under direct vision, avoiding trapping of the vaginal cuff/bladder. The anastomosis was tested for leak by filling pelvis with saline and performing air leak test by rigid proctoscopy and found to be intact. Two complete doughnuts were obtained and submitted to pathology, after being marked as proximal and distal*.

If sutured: *The proximal bowel was brought down to the pelvis and made to lie comfortably in an end-to-end fashion. Using retractors to assist with exposure, an anastomosis was then constructed using interrupted 3-0 Vicryl ± an outer layer of interrupted 3-0 Vicryl Lembert sutures. The anastomosis was checked and found to be patent and intact*.

The pelvis was then copiously irrigated. Hemostasis was again checked. *Closed suction drain can be placed in the pelvis in certain circumstances but should not be standard*.

If a diverting loop ileostomy created: *A suitably mobile loop of terminal ileum was selected and confirmed to reach to the anterior abdominal wall and the pre-determined site of ostomy marking. A window was made in the mesentery and a moist umbilical tape passed through it. Ileum was marked with two different color sutures or pen for orientation. An ellipse of skin was excised at the site of ostomy marking and the subcutaneous tissues divided vertically. Using handheld retractors, the anterior fascia was incised vertically for 3 cm. Rectus fibers were bluntly spread with a clamp and the posterior fascia was incised with care taken to protect the underlying bowel. The ostomy opening admitted 1.5 fingers. The loop of bowel was passed through and orientation confirmed. The ostomy was checked to ensure no tension or torsion. Fascia and skin were closed as below, and the ostomy was matured using 3-0 chromic/Vicryl in a Brooke fashion. An ostomy bag was applied.*

The fascia was closed with *a running interrupted suture of* ____. The skin was closed with *skin staples/subcuticular sutures of*____.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated in the operating room, and taken to the postanesthesia care unit in stable condition. There were *no immediate complications* (*if there were, describe them briefly and what was done to remedy them*).

Acknowledgment This chapter was contributed by Eanas S. Yassa, MD, and John C. Bryn, MD, in the previous edition.

54 Laparoscopic Low Anterior Resection

Georges J. Samaha and Sandy Hwang Fang

Indication

- Rectal adenocarcinoma.

Essential Steps

1. Preoperative bowel preparation, including PO antibiotics
2. Lithotomy position, both arms are tucked.
3. Foley catheter and orogastric tube.
4. If not tattooed prior to surgery, perform rigid proctosigmoidoscopy to identify 2 cm distal to the tumor.
5. Placement of trocars:
   - Periumbilical Hasson port
   - Two 5-mm trocars in the right upper and left lower quadrant.
   - One 12-mm trocar in the right lower abdomen (site for diverting ileostomy if needed).
6. Explore the abdomen for evidence of metastatic disease.
7. Place the operating table in Trendelenburg position.
8. Isolation of the inferior mesenteric artery (IMA) with a medial to lateral dissection. Identification and protection of the left ureter with a high ligation of the IMA.
9. Incise the white line of Toldt to mobilize the descending colon.
10. Retract the rectum and mesorectum anteriorly and perform a posterior mesorectal dissection with electrocautery or an energy device.
11. Identify, isolate, and protect the hypogastric nerves.
12. In a female, a stitch may be placed in the uterus to fix the uterus to the anterior abdominal wall if the uterus obstructs the anterior plane of dissection.
13. The dissection is performed circumferentially.
14. Take down the lateral attachments of the rectum avoiding injury to the hypogastric nerves within the lateral stalks.
15. Open the peritoneal reflection anteriorly, staying behind Denonvilliers' fascia, avoiding injury to the prostate and seminal vesicles in males and to the uterus and vagina in females.
16. Dissect posteriorly close to the posterior colonic wall along Waldeyer's fascia, avoiding injury of the sacral venous plexus.
17. Divide the rectum using a reticulated laparoscopic stapler at a point distal to the mass in order to obtain adequate margins.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_54

18. Create a Pfannenstiel incision, and place a wound protector.
19. Exteriorize the sigmoid colon and the rectum through the incision.
20. Divide the mesentery of the sigmoid colon.
21. Divide the colon at the level of the sigmoid. Send the specimen to pathology and check for adequacy of the distal margin (at least 1 cm distal margin for a super low tumor, 2 cm for a low rectal cancer).
22. Perform a rectal exam, dilate the anus, and measure the adequate diameter with sizers before choosing the size of the circular stapler.
23. Open the staple line of the proximal colon. Secure the anvil with a double purse-string stitch.
24. Perform a side-to-end or end-to-end anastomosis using the circular end-to-end anastomosis (EEA) stapler. (Make sure the mesentery is not twisted and the anastomosis is without tension).
25. Perform a rigid proctosigmoidoscopy and check the anastomotic line. Test the anastomosis with air insufflation, with the pelvis filled with saline.
26. Identify the ileocecal valve at this time.
27. If *ileostomy* is *elected* (*usually for a low colorectal/coloanal anastomosis*):
    - Run the small bowel proximally and identify a point around 40 cm proximal to ileocecal valve.
    - Use the 12-mm trocar site to construct an ileostomy site (site previously marked by an enterostomal nurse) and exteriorize the small bowel.
    - Relieve any tension or twist in the mesentery of the small bowel.
    - Mature the loop ileostomy in regular fashion.
28. Check for adequate hemostasis and suction all fluid in the pelvis. Place a drain in the pelvis if dissection is below the peritoneal reflection.
29. Remove all trocars under direct vision.
30. Close the Pfannenstiel incision.
31. Close skin with a running subcuticular Monocryl suture at all trocar sites and deep dermal interrupted buried knot sutures at the Pfannenstiel incision.
32. Apply a dressing and stoma appliance.
33. Extubate patient and transfer to PACU.

Note These Variations

- Cystoscopy with placement of bilateral ureteral stents by urology.
- Hand-assisted low anterior resection with a hand port established at the beginning of the operation through either a Pfannenstiel incision or a low midline incision.
- IMA and IMV may be divided at the beginning of the procedure, and the dissection can be carried medially up to the level of the splenic flexure.
- If more length is needed or if the anastomosis is under tension, the IMA/IMV may be divided and/or the transverse colon can be further mobilized in this situation.
- The diverting loop ileostomy is used for low colorectal/coloanal anastomoses.

Complications

- Injury to small bowel
- Injury to both ureters
- Laceration of the spleen or tail of the pancreas
- Injury to the hypogastric nerves
- Injury to the posterior wall of the vagina
- Anastomotic leak
- Bleeding from the presacral venous plexus
- Injury to left common iliac vessels
- Injury to the rectum itself
- Sexual dysfunction
- Urinary retention
- Stoma-related complications

Template Operative Dictation

Preoperative Diagnosis Rectal cancer s/p neoadjuvant chemoradiotherapy

Procedure (Rigid sigmoidoscopy) laparoscopic low anterior resection with colorectal stapled anastomosis. *Diverting loop ileostomy*

Postoperative Diagnosis Same

Indications The patient is ___-year-old *male/female* with a history of _______. Different treatment options were discussed with the patient. The procedure of laparoscopic (possible open) lower anterior resection was reviewed with the patient. The procedure, indication, alternatives, benefits, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

After inducing general endotracheal anesthesia; *he/she* was placed in lithotomy position with both arms tucked. Intravenous antibiotic and subcutaneous heparin were administered. An orogastric tube was inserted. All extremities were properly padded. The rectum was irrigated with normal saline and betadine. The abdmoen was prepped and draped in usual sterile fashion.

If ureteral stent: *Urology performed cystoscopy with placement of bilateral ureteral stents. Please see Dr. [Urologist's name] procedure note for further details of the procedure*.

A periumbilical Hasson port was used to access the peritoneal cavity and secured with an 0 Vicryl U stitch through the fascia. The abdomen was insufflated to 15 mmHg carbon dioxide pneumoperitoneum. The abdominal cavity was explored to rule out any metastatic disease. The liver and peritoneum were examined and no metastasis was identified. Subsequently, two 5-mm trocars were inserted in the right upper quadrant and in the left lower quadrant under direct visualization as well as a 12-mm trocar in the right lower quadrant. The patient was placed in a Trendelenburg position with the right side down. The sigmoid colon was grasped and retracted anteriorly and laterally. The inferior mesenteric artery pedicle was identified, and the peritoneum of the sigmoid mesentery was incised from the sacral promontory, superiorly to the inferior mesenteric artery. A medial to lateral dissection was performed to identify the left ureter, and the ureter was protected from harm's way. The inferior mesenteric artery was isolated and divided as a high ligation, using the laparoscopic *LigaSure/laparoscopic vascular stapler/different energy source/clip*. The left mesocolon was then lifted off the retroperitoneum from a medial to lateral approach, and blunt dissection was carried out toward the splenic flexure. The left colon was mobilized from a lateral to medial approach by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg position. The splenic flexure was taken down by dividing the splenocolic ligament.

Next, the posterior dissection of the rectum was done in the presacral space using *electrocautery/other energy device* until the levator ani muscles to complete the posterior portion of total mesorectal excision (TME) (if a low rectal tumor). Lateral dissection was performed along the right and left pelvic sidewalls. Care was taken to avoid injury to the ureters. The sacral promontory was visualized, and both hypogastric nerves were identified and protected. Using blunt dissection and electrocautery, the presacral avascular plane was developed close to the posterior rectal wall along Waldeyer's fascia. The lateral attachments of the rectum were divided. The peritoneal reflection was opened anteriorly and dissection was carried posterior to Denonvilliers' fascia. The mesentery of the rectum was taken down with a thermal device about 2 cm inferior to the tumor height.

The rectum was divided using a laparoscopic stapler. Following that a 4–6 cm Pfannenstiel incision was created. The specimen was exteriorized through the Alexis wound retractor at the incision. The sigmoid was divided with the *stapler/sharply with electrocautery*. Sizers were used to measure the diameter of the rectum and a 29-mm EEA stapler was used. A double purse-string suture was used to secure the anvil at the distal aspect of the sigmoid colon. A *side-to-end/end-to-end* stapled anastomosis was performed using the 29-mm EEA stapler. Donuts were inspected and found to be intact. The anastomosis was checked for leak using air insufflation test while performing a rigid sigmoidoscopy to visualize the anastomosis. At the end of the anastomosis, the mesentery was without twist or tension.

If diverting loop ileostomy: *The ileocecal valve was identified. The small bowel was run, and at a point 40 cm from the ileocecal valve, the small bowel was exteriorized through the right 12-mm trocar site. A loop ileostomy was fashioned matured using 3-0 Vicryl sutures*.

Hemostasis was assured. All trocars were removed under direct visualization. Closure of the Pfannenstiel incision was performed in layers with 0 Vicryl to close the peritoneum and a #1 running loop PDS for the fascia. The skin was closed using 3-0 Vicryl deep dermal interrupted stitches. 4-0 Monocryl deep dermal interrupted stitches were used to close the port sites. Skin glue was applied to the port sites, and sterile dressings were applied to the Pfannenstiel incision. An ostomy appliance was placed. All instrument, needles, and sponge counts were correct times two. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated, and was taken to the recovery unit in stable condition.

Acknowledgment This chapter was contributed by Mohammad Khreiss, M.D., and Vassiliki Liana Tsikitis, M.D., in the previous edition.

55 Robotic Low Anterior Resection

Anuradha R. Bhama and Robert K. Cleary

Indication

- Carcinoma of the rectum, not involving the anal sphincters

Essential Steps

1. Combined lithotomy–supine position.
2. Place laparoscopic/robotic cannula.
3. Explore the abdomen for metastatic disease (liver and peritoneum and ovaries in female).
4. Mobilize the mesentery from the retroperitoneum, working from medial to lateral.
5. Identify the left ureter.
6. Identify and ligate the inferior mesenteric artery.
7. Mobilize the splenic flexure.
8. Mobilize the sigmoid and descending colon from remaining attachments, working from lateral to medial.
9. Total mesorectal excision of the rectum.
10. Staple at pelvic floor.
11. Check the anastomosis for patency and integrity using leak test.
12. Diverting loop ileostomy if indicated.
13. Close the abdomen.

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Note These Variations

- Robotic or laparoscopic identification of IMA, medial to lateral dissection of left colon off retroperitoneum, mobilization of splenic flexure.
- Note and document any metastatic disease.
- Stapled vs. *sutured* anastomosis.
- *Size of stapler/type of suture.*
- *Diverting loop ileostomy.*

Complications

- Injury to the ureters
- Injury to the spleen
- Anastomotic leak

Template Operative Dictation

Preoperative Diagnosis Malignant neoplasm of the rectum

Procedure Low anterior resection with primary anastomosis

Postoperative Diagnosis Same (*enumerate any metastatic disease found*)

Indications This ____-year-old *male/female* with *abdominal pain/bleeding/obstructive symp-*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_55

toms was found to have carcinoma of the *upper/mid/lower third* of the rectum approximately ___cm from the anal verge. Workup with *computed tomography scan of the chest*, *abdomen, and pelvis* revealed *no evidence of metastatic disease/other. Endoscopic ultrasound/MRI* revealed _______ disease. The patient *did/did not* undergo neoadjuvant chemoradiation therapy. Elective resection was indicated.

Description of Procedure The patient was taken to the operating room and placed supine on the operating room table. Sequential compression device stockings were placed and subcutaneous heparin was administered. Time-outs were performed using both preinduction and preincision safety checklists to confirm correct patient, procedure, positioning, administration of IV antibiotics, VTE prophylaxis, and address any anesthesia or surgeon concerns. After the induction of general anesthesia, the patient was placed in the lithotomy position with all pressure points padded appropriately. The patient's upper extremities were tucked at both sides with pressure points padded appropriately. A urinary catheter *and an orogastric tube* were placed. The abdomen was prepped and draped in the usual sterile fashion.

Using a Veress needle/Hasson technique at the umbilicus, carbon dioxide pneumoperitoneum of 15 mmHg was obtained. A 12 mm port was placed at the midline location. A laparoscope was used to examine the abdomen to identify any iatrogenic injury and none was seen. The abdomen was explored for metastatic disease, and *note absence or presence of metastatic disease*.

Additional working cannulas were placed under direct vision. This included a 13 mm robotic cannula in the right lower quadrant, an 8 mm robotic cannula in the left lower quadrant, and an 8 mm robotic cannula in the subcostal area just to the right of the midline. A 5 mm assistant port was placed in the right upper quadrant. (*Port placement may vary based on surgeon preferences*.)

The patient was placed in steep Trendelenburg position and tilted to the right. The small bowel was retracted out of the pelvis. The patient cart was then brought *over the patient's left hip/between the legs*. The robotic arms were then attached to the instrument cannulas. The instruments were then placed under direct vision.

An incision was made in the mesentery near the origin of the inferior mesenteric artery. A plane was created between the mesentery and the retroperitoneal tissue using a combination of blunt and sharp dissection. The left ureter was identified and care was taken to avoid injury to this structure. The IMA was clipped and then divided using the Vessel Sealer®. Dissection of the colon mesentery off the retroperitoneal structures was continued cephalad and laterally. After taking down the splenic flexure, lateral to medial dissection of the sigmoid, descending colon and splenic flexure was performed, thereby fully mobilizing the left colon. *If needed to achieve adequate length of the colon to create a tension-free anastomosis*: *the inferior mesenteric vein was identified*, *clipped*, *and ligated at the inferior border of the pancreas*. The presacral space was entered and the rectum was fully mobilized to the levators posteriorly, staying in the correct plane between the presacral fascia and the fascia propria of the rectum, as well as laterally and anteriorly to ensure a total mesorectal excision with an intact mesorectal envelope. The lowermost part of the rectum devoid of mesorectum was well below the neoplasm, and the lower rectum was transected using the robotic stapler approximately 4–5 cm above the anal verge. The mesentery was then taken down with the vessel sealer from point of transection inferior mesenteric vessels to the mid descending colon where the bowel was soft and pliable (well out of the radiation field). Fluorescent imaging at this time confirmed viability of the proposed segment of descending colon to be used for the anastomosis. This concluded the robotic part of the operation. The transected end of the rectum was grasped with a laparoscopic locking grasper under vision.

The robotic instruments were removed under direct vision. The robotic arms were detached from the trocars and the robot removed from the patient. The robot remained sterile in case docking was required to suture repair any leak of the anastomosis. A small Pfannenstiel incision was made, carried through the subcutaneous tissue, fascia, and peritoneum. A wound protector was placed.

The proximal end of the divided rectum was brought through the wound protector to the mid descending colon that was previously cleared. *A purse-string clamp was placed on the descending colon. A 2-0 nylon on a Keith needle was passed through the purse-string clamp, and a heavy scissor was used to transect the colon distal to the clamp*. The specimen was then handed off for permanent pathology. A *___mm EEA stapler* was chosen for the circular stapled anastomosis. The purse-string clamp was removed, and the anvil was placed within the descending colon. The purse-string suture was cinched down and tied around the anvil. The anvil and descending colon were returned to the abdominal cavity, and pneumoperitoneum was reinstituted. The perineal operator then went below. The circular stapler was introduced per anum. The spike was introduced *anterior/posterior* to the staple line. The anvil on the descending colon was attached to the circular stapler and the circular stapler was closed and fired, thereby creating a laparoscopic colorectal anastomosis between the mid descending colon and lower rectum. Two complete donuts were obtained from the stapling mechanism. Flexible sigmoidoscopy was performed. This revealed an anastomosis that was widely patent, without tension, and clearly viable. It was tested for leak with air insufflation, saline in the pelvis, and occlusion of the proximal colon, and no leak was noted.

The pelvis was irrigated with warm saline and hemostasis was complete. Again, inspection of the abdomen and pelvis revealed no other apparent abnormalities.

If a loop ileostomy is created: Inspection *of the abdomen and pelvis revealed that hemostasis was complete. A loop of ileum about 15–20 cm proximal to the ileocecal valve was chosen for the diverting loop ileostomy. A circular incision was made in the skin at the previously marked site*, *carried through the subcutaneous tissue*, *and an incision was made in the fascia. The peritoneum was incised and two fingerbreadths of fascia opening was made for the stoma site. Taking care to ensure proper orientation*, *the distal ileum was brought through the stoma site using laparoscopic visualization. A Babcock clamp was placed on the ileum to prevent retraction back into the abdominal cavity. The loop of ileum was left at this location and matured after wound closure*.

The 13 mm trocar site fascia in the right lower quadrant was closed with 0 Vicryl suture. The camera port fascia was similarly closed with 0 Vicryl suture. The peritoneum of the Pfannenstiel incision was closed with running 2-0 Vicryl and the fascia over the muscle was closed with 2-0 Vicryl suture. The subcutaneous tissue was irrigated with warm saline. All skin wounds were closed with running subcuticular 4-0 Monocryl followed by the application of Dermabond. Attention was then placed to the stoma, which was matured in the usual Brooke fashion as a loop ileostomy with interrupted 4-0 Vicryl. The stoma was clearly viable and without tension. A stoma appliance was placed it.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then taken out of lithotomy position, extubated, and taken to the recovery room in stable condition. The patient tolerated the procedure well with no immediate complications.

Hartmann's Procedure

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Naina Bagrodia and Muneera R. Kapadia

Indications

- Complicated diverticulitis (i.e., perforation) or recurrent diverticulitis
- Rectosigmoid carcinoma (management of obstruction, perforation, or bleeding in an emergency setting or for cure or palliation in an elective situation)
- Other situations necessitating sigmoid resection in which conditions are not favorable for anastomosis (i.e., patients who are hemodynamically unstable during the operation, who are malnourished, who are severely immunocompromised, or who have poor fecal continence).

Essential Steps

1. Midline incision.
2. Explore the abdomen.
3. Incise the white line of Toldt to free the sigmoid colon and descending colon from its peritoneal attachments.
4. Identify and protect the ureters.
5. Divide the colon proximally and distally to the pathology.
6. Ligate the mesenteric vessels and intervening mesentery.
7. Remove the specimen.
8. Create ostomy site and deliver the proximal colon.
9. Close the abdomen.
10. Mature the colostomy.

Note These Variations

- Mobilization of the splenic flexure is optional.
- Primary anastomosis with or without diverting loop ileostomy is an alternative in some situations.

Complications

- Ureteral injury
- Splenic injury

Template Operative Dictation

Preoperative Diagnosis *Complicated diverticular disease/rectosigmoid carcinoma/other*

Procedure Left colon resection with end colostomy (Hartmann's procedure)

Postoperative Diagnosis Same.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_56

Indications This is a ___-year-old *male/female* who presents with *abdominal pain/fever/obstructive symptoms/recurrent bouts of diverticulitis* and was found to have *an acute perforation of the sigmoid colon/other. Elective/emergent* resection was indicated.

Description of Procedure The patient was placed in the supine position and general endotracheal anesthesia was induced. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Preoperative antibiotics and subcutaneous heparin were given. A urinary catheter and orogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made from *above the umbilicus to the pubis*. This was deepened through the subcutaneous tissues to the level of the fascia. The linea alba was identified and incised, and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors/under direct vision with electrocautery. A sigmoid colon perforation with purulence in the left lower quadrant/a mass in the sigmoid colon/other* was found.

The small bowel was inspected and retracted toward the right upper quadrant using a moist towel and the (*Bookwalter/Thompson/Omni/Kirschner*) retractor system. The sigmoid colon and descending colon were then mobilized by incising along the white line of Toldt proximally from the pelvic inlet toward the splenic flexure. The left ureter was identified and protected.

Points of transection were selected proximally (*usually the descending colon or proximal sigmoid colon*) and distally (*usually proximal rectum*) to the affected bowel. Proximally, a mesenteric defect was created, and the colon was divided with a linear cutting stapler. The distal point of transection was divided in a similar fashion using a *linear/curved cutting* stapler. The peritoneum overlying the mesentery was then scored with electrocautery, and the *inferior mesenteric artery/sigmoid vessels was/were* identified, double ligated with 2-0 Vicryl sutures, and transected. The remaining intervening mesentery between the colonic transection points was divided and ligated. The specimen was removed and sent to pathology. The abdominal cavity was then copiously irrigated.

The proximal colon reached easily to the proposed colostomy site without tension. A ___-cm circular disk of skin was excised from the colostomy site in the *left lower quadrant/other location*. The incision was deepened through all of layers of the abdominal wall. The anterior rectus sheath was incised vertically, and the muscle was bluntly split. The posterior rectus sheath and peritoneum were incised vertically and the resultant defect was dilated to admit *two/three* fingers. A Babcock clamp was advanced through the colostomy skin incision into the abdominal cavity and used to grasp the stapled proximal bowel. The colon was passed out through the ostomy site without torsion or tension.

The fascia was closed with *a running/ interrupted suture of* ____. The skin was closed with *skin staples/subcuticular sutures of ___/other*. The staple line was removed from the proximal colon, and the colostomy was then matured using multiple 3-0 Vicryl sutures in an interrupted fashion. Dressings were applied and an ostomy bag was applied over the colostomy.

The patient was awoken and extubated. *She/he* tolerated the procedure well and was taken to the postanesthesia care unit in stable condition. All counts were correct at the completion of the procedure.

Acknowledgment This chapter was contributed by Carol E.H. Scott-Conner, MD, in the previous edition.

Reversal of Hartmann's Procedure

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Naina Bagrodia and Muneera R. Kapadia

Indication

- Restoration of bowel continuity once the original pathologic process necessitating Hartmann's procedure has subsided.

Essential Steps

1. Preoperative study to evaluate the Hartmann's pouch, including either a flexible sigmoidoscopy and/or a contrast enema.
2. Position patient in modified lithotomy or split-leg position.
3. Remove ostomy appliance, and cover the colostomy with gauze to prevent contamination of the surgical field.
4. Midline incision through previous laparotomy scar.
5. Identify the Hartmann's pouch and free it from surrounding adhesions.
6. Reduce colostomy into abdomen.
7. Mobilize the left colon as needed to create enough length for a tension-free anastomosis.
8. Assess both ends of bowel for perfusion/viability and freshen ends as needed.
9. Create tension-free anastomosis via (a) end-to-end anastomotic stapler (EEA stapler) or (b) end-to-end hand-sewn anastomosis.
10. Test anastomosis for air leak by insufflating the rectum while submerging anastomosis in saline.
11. Confirm hemostasis.
12. Close both the midline laparotomy incision and previous colostomy incision.

Note These Variations

- Type of anastomosis: EEA stapler or end-to-end hand-sewn anastomosis.
- Temporary diverting loop ileostomy.

Complications

- Ureteral injury
- Wound infection
- Anastomotic stricture
- Anastomotic leak

Template Operative Dictation

Preoperative Diagnosis *End colostomy and Hartmann's pouch*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_57

Procedure Reversal of Hartmann's procedure

Postoperative Diagnosis Same

Indications This is ___-year-old *male/female* that underwent a Hartmann's procedure with end colostomy for ____ on __/__/__ and presents today for colostomy reversal and restoration of bowel continuity.

Description of Procedure The patient was taken to the operating room and placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. A Foley catheter and an orogastric tube were placed. Preoperative antibiotics were given. The patient was repositioned in the modified lithotomy position with stirrups and care was taken to pad all pressure points. The colostomy appliance was removed. The patient's abdomen and perineum were then prepped and draped in the usual sterile fashion. The colostomy was covered.

A midline laparotomy incision was made through the previous midline scar. The incision was deepened through the subcutaneous tissues, the fascia was identified and incised, and the peritoneal cavity was entered. The abdomen was explored, and adhesions were lysed using a combination of sharp and blunt dissection. A self-retaining abdominal retractor was placed, and the small bowel was packed into the right upper quadrant. The Hartmann's pouch was identified in the pelvis and appeared healthy.

Attention was then turned towards the colostomy takedown. An incision was made around the colostomy, and was deepened through the subcutaneous tissues. The colostomy was freed from its surrounding attachments, taking care to avoid injury to the bowel wall. Once the colostomy was completely freed, it was returned to the abdomen. *The proximal colon was found to reach the pouch without tension/the left colon was mobilized by incising the white line of Toldt up to the splenic flexure, allowing the proximal colon to reach the pouch without tension.* The proximal colon end was freshened by removing the distal 2 cm.

A tension-free anastomosis was created between the proximal and distal colon in the following manner:

Choose One

If using an EEA stapler: *A purse-string stitch using 2-0 Prolene was placed in the proximal end of the colon and fastened around the __ Fr EEA anvil. An EEA sizer was used to dilate the rectum and confirm the absence of any stricture. A __ Fr EEA stapler was carefully advanced by an assistant from below to the proximal end of the rectal stump. The pin was advanced through the Hartmann's pouch. The anvil was married to the stapler and fired. The stapler was removed, and two complete, intact rings of tissue retained in the stapler were noted.*

If using hand-sewn anastomotic technique: *A hand-sewn anastomosis was created in one/two layers using interrupted 3-0 Vicryl sutures in an interrupted/running fashion.*

The pelvis was filled with irrigation and the proximal left colon was occluded. Proctoscopy was performed from below, insufflating the rectosigmoid and *no air bubbles were identified/describe other findings.*

If temporary loop ileostomy: *A 3-cm circle of the skin is excised in the abdominal wall to the right upper/lower quadrant overlying the rectus muscle. The incision is deepened through the subcutaneous fat to the anterior fascia, which was divided vertically. The fascial opening was widened to allow two fingers to pass. A distal loop of ileum was passed through the opening, taking care to not twist the intestine. (After abdominal wall/wound closure: the loop of ileum was opened transversely and matured in a Brooke fashion using multiple interrupted 3-0 Vicryl stitches. An ostomy appliance was then placed over the loop ileostomy).*

The self-retaining retractor was removed. Hemostasis was confirmed. The fascia of the midline incision and previous colostomy site were closed with a running suture of *looped #1-PDS/other*. The skin was closed with *skin staples/run-*

ning subcuticular stitch using 4-0 Monocryl suture/other. The previous colostomy incision was loosely closed using *staples/a 4-0 Monocryl subcuticular stitch in a purse-string fashion and packed with gauze/other*. Dressings were applied.

All counts were correct at the completion of the procedure. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was awoken and extubated. *He/she* tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Samy Maklad, M.D., and John W. Cromwell, M.D., in the previous edition.

58 Laparoscopic Closure of Hartmann's Procedure

Chady Atallah and Sandy Hwang Fang

Indications

Elective closure of previous Hartmann's procedure performed for:

- Perforated diverticulitis, carcinoma, penetrating trauma, bleeding, inflammatory bowel disease, ischemia, or infection
- Anastomotic leak following prior left hemicolectomy, sigmoidectomy, or anterior resection requiring conversion to Hartmann's procedure
- Prior colon resection in hemodynamically unstable, severely malnourished, or immunocompromised patients

Essential Steps

1. Preoperative endoscopy/gastrografin enema.
2. Lithotomy position, both arms are tucked.
3. Foley catheter and orogastric tube.
4. If short rectal stump on preoperative evaluation, multiple prior abdominopelvic operations, and then stent both ureters.
5. Close the colostomy with a running locking stitch and make a skin incision around the colostomy site.
6. Dissect around the colostomy in the subcutaneous plane until the fascia is reached.
7. Dissect the bowel circumferentially and free it from the abdominal wall.
8. Perform a limited lysis of adhesions through the stomal wound.
9. Inspect the visualized portion of the colon and remove all fatty tissue, the mesenteric border and the epiploic appendages from the distal edge of the colon.
10. Establish purse-string and place anvil of circular EEA stapler.
11. Reduce descending colon back inside abdominal cavity.
12. Place an extra small Alexis wound retractor through the previous colostomy takedown site and secure around a 12-mm port to establish pneumoperitoneum.
13. Under direct visualization, place three trocars in the right lower quadrant (12 mm), supraumbilical area (5 mm), and right mid abdomen (5 mm).
14. Lyse adhesions as needed for adequate bowel mobilization.
15. Mobilize the splenic flexure to ensure a tension-free anastomosis (needed in most cases).
    - Place the patient in the reverse Trendelenburg position.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_58

- Mobilize the left colon from the lateral to medial approach by incising the lateral attachments at the white line of Toldt.
- Take down the splenic flexure by lifting the omentum off the distal transverse colon and joining the dissection with the medially mobilized descending colon.

16. Identify the rectal stump and free it from any surrounding adhesions. Make sure to protect the bilateral ureters from the rectal stump.
17. Resect the top portion of the rectal stump to healthy-appearing rectum with an Endo GIA stapler.
18. Identify rectal stump by bringing a rectal dilator transanally and advance to the top of the rectal stump.
19. Remove dilator and advance circular EEA stapler transanally and perform an end-to-end stapled colorectal anastomosis.
20. If the colorectal anastomosis is low, consider performing a diverting loop ileostomy.
21. Test the anastomosis by insufflating the rectum transanally with the pelvis submerged in saline solution.
22. Irrigate and suction the pelvis.
23. Consider a pelvic drain if extensive pelvic dissection or prior radiation.
24. Remove all trocars and close the fascia of the 12-mm trocars.
25. Close the skin wounds except for the prior stoma site which is partially approximated and a Penrose drain is left within the wound for adequate drainage.

Note These Variations

- In a minority of patients, completion proctectomy of the rectal stump is necessary with a coloanal anastomosis (i.e., in the case of multiple prior pelvic operations, extensive pelvic fibrosis).
- Splenic flexure mobilization is commonly, but not always, needed for tension-free anastomosis.
- An alternative technique involves starting with insertion of the trocars and establishing pneumoperitoneum, followed by intra-abdominal colostomy dissection and bowel mobilization.
- A single-incision Hartmann's reversal laparoscopic procedure can be performed using the existing colostomy as the entry point, without need for additional ports.

Complications

- Transection of the ureter
- Laceration of the spleen
- Small bowel enterotomy
- Transection of the hypogastric nerve trunk
- Anastomotic leak
- Severe bleeding
- Wound infection and complications (especially at the colostomy site)
- Need for conversion to open procedure if extensive intra-abdominal adhesions and fibrosis are encountered

Template Operative Dictation

Preoperative Diagnosis Prior sigmoidectomy with Hartmann's procedure for _____

Procedure Laparoscopic closure of Hartmann's pouch

Postoperative Diagnosis Same

Indications The patient is a _____-year-old *male/female* with a history of _____. Different treatment options were discussed with the patient. The procedure of laparoscopic possible open closure of Hartmann's procedure was reviewed with the patient. The procedure, indication, alternatives, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, he/she was placed in the lithotomy position with both arms tucked. Intravenous antibiotic and subcutaneous heparin were administered. A Foley catheter and an orogastric tube were inserted. *(If ureteral stents are needed, then cystoscopy and bilateral ureteral stents are performed at this stage.)* All pressure points were properly padded. The rectum was irrigated with normal saline and Betadine. The abdomen was shaved and prepped in the usual sterile fashion.

The colostomy was closed with a 2-0 Vicryl running locking suture. A skin incision was made with the cut mode of electrocautery around the colostomy site. Dissection was carried in the subcutaneous plane until the fascia was reached and the bowel is dissected circumferentially and freed from the abdominal wall. Limited adhesiolysis was performed through the stomal wound. The distal edge of the colostomy was visually inspected, and all fatty tissues, the mesenteric border and the epiploic appendages, were removed. The colostomy was resected with a GIA stapler, leaving healthy-appearing colon. A 2-0 Prolene suture was used as a purse-string and the anvil of a (28–34-mm range) circular EEA stapler was placed and the purse-string was tied. The descending colon was reduced inside the abdominal cavity. An extra small Alexis wound retractor was placed into the colostomy takedown site and secured around a 12-mm trocar with tied suture. Pneumoperitoneum was established. Under direct visualization, three trocars were placed in the right lower quadrant (12 mm), supraumbilical area (5 mm), and right mid abdomen (5 mm). Adhesiolysis was performed. Splenic flexure mobilization was performed to ensure a tension-free anastomosis.

The patient was placed in the reverse Trendelenburg position, and the left colon was mobilized from a lateral to medial approach by incising the lateral attachments at the white line of Toldt. The splenic flexure was taken down by lifting the omentum off the distal transverse colon and joining the dissection with the mobilized descending colon.

The patient was positioned in the Trendelenburg position again. The rectal stump was mobilized making sure that the bilateral ureters were protected from harm's way. The top of the rectal stump was resected to healthy-appearing rectum. The dilator was exchanged for a circular EEA stapler and a stapled *end-to-end/end-to-posterior rectal side* anastomosis was performed under direct visualization. The anastomosis was tested by insufflating the rectum transanally after submerging the pelvis with saline solution and gently occluding the proximal descending colon. No air leak was noted (or a leak was noted at the _____ side of the anastomosis. 3-0 silk/Vicryl interrupted Lembert sutures were placed). The pelvis was irrigated and suction. *A 19-French closed suction drain was placed in the pelvis through the right lower quadrant trocar site and secured to the skin with 2-0 nylon suture*. Under direct visualization with the camera through the 12-mm prior stoma site, all trocars were removed.

The skin was closed with subcuticular 4-0 Monocryl sutures. The port and Alexis retractor at the stoma site were removed and the anterior fascia was closed with figure-of-eight 1 PDS sutures and the skin was partially approximated with 3-0 Vicryl deep dermal interrupted buried knot stitches. A Penrose drain was inserted through the ends of the colostomy takedown site for drainage. Sterile dressings were applied. At the end of the case, needle, sponge, and instrument counts were correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated, and was taken to the recovery unit in stable condition.

Acknowledgment This chapter was contributed by Maher A. Abbas, MD, in the previous edition.

59 Subtotal Colectomy with Ileostomy and Hartmann's Pouch

Courtney L. Olmsted and Muneera R. Kapadia

Indication

- Emergency resection for lower gastrointestinal bleeding, ischemia, intractable colitis, or toxic megacolon when primary anastomosis is inadvisable

Essential Steps

1. Midline incision.
2. Explore the abdomen.
3. Mobilize the right colon:
   - Incise the lateral peritoneal reflection to the right colon from the cecum to hepatic flexure.
   - Separate the right colon from the retroperitoneum.
   - Identify and protect the right ureter and duodenum.
4. Mobilize the transverse colon by separating the greater omentum from the colon.
5. Mobilize the splenic flexure and left colon:
   - Incise the lateral peritoneal reflection to the left colon from the splenic flexure to the sigmoid colon.
   - Separate the left colon from the retroperitoneum.
   - Identify and protect the left ureter.
6. Identify points of transection at the terminal ileum and rectosigmoid colon.
7. Divide the terminal ileum with a linear cutting stapler.
8. Score the peritoneum overlying the intended line of mesenteric division.
9. Ligate and divide the mesenteric vessels sequentially from the terminal ileum to the sigmoid colon.
10. Identify the point of division on the rectosigmoid colon (in general above the peritoneal reflection, at the point where taeniae splay to form a continuous longitudinal muscle layer).
11. Divide the rectosigmoid colon with a linear cutting stapler and remove the specimen.
12. Check hemostasis.
13. Create an abdominal wall defect in the right lower quadrant for ileostomy (preferably at a site previously chosen in conjunction with a stoma nurse).
14. Pass the terminal ileum through abdominal wall ensuring that the bowel is not twisted.
15. Close the abdomen.
16. Mature the ileostomy in a Brooke fashion.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_59

Note These Variations

- Level of distal transection varies depending upon pathology.
- Hartmann's pouch may be tacked to the presacral fascia or marked with long monofilament suture.

Complications

- Necrosis of ileostomy
- Small bowel obstruction
- Rectal stump blowout

Template Operative Dictation

Preoperative Diagnosis *Lower gastrointestinal bleeding/intractable colitis/toxic megacolon*

Procedure Subtotal colectomy with end ileostomy

Postoperative Diagnosis Same

Indications This ____-year-old *male/female* had *lower gastrointestinal bleeding/colitis/other* found on workup with *colonoscopy/sigmoidoscopy/CT scan/angiography. It was not amenable to/The patient failed* medical management; therefore, surgical resection was required.

Description of Procedure The patient was placed in the supine position and anesthesia monitors were placed. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. *A Foley catheter and an orogastric tube were placed.* The abdomen was prepped and draped in the usual sterile fashion. A vertical midline incision was made and deepened through the subcutaneous tissues. The linea alba was identified, sharply incised, and the peritoneal cavity entered. *Adhesions were lysed under direct vision.*

The abdominal cavity was explored and inspected for gross abnormalities *(detail appearance of the colon and extent of disease).* The small bowel was inspected for evidence of disease and was found to be *normal/describe other findings*.

The right colon was mobilized by incising the peritoneal attachment from the cecum to the hepatic flexure. The colon and terminal ileum were mobilized medially, separating the right colon from the retroperitoneum, and care was taken to protect the duodenum and right ureter. The greater omentum was separated from the transverse colon, entering the lesser sac. The lateral peritoneal attachment of the left colon was then incised from the sigmoid colon to the splenic flexure. The left colon was mobilized medially. Care was taken to protect the left ureter.

Points of division on the terminal ileum and rectosigmoid colon were then chosen. The terminal ileum was divided with a linear cutting stapler. The colonic mesentery was scored and divided sequentially. Mesenteric vessels were secured with *2-0 suture ligatures/a vessel sealer*. The colon was divided at the rectosigmoid junction. The specimen was then removed. Hemostasis was assured. The rectal stump *was/was not* marked with a nonabsorbable monofilament suture.

Attention was then turned to the right lower quadrant. A disk of skin was excised *at the previously marked site (if patient's ileostomy site was marked preoperatively)*. The subcutaneous tissues and anterior fascia were divided vertically. The rectus muscle was split and the posterior sheath and peritoneum were incised vertically. The opening created in the abdominal wall was sufficient to pass *two/three* fingers. The ileum was passed through this opening and determined to lie comfortably without tension nor torsion. *(If tension was appreciated, describe method used to release the tension.)* The fascia was closed with *a running/interrupted suture of* ____. The skin was *left open/closed with skin staples/subcuticular sutures of ____/other*.

A dressing was placed over the incision and attention was given to creation of the ostomy. The ileostomy was matured using the Brooke ileostomy technique with multiple interrupted sutures of ____ *absorbable polyfilament/monofilament*. A well-vascularized, everted ileostomy with good protrusion was produced, and an ostomy appliance was placed. All final needle, sponge, and surgical instrument counts were correct at the end of the case.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the *postanesthesia care unit/surgical intensive care unit* in stable condition.

Acknowledgment This chapter was contributed by Samy Maklad, MD, and John W. Cromwell, MD, in the previous edition.

60 Laparoscopic Subtotal Colectomy with Ileostomy and Hartmann's Pouch

Georges J. Samaha and Sandy Hwang Fang

Indications

- Fulminant colitis
- Acute lower gastrointestinal hemorrhage
- Ulcerative colitis
- Clostridium difficile colitis

Essential Steps

1. Lithotomy position, both arms are tucked.
2. Foley catheter and orogastric tube.
3. 15mm Hg pneumoperitoneum.
4. Place five trocars.
   - Three 5-mm trocars in the right upper, left upper, and left lower abdomen.
   - Two 12-mm trocars in the right lower quadrant (at the marked ileostomy site) and camera port. Place the table in Trendelenburg position, with right side down. The surgeon stands at the patient's right side with the assistant.
5. Retract the sigmoid colon anteriorly and laterally and identify the inferior mesenteric artery.
6. Score the sigmoid mesentery at the level of the sacral promontory and perform a medial to lateral dissection to identify the left ureter and isolate the inferior mesenteric artery.

   Identify and protect the left ureter and gonadal vessels.
7. Isolate the inferior mesenteric artery and divide using a vascular stapler, an energy source, or clips, avoiding injury to the ureter.
8. Identify the inferior mesenteric vein which is divided in a similar fashion.
9. Mobilize the left colon from the lateral to medial approach by incising the lateral attachments at the white line of Toldt (this step can precede the inferior mesenteric artery dissection in a lateral to medial technique).
10. Place the patient in the reverse Trendelenburg position.
11. Take down the splenic flexure by retracting the omentum cephalad, dividing the splenocolic ligament, and taking down the avascular plane between the omentum and colon. Join the dissection with the medially mobilized descending colon.
12. Place the table in Trendelenburg position, with the left side down. The surgeon stands on the patient's left side with the assistant.
13. Lift the cecum anteriorly and identify the ileocolic artery and vein. Open a mesenteric window on both sides of these vascular structures. Perform a medial to lateral dissection

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_60

to keep the duodenum down toward the spine and away from the ileocolic vessels.

14. Divide the ileocolic vessels using a vascular stapler, an energy source, or clips.
15. Lift the right mesocolon off the retroperitoneum and dissect bluntly in this medial to lateral plane toward the hepatic flexure.
16. Mobilize the ascending colon from a lateral to medial approach by incising the lateral attachments at the white line of Toldt.
17. Place the patient in reverse Trendelenburg position and take down the hepatic flexure by dividing the hepatocolic ligament.
18. Continue to take down the gastrocolic ligament to mobilize the transverse colon.
19. Divide the terminal ileum just proximal to the ileocecal valve using a laparoscopic Endo GIA.
20. Take down the remaining mesentery with an energy device. Identify and divide the middle colic vessels (right and left branches).
21. Transect the rectosigmoid junction with an Endo GIA stapler after taking down the mesorectum posteriorly.
22. Extract the colon through an extra small Alexis wound retractor at the right lower quadrant port that was previously marked as the ileostomy site.
23. Remove all trocars under direct camera visualization and close the fascia of the 12-mm right lower quadrant and camera trocars.
24. Close the skin at the trocar sites.
25. Fashion an end ileostomy.

Note These Variations

- Hand-assisted subtotal colectomy with a hand port established at the beginning of the operation through a Pfannenstiel's incision.
- All five trocars can be 5 mm if no stapling is necessary (energy source is used for vascular pedicle division).
- For fulminant colitis, a large Malecot catheter may be placed transanally into the rectal stump, in order to prevent rectal stump blowout.

Complications

- Transection of the ureter
- Perforation of the duodenum or stomach
- Laceration of the spleen
- Small bowel enterotomy
- Stoma related complications
- Transection of the hypogastric nerve trunk

Template Operative Dictation

Preoperative Diagnosis Fulminant colitis, ulcerative colitis, *Clostridium difficile* colitis, and lower gastrointestinal bleeding

Procedure Laparoscopic subtotal colectomy with end ileostomy and Hartmann's pouch

Postoperative Diagnosis Same

Indications The patient is a ______-year-old *male/female* with a history of ______. Different treatment options were discussed with the patient. The procedure of laparoscopic (possible open) subtotal colectomy with end ileostomy and Hartmann's pouch was reviewed with the patient. The procedure, indication, alternatives, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, he/she was placed in the lithotomy position with both arms tucked.

Intravenous antibiotic and subcutaneous heparin were administered. A Foley catheter and an orogastric tube were inserted. All extremities were well padded. The rectum was irrigated with normal saline and Betadine. The abdomen was shaved and prepped in the usual sterile fashion.

The peritoneal cavity was accessed with a Hassan port and carbon dioxide pneumoperitoneum of 15 mmHg was established. Under direct visualization, a 12-mm trocar was placed in the right lower quadrant at the planned ileostomy site, followed by 5-mm trocars in the right upper, left upper, and left lower abdomen. The patient was placed in the Trendelenburg position with right side down. The sigmoid colon was grasped and retracted anteriorly and laterally. The inferior mesenteric artery pedicle was identified, and the sigmoid mesentery was scored from the sacral promontory, superiorly to the inferior mesenteric artery. A medial to lateral dissection was performed to identify the left ureter and protect it from harm's way for the entirety of the operation. The sigmoid vessels were isolated and divided. The inferior mesenteric artery was isolated and divided using a *laparoscopic vascular stapler/energy device/clip*. Next the inferior mesenteric vein was identified, isolated, and divided in a similar fashion. The left mesocolon was then lifted off the retroperitoneum from a medial to lateral approach and blunt dissection was carried out toward the splenic flexure. The left colon was mobilized from a lateral to medial approach by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg position. The splenic flexure was taken down by dividing the splenocolic ligament, lifting the omentum off the distal transverse colon and joining the dissection with the mobilized descending colon. The patient was placed in Trendelenburg position the left side down. The cecum was lifted anteriorly and the ileocolic vessels were isolated by creating mesenteric windows on each side. A medial to lateral dissection was performed. The duodenum was identified and protected. The ileocolic vessels were divided with the laparoscopic vascular stapler. The right mesocolon was lifted off the retroperitoneum and blunt dissection was carried from a medial to lateral approach toward the hepatic flexure. The ascending colon was mobilized medially by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg and the hepatic flexure was taken down. The dissection was carried on to join the mobilized transverse colon. The transverse colon was lifted anteriorly, and the remaining mesentery was taken down with the energy device (a vascular stapler may be used) while identifying the middle colic vessels. At the rectosigmoid junction, the posterior mesorectum was taken down. An EndoGIA stapler was fired. The specimen was extracted through the right lower quadrant port using an extra small Alexis wound retractor. The specimen was transected at the terminal ileum. The specimen was sent for pathological evaluation. The trocar site skin wounds were closed with 3-0 Vicryl suture in a subcuticular fashion. An end Brooke ileostomy was matured using 3-0 Vicryl sutures. Stoma appliance was placed. At the end of the case, the needle, sponge, and instrument counts were correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the recovery unit in stable condition.

Acknowledgment This chapter was contributed by Maher A. Abbas, MD, in the previous edition.

Subtotal Colectomy for Lower Gastrointestinal Bleeding

61

Matthew B. Wilkinson and Celia M. Divino

Indications

- Bleeding from the lower gastrointestinal tract for which the location within the colon cannot be determined
- Bleeding from the lower gastrointestinal tract that is refractory to nonoperative treatment measures
- Bleeding from the lower gastrointestinal tract due to diffuse diverticular disease
- Bleeding from the lower gastrointestinal tract that is either nonlocalized by radiologic or endoscopic means or cannot otherwise be controlled

Essential Steps

1. Make a vertical laparotomy incision in the midline.
2. Explore all four quadrants of the abdominal cavity.
3. Mobilize the right colon:
   - Make a division in the lateral peritoneal reflection and extend this opening from the cecum to the hepatic flexure. Take down any adhesions between the retroperitoneum and colon. Identify and protect the duodenum and right ureter from injury.
4. Mobilize the transverse colon by dividing the greater omentum near the colon.
5. Mobilize the splenic flexure and left colon:
   - Make a division in the lateral peritoneal reflection and extend this opening from the splenic flexure to the sigmoid colon. The left colon should be reflected medially by taking down any adhesions between it and the retroperitoneum.
   - Identify points of transection on the terminal ileum and rectosigmoid colon.
6. Identify the point of intended transaction of both the rectosigmoid colon and the terminal ileum.
7. Use a linear-cutting stapler to divide the terminal ileum.
8. Use electrocautery to score the peritoneum overlying the intended line of mesenteric resection.
9. Use 2-0 ties and suture ligatures or, alternatively, an electronic vessel-sealing system, to divide the mesentery.
10. Plan the site of intended division of the rectosigmoid colon (most commonly, above the peritoneal reflection at the point where the taenia fuse to form a single longitudinal muscular layer on the rectum).

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_61

11. Divide the rectosigmoid junction with a linear-cutting stapler and remove the specimen.
12. Obtain hemostasis.
13. *If using staplers to create the anastomosis*:
    - *Bring together the stapled ends of the terminal ileum and rectosigmoid colon.*
    - *Place two stay sutures with 3-0 silk.*
    - *Use electrocautery to make enterotomies.*
    - *Place a linear-cutting stapler across the common wall and fire (caution should be taken to ensure that no mesentery protrudes into the intended staple line).*
    - *Inspect the staple line for hemostasis. Use gentle electrocautery, as needed, along the staple line to ensure hemostasis.*
    - *Use either a linear-cutting stapler or two-layer suture closure to close the remaining enterotomies.*
14. *If using sutures to create the anastomosis*:
    - *Bring together the end of the rectosigmoid colon and the antimesenteric border of the terminal ileum.*
    - *Create a two-layered anastomosis between the rectosigmoid stump and the antimesenteric border of the terminal ileum. For the inner layer, use running or interrupted 3-0 Vicryl and for the outer layer, use interrupted 3-0 silk.*
15. Check the luminal size and integrity of the anastomosis. Ensure there is no tension or torsion of the anastomosis.
16. Obtain hemostasis.
17. Irrigate the abdomen.
18. Place drains, if desired.
19. Close the midline wound in layers.

Note These Variations

- Primary anastomosis versus diverting ileostomy with Hartmann's pouch or mucus fistula
- Stapled versus sutured anastomosis

Complications

- Ureteral or duodenal injury
- Recurrent bleeding
- Anastomotic leak
- Abscess

Template Operative Dictation

Preoperative Diagnosis Lower gastrointestinal bleed

Procedure Subtotal colectomy with ileoproctostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed bright red blood from the rectum, and on workup with *tagged red blood cell scan/sigmoidoscopy/colonoscopy/angiography* was found to have *angiodysplasia/diverticular disease/indeterminate colonic source* refractory to blood transfusion and conservative management. After a full discussion was held with the patient regarding the potential risks, potential benefits, and alternative treatment options to surgery, *he/she* ultimately consented to subtotal colectomy with ileocolonic anastomosis for definitive management.

Description of Procedure The patient was properly identified in the holding area and taken to the operating room. *Epidural catheter was placed for postoperative pain relief.* The patient was placed in the supine on the operating room table, and sequential compression stockings were placed bilaterally. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The abdomen was prepped and draped in the usual sterile fashion. An IV line was inserted, general anesthesia was induced, and the patient was successfully intubated. Perioperative antibiotics were given. A Foley catheter was placed in the patient's urinary bladder utilizing sterile technique.

A vertical midline incision was made. This was deepened through the subcutaneous layer, and hemostasis was achieved with electrocautery.

The linea alba was incised and the peritoneal cavity entered. The abdomen was explored. *Given that the patient had undergone previous abdominal surgery, adhesions were sharply taken down under direct vision with the Metzenbaum scissors.*

The abdominal cavity was inspected for gross abnormalities. The colon appeared to be full of blood *with an extensive amount of diverticula throughout the colon, starting somewhat above the sacral promontory at the peritoneal reflection all the way to the cecum/other.* The small bowel was also inspected for evidence of bleeding. With the exception of the region of the terminal ileum, no blood was found in the lumen of the small bowel, and there were no abnormalities noted.

Initially the right colon was mobilized by dividing the peritoneal attachment from the cecum to the hepatic flexure. The colon and terminal ileum were mobilized medially, and caution was taken to identify and protect the duodenum and right ureter. We then sharply took down attachments of the greater omentum from the transverse colon extending up to the splenic flexure. At this point, we divided the lateral peritoneal reflection of the left colon, from the splenic flexure to the sigmoid colon. The left colon was reflected medially. Care was taken at all times to protect the left ureter.

Points of division on the terminal ileum and rectosigmoid colon were then selected. The bowel was divided in both locations with a linear-cutting stapler. The mesentery was scored and divided. The mesenteric vasculature was secured with *ties and suture ligatures/an electronic vessel-sealing system*. The specimen was removed and sent to pathology.

Hemostasis was ensured along the staple line.

Choose One

If stapled anastomosis: *The end of the rectosigmoid colon was brought together with the antimesenteric border of the terminal ileum, and two 3-0 silks were placed. Enterotomies were made. The linear-cutting stapler was inserted and fired along the common wall. The staple line was inspected for hemostasis. The linear-cutting stapler/a two-layer suture closure technique was used to close the enterotomies. The staple lines were imbricated with ___ suture.*

If sutured anastomosis: *The rectosigmoid colon was then sutured to the terminal ileum in two layers: An inner layer of interrupted/running 3-0 Vicryl and an outer layer of interrupted 3-0 silk.*

The luminal size and strength of the anastomosis were verified. Hemostasis was ensured. A *drain was placed near the anastomosis.*

(Optional: Multiple interrupted through-and-through retention sutures of ____ were placed.) The fascia was closed with *interrupted _______/a running suture of* ____. The skin was closed with *skin staples/subcuticular sutures of ___/other.*

A sterile dressing was applied. The patient was successfully extubated at the end of the procedure. All needle, sponge, and instrument counts were correct at the end of the case. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Brian A. Coakley, M.D., in the previous edition.

Total Proctocolectomy with Ileoanal Reservoir and Ileoanal Anastomosis

62

Irena Gribovskaja-Rupp

Indications

- Ulcerative colitis refractory to medical management
- Familial polyposis syndromes

Essential Steps

1. Low lithotomy position with buttocks at the edge of operating table.
2. Midline incision.
3. Explore the abdomen.
4. Mobilize the right colon:
   - Incise the lateral peritoneal reflection from the cecum to the hepatic flexure.
   - Sharply elevate the colon from retroperitoneum.
   - Identify and preserve the duodenum and right ureter.
5. Mobilize the transverse colon by entering the lesser sac and taking down the gastrocolic ligament close to the colon.
6. Mobilize the splenic flexure and left colon:
   - Incise the peritoneum lateral to the left colon from the sigmoid colon to splenic flexure.
   - Reflect the colon medially, sharply dividing adhesions to the retroperitoneum.
   - Identify and protect the spleen and left ureter.
7. Identify and transect the terminal ileum with a linear cutting stapler, preserving ileocolic artery blood supply.
8. Score the peritoneum and separate small bowel mesentery from colonic mesentery.
9. Divide mesentery of the colon, *securing mesenteric vessels with 2-0 Vicryl ties or suture ligatures/Ligasure*.
10. Incise the peritoneum and dissect the rectum along the total mesorectal excision (TME) plane.
11. Continue dissection circumferentially to levators, staying close to the mesorectum to avoid autonomic nerves and presacral vessels in posterior plane (posterior dissection first, then lateral, then anterior)
12. Divide the rectum just above the anorectal ring (anal exam to confirm level of transection prior to firing stapling device) and remove the specimen.
13. Construct ileal reservoir (15 cm).
14. Construct stapled/sutured ileal pouch-anal anastomosis.
15. Test anastomosis for leak.
16. *Place drain (recommended).*
17. *Temporary diverting loop ileostomy (recommended).*
18. Close the abdomen.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_62

Note These Variations

- Mucosectomy vs. double stapled anastomosis
- J-pouch (standard stapled configuration) versus S-pouch (hand-sewn to allow 2 cm extra length)

Complications

- Injury to the ureters
- Hemorrhage from the presacral venous plexus
- Sexual dysfunction
- Urinary retention
- Anastomotic leak/stricture
- Leak from blind end of the pouch
- Pouchitis
- Incontinence
- Infertility

Template Operative Dictation

Preoperative Diagnosis *Ulcerative colitis/Crohn's colitis refractory to medical management/familial polyposis for cancer risk reduction*

Procedure Total proctocolectomy with ileal reservoir and ileoanal anastomosis

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* has *ulcerative colitis refractory to medical management/familial polyposis*. Total proctocolectomy with ileal reservoir and ileoanal anastomosis was chosen for *definitive management/cancer risk reduction*.

Description of Procedure The patient was brought to the operating room and placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced without complications. A Foley catheter and orogastric tube were placed. The patient was then positioned in stirrups in low lithotomy position with care taken to pad all pressure points. The abdomen and perineum were prepped and draped in the usual sterile fashion.

If mucosectomy: *The anus was gently dilated. Gelpi retractors/Lone Star retractor was placed to expose the dentate line and evert the anus. A solution of dilute epinephrine was infiltrated in the submucosal plane. An incision was made at the dentate line and the mucosa excised in a sleevelike fashion to a distance ___ cm above the dentate line. It was divided, excised, and submitted to pathology. Hemostasis was achieved with electrocautery*.

A vertical midline incision was made sharply. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. Wound protector was placed. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

The abdominal cavity was inspected for gross abnormalities. *No abnormalities/the following abnormalities (enumerate) were found. No evidence of Crohn's disease was visualized in the small intestine*. The right colon was mobilized by incising the peritoneal attachment along the white line of Toldt from the cecum to the hepatic flexure. The colon and terminal ileum were mobilized medially, taking care to identify and protect the duodenum and the right ureter. The hepatocolic ligament was divided using electrocautery. The greater omentum was then taken from the transverse colon up to the splenic flexure. The lateral peritoneal attachment of the left colon was incised from the splenic flexure to the sigmoid colon. The splenocolic ligament was divided using electrocautery along avascular plane. Splenic flexure was taken down in layers along the avascular plane. The left colon was mobilized medially. Care was taken to identify and protect the left ureter.

A point of division was chosen on the terminal ileum just proximal to the cecum. The bowel was divided with a linear cutting stapler. The colonic mesentery was scored and divided, taking care to preserve the ileocolic artery and its branches.

Mesenteric vessels were secured with ties and suture ligatures of 2-0 Vicryl/Ligasure device. Right colic, middle colic, left colic and sigmoidal branches were taken in this fashion. The inferior mesenteric artery was then identified and divided. Dissection was carried down on both sides of the rectosigmoid to sacral promontory while staying close to the rectosigmoid colon to avoid injuring the pelvic nerves. Care was also taken not to damage the ureters, presacral nerves and vessels, and gonadal vessels.

The rectum was then mobilized along the total mesorectal excision (TME) plane first posteriorly, applying traction and accessing the posterior avascular plane. Dissection progressed then laterally on both sides using traction and countertraction to take down the lateral stalks and finally anteriorly taking care not to injure the *bladder/seminal vesicles/vagina*. We used St. Mark's and Wylie renal vein retractors to expose pelvic planes. The rectum was carefully elevated until the levator sling was identified. The rectum was divided with *electrocautery/roticulating stapler* immediately proximal to the sphincter complex, and the specimen was removed.

If rectal mucosectomy: *Total mucosectomy was confirmed*. The pelvis was inspected for hemostasis, irrigated, and packed.

Attention was turned to the terminal ileum, which was inspected for viability. A *J-pouch/S-pouch* was planned and it was confirmed that the apex of the pouch reached the top of the pubic bone without undue tension by grasping it gently with Babcock clamp and pulling it down. The antimesenteric borders of the limbs of the reservoir were aligned and secured with several sutures of 3-0 Vicryl. Enterotomy was made in the terminal ileum to insert the stapler. Care was taken to ensure that enterotomy was away from the mesenteric border. The linear cutting stapler was used to create the reservoir. The length of reservoir was 15 cm. The overlapping staple lines were oversewn with 3-0 Vicryl sutures. The blind limb of the J-pouch was buttressed with Lembert 3-0 Vicryl. *An end-to-end stapler (size 28 or 29) was brought on the field. A 2-0 Prolene purse string was secured around the enterotomy of the pouch, an anvil was placed into the enterotomy, and the stitch was tied snugly.* Attention was then turned to the pelvis. The ileal pouch was passed down into the pelvis and aligned with the rectal remnant to avoid torsion and tension and prevent mesenteric torsion of the pouch. (If double stapled anastomosis): Anal sphincters were dilated, and an end to end stapler (28 or 29 mm) was passed to the top of the anal cuff. Pin was opened under direct vision immediately anterior/posterior to the staple line. Anvil and pin were matched and the stapler closed and fired. *The apex of the reservoir* was *brought through the muscular cuff and* then *stapled/sutured to the anus at the dentate line with multiple interrupted sutures of 4-0 PDS/__-mm circular stapler*. Leak test was performed and confirmed negative.

A closed suction drain was placed in the pelvis and brought out through separate stab wound lateral to the abdominal incision. This was secured in place with 3-0 Nylon.

If temporary loop ileostomy (recommended): *A proximal loop of ileum was identified and a defect was created in the abdominal wall of the right abdomen. The loop of ileum was passed through this opening without tension or torsion. Orientation was marked prior to passing bowel through abdominal wall with suture or pen marking.*

The abdominal cavity was then irrigated. Hemostasis was confirmed.

The fascia was closed with *a running/interrupted suture of #1 looped PDS*. The skin was closed with *skin staples/subcuticular sutures of ___/other*. A dressing was applied.

The terminal ileum was opened perpendicular to the orientation of the bowel and matured in a Brooke fashion with interrupted sutures of 3-0 Vicryl. An ostomy appliance was placed.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the post-anesthesia care unit in stable condition. There were no operative complications (*if there were, describe briefly which and how they were managed*).

Acknowledgment This chapter was contributed by Danny Liu, MD, and John W. Cromwell, MD, in the previous edition.

63 Laparoscopic Total Proctocolectomy with Ileal Pouch-Anal Anastomosis with Diverting Loop Ileostomy

Georges J. Samaha and Sandy Hwang Fang

Indications

- Ulcerative colitis
- Familial polyposis

Essential Steps

1. Lithotomy position, both arms are tucked.
2. Foley catheter and orogastric tube.
3. Place five trocars.
   - Three 5-mm trocars in the right upper, left upper, and left lower abdomen.
   - Two 12-mm trocars in the right lower quadrant (at the marked ileostomy site) and periumbilical camera port. Place the table in Trendelenburg position, with right side down. The surgeon stands at the patient's right side with the assistant.
4. Pneumoperitoneum to 15 mmHg using either a Veress needle or an open Hasson technique.
5. Retract the sigmoid colon anteriorly and laterally and identify the inferior mesenteric artery.
6. Score the sigmoid mesentery at the level of the sacral promontory and perform a medical to lateral dissection to identify the left ureter and isolate the inferior mesenteric artery.

   Identify and protect the left ureter and gonadal vessels from this angle.
7. Isolate the inferior mesenteric artery and divide using a vascular stapler, an energy source, or clips, avoiding injury to the ureter.
8. Lift the mesocolon off the retroperitoneum from a medial to lateral approach and dissect as far as possible.
9. Identify the inferior mesenteric vein which is divided in a similar fashion.
10. Mobilize the left colon from the lateral to medial approach by incising the lateral attachments at the white line of Toldt (this step can precede the inferior mesenteric artery dissection in a lateral to medial technique).
11. Place the patient in the reverse Trendelenburg position.
12. Take down the splenic flexure by retracting the omentum cephalad, dividing the splenocolic ligament, and taking down the avascular plane between the omentum and colon. Join the dissection with the medially mobilized descending colon.
13. Place the table Trendelenburg position, with left side down. Surgeon stands on the patient's left side with the assistant.
14. Lift the cecum anteriorly and identify the ileocolic artery and vein. Open a mesenteric window on both sides of these vascular structures. Perform a medial to lateral

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_63

dissection to keep the duodenum down toward the spine and away from the ileocolic vessels.
15. Divide the ileocolic vessels using a vascular stapler, an energy source, or clips.
16. Lift the right mesocolon off the retroperitoneum and dissect bluntly in this medial to lateral plane toward the hepatic flexure.
17. Mobilize the ascending colon from a lateral to medial approach by incising the lateral attachments at the white line of Toldt.
18. Place the patient in reverse Trendelenburg position and take down the hepatic flexure by dividing the hepatocolic ligament.
19. Continue to take down the gastrocolic ligament to mobilize the transverse colon.
20. Take down the remaining mesentery with an energy device. Identify and divide the middle colic vessels (right and left branches).
21. Place the table in Trendelenburg position again.
22. Identify the hypogastric nerves at the sacral promontory in the previously opened window. Protect the nerves.
23. If there is a cancer or suspicion for cancer, perform a posterior mesorectal dissection, in the avascular presacral plane, with an energy device or electrocautery all the way down to the levator muscles. If by endoscopic evaluation, there is no concern for cancer, then the surgeon may "cheat" on the mesorectal dissection to ensure preservation of the sacral neurovasculature (see below "note these variations" section).
24. Take down the lateral attachments of the rectum avoiding injury to the hypogastric nerves.
25. Open the peritoneal reflection anteriorly staying behind Denonvilliers' fascia, avoiding injury to the prostate and seminal vesicles in males and to the uterus and vagina in females.
26. Dissect posteriorly close to the posterior colonic wall along Waldeyer's fascia, avoiding injury of the sacral venous plexus.
27. Divide the rectum at the anorectal junction using the laparoscopic stapler.
28. Make a 4–8-cm Pfannenstiel's skin incision. Create subcutaneous flaps and divide the anterior fascia and peritoneum in a vertical fashion.
29. Place a small or medium Alexis wound protector.
30. Extract the colon and rectum through the wound and divide the terminal ileum with a linear stapler.
31. Fashion a 20-cm ileal J-pouch using a 100-mm linear stapler.
32. Place a double purse-string suture at apex of J pouch and tie after introducing the anvil of an EEA circular stapler.
33. Perform a stapled side-to-side ileoanal anastomosis. The orientation of the mesentery is checked prior to the stapling to ensure that the pouch is properly oriented and not twisted.
34. Test the anastomosis by transanally insufflating the pouch with the pelvis submerged with saline solution.
35. Run the ileum in a retrograde fashion and identify a segment about 30–40 cm proximal to the pouch.
36. Exteriorize this segment through the right lower quadrant trocar site or an alternative site previously marked by the stoma nurse. Secure bowel over a rod at the skin level. Care is taken not to twist the bowel.
37. Remove all trocars under direct visualization through the Pfannenstiel's incision.
38. Close the Pfannenstiel's incision in three layers (peritoneum, fascia, and skin).
39. Close the anterior fascia of the 12-mm left lower quadrant trocar and the periumbilical Hasson port site.
40. Close the skin at the trocar sites.
41. Cover all wounds.
42. Mature a diverting loop ileostomy.
43. Cover the ileostomy with the proper appliance.

Note These Variations

- Hand-assisted total proctocolectomy with a hand port established at the beginning of the operation through a Pfannenstiel's incision.
- All five trocars can be 5 mm if no stapling is necessary (energy source is used for vascular pedicle division. Anorectum is extracted transanally following mucosectomy).
- Anal mucosectomy with handsewn ileoanal anastomosis.

- The J-pouch may be created in extracorporeal fashion via the ileostomy incision.
- The proctectomy portion of the operation performed by dividing the mesorectum next to the rectal wall instead of the total mesorectal excision dissection which was described above.
- Omission of the ileostomy in a select group of patients.

Complications

- Transection of the ureter
- Perforation of the duodenum or stomach
- Laceration of the spleen
- Small bowel enterotomy
- Transection of the hypogastric nerve trunk
- Anastomotic leak
- Twisting of the ileal pouch
- Twisting of the mesentery to the diverting loop ileostomy

Template Operative Dictation

Preoperative Diagnosis Ulcerative colitis refractory to medical management/familial polyposis

Procedure Laparoscopic total proctocolectomy with ileal pouch-anal anastomosis, diverting loop ileostomy

Postoperative Diagnosis Same

Indications The patient is a _____-year-old *male/female* with a history of _____. Different treatment options were discussed with the patient. The procedure of laparoscopic (possible open) total proctocolectomy with ileal pouch-anal anastomosis with diverting loop ileostomy was reviewed with the patient. The procedure, indication, alternatives, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, he/she was placed in the lithotomy position with both arms tucked.

Intravenous antibiotic and subcutaneous heparin were administered. A Foley catheter and an orogastric tube were inserted. All extremities were well padded. The rectum was irrigated with Betadine. The perineum was prepped in usual sterile fashion.

Urology performed cystoscopy with placement of bilateral ureteral stents.

The abdomen was shaved and prepped in the usual sterile fashion.

The peritoneal cavity was accessed with a 10-mm Hasson port and secured with an 0 Vicryl U-stitch. Carbon dioxide pneumoperitoneum of 15 mmHg was established. Under direct visualization, a 12-mm trocar was placed in the right lower quadrant at the planned ileostomy site and one in the left lower quadrant followed by two additional 5-mm trocars in the right and left mid-abdomen. The patient was placed in the Trendelenburg position. The sigmoid colon was grasped and retracted anteriorly.

The inferior mesenteric artery pedicle was identified; the sigmoid mesentery was scored from the sacral promontory, superiorly to the inferior mesenteric artery. A medial to lateral dissection was performed to identify the left ureter and create a window between the artery and the retroperitoneum. The left ureter was identified and protected from harm's way for the entirety of the operation. The inferior mesenteric artery was isolated and divided using a *laparoscopic vascular stapler/energy device/clip*. Next the inferior mesenteric vein was identified, isolated, and divided in a similar fashion. The left mesocolon was then lifted off the retroperitoneum from a medial to lateral approach and blunt dissection was carried out toward the splenic flexure. The left colon was mobilized from a lateral to medial approach by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg position. The splenic flexure was taken down by dividing the splenocolic ligament, lifting the omentum off the distal transverse colon, and joining the dissection with the mobilized descending colon. The patient was placed in Trendelenburg position the left side down. The cecum was lifted anteriorly and the ileocolic vessels were isolated by creating mesenteric windows on each side. A medial to lateral dissection was performed. The duodenum was identified and protected and kept posteriorly toward the spine. The ileocolic vessels were divided with the *laparoscopic vascular stapler/energy device/clip*. The right mesocolon was lifted off the retroperitoneum and blunt dissection was carried from a medial to lateral approach toward the hepatic flexure. The ascending colon was mobilized medially by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg and the hepatic flexure was taken down by dividing the hepatocolic ligament. The dissection was carried on to join the mobilized transverse colon. The transverse colon was lifted anteriorly and the remaining mesentery was taken down with the *energy device/a vascular stapler* while identifying the middle colic vessels.

The patient was placed in Trendelenburg position again and the small bowel was retracted out of the pelvis. The sacral promontory was visualized and both hypogastric nerves were identified and protected. Using blunt dissection and *electrocautery/energy device*, the presacral avascular plane was developed close to the posterior rectal wall along Waldeyer's fascia. Dissection was carried down to the levator muscles. The lateral attachments of the rectum were divided. The peritoneal reflection was opened anteriorly and dissection was carried posterior to Denonvilliers' fascia. Once the dissection was complete circumferentially at the level of the pelvic floor, the rectum was divided at the anorectal junction using the 45-mm laparoscopic Endo GIA (3.5 mm-/4.8-mm staple height). A 4- to 8-cm Pfannenstiel's skin incision was made and subcutaneous flaps were raised superiorly and inferiorly. The anterior fascia and peritoneum were divided at the midline in a vertical fashion. A small Alexis wound protector was used to retract the wound. The colon and rectum were extracted through the wound and the terminal ileum was divided with a linear 80-mm stapler.

A 20-cm ileal J-pouch was created using the 100-mm linear stapler. A 2-0 Prolene double purse-string stitch was placed at the apex of the pouch to secure the anvil of a circular stapler (size would have been determined during sizing of the anal canal). The pouch was brought down to the pelvis taking care not to twist the mesentery and an end-to-end stapled anastomosis was performed with the EEA circular stapler. The anastomosis was insufflated transanally with air after submerging the pelvis with sterile saline and gently occluding the ileum proximal to the pouch to test for an air leak. A loop of small bowel was identified 40 cm proximal to the pouch and was exteriorized over a plastic rod through a stomal opening created at the site of the right lower quadrant trocar. Care was taken not to twist the ileostomy. The remaining trocars were removed under direct visualization through the Pfannenstiel's incision. The incision was then closed in three layers, approximating the peritoneum with 0 Vicryl suture, the anterior fashion with 0 PDS suture, and the skin with 3.0 Vicryl deep dermal interrupted buried knot stitches. The anterior fascia of the 12-mm left lower quadrant and Hasson trocar was closed with 0 Vicryl. The trocar site skin wounds were approximated deep dermal interrupted buried knot stitches and all wounds were dressed. A diverting loop ileostomy was matured using 3-0 Vicryl sutures. An ostomy appliance was placed. All instrument, needle, and sponge counts were correct at the end of the case. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the recovery unit in stable condition.

Acknowledgment This chapter was contributed by Maher A. Abbas, MD, in the previous edition.

64 Total Proctocolectomy with End Ileostomy

Irena Gribovskaja-Rupp

Indication

- Ulcerative or Crohn's colitis refractory to medical management, when sphincter preservation is not desired or feasible.
- Familial polyposis syndromes when sphincter preservation is not desired/not feasible.

Essential Steps

1. Low lithotomy position with buttocks at the end of the operating table.
2. Midline incision.
3. Explore the abdomen.
4. Mobilize the right colon:
   - Incise the lateral peritoneal reflection from the cecum to the hepatic flexure.
   - Divide colonic attachments to the retroperitoneum.
   - Identify and preserve the duodenum and the right ureter.
5. Mobilize the transverse colon by accessing lesser sac and dividing gastrocolic ligament.
6. Mobilize the splenic flexure and left colon:
   - Incise the peritoneum lateral to the left colon from the sigmoid colon to splenic flexure.
   - Reflect the colon medially, dividing attachments to the retroperitoneum.
   - Identify and protect the spleen and the left ureter.
7. Identify terminal ileum.
8. Divide the terminal ileum with a linear cutting stapler, preserving maximal bowel length.
9. Score the peritoneum and separate small bowel mesentery from colonic mesentery.
10. Divide colonic mesentery, securing vessels with *2-0 Vicryl ties and suture ligatures/ Ligasure.*
11. Dissect the rectum along the total mesorectal excision (TME) planes (dissect the posterior presacral avascular plane and then both lateral stalks using traction-countertraction, then the anterior plane being careful not to injure *vagina/seminal vesicles*).
12. Confirm dissection down to the pelvic floor by identifying levators.
13. Switch to perineal approach: incise skin around the anus (intersphincteric dissection if no perianal disease and no cancer present).
14. Enter the peritoneal cavity in posterior midline just anterior to coccyx; incise the levators anteriorly and connect to abdominal dissection plane.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_64

15. *If male, avoid injury to the urethra. If female, carefully dissect along the rectovaginal plane*. Dissect anterior septum last.
16. Pass specimen off the field.
17. Place drain.
18. *Close perineum in 3–4 absorbable suture layers (use internal sphincter if intersphincteric dissection was done)*.
19. Create defect in the abdominal wall for the ileostomy.
20. Deliver the terminal ileum, taking care to construct the stoma through the rectus muscle with a fascial defect that admits 1.5 fingers.
21. Close the abdomen.
22. Mature ileostomy in Brooke's fashion.

Complications

- Injury to the ureters, small bowel, spleen, and duodenum
- Injury to the urethra (male), vagina (female), and bladder
- Hemorrhage from the presacral venous plexus
- Sexual dysfunction
- Urinary retention
- Parastomal hernia
- Ileostomy pouch problems, suboptimal stoma
- Ileostomy-related dehydration

Template Operative Dictation

Preoperative Diagnosis *Ulcerative colitis/Crohn's colitis* refractory to medical management/familial polyposis

Procedure Total proctocolectomy with end ileostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* has *ulcerative colitis/Crohn's colitis with extensive rectal involvement* refractory to medical management/*familial polyposis syndrome*. Sphincter preservation is not desired or feasible. Total proctocolectomy with end ileostomy was chosen for definitive management.

Description of Procedure The patient was brought to the operating room and placed in supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced without complications. A Foley catheter and *oral/naso*gastric tube were placed. The patient was then positioned in *low lithotomy position* with care taken to pad all pressure points. The abdomen and perineum were prepped and draped in the usual sterile fashion. A vertical midline incision was made sharply. This was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. Wound protector was placed. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

The abdominal cavity was inspected. *No abnormalities/the following abnormalities (enumerate) were found*. The right colon was mobilized by incising the peritoneal attachment along the white line of Toldt from the cecum to the hepatic flexure. The colon and terminal ileum were mobilized medially, taking care to protect the duodenum and right ureter. The hepatocolic ligament was divided using electrocautery. The lesser sac was accessed and the gastrocolic ligament divided. The splenic flexure was taken down along avascular plane, taking care not to avulse the splenic capsule. The lateral peritoneal attachments of the left colon were then incised from the splenic flexure to the sigmoid colon. The left colon was mobilized medially. Care was taken to protect the left ureter and gonadal vessels.

A point of division was chosen on the terminal ileum. The bowel was divided with a linear cutting stapler. *The mesentery was scored and divided using the Ligasure/double clamps and serial suture ligatures of 2-0 Vicryl. Mesenteric vessels were secured with ties and suture ligatures of 2-0 Vicryl*. The inferior mesenteric artery was then identified and divided. Dissection was carried down on both sides of the rectosigmoid junction to the sacral promontory. Care was also taken not to damage the ureters and gonadal vessels.

The rectum was then mobilized along the total mesorectal excision (TME) plane by using electrocautery dissection. Dissection started by entering avascular presacral posterior plane and progressing laterally to take both lateral stalks and finally anteriorly to separate the rectum from the *vagina/seminal vesicles*. St. Mark's and Wylie renal vein retractors were used to expose pelvis. Posterior presacral vessels and nerves were avoided by staying close to the mesorectal envelope. The rectum was carefully elevated in this fashion until levator sling was identified. *If male: The dissection was carried down behind the prostate*. The pelvic dissection was continued to the lowest level possible to facilitate the perineal excision.

Attention was then turned to the perineal phase of the dissection. A narrow elliptical incision was made encompassing the anus. *In the absence of perianal disease or rectal malignancy, intersphincteric dissection is carried out.* Dissection then progressed through subcutaneous tissues circumferentially. Hemostasis was achieved with electrocautery. The posterior portion of the incision is extended anterior to the coccyx, entering the abdomen. The levators were then divided with electrocautery beginning posteriorly and progressing anteriorly. *If male: The prostate and the urethral catheter is palpated and protected from accidental injury. If female: Dissection through the rectovaginal plane was carefully completed*. The remaining anterior attachments were then severed and the specimen removed through the perineal defect. Hemostasis was achieved in the pelvis and perineal wound.

Closed suction drain is placed in the pelvis and brought out through a separate stab wound. The drain is secured in place with 3-0 Nylon. The perineal wound was closed in layers with interrupted 3-0 Vicryl (two layers), and the skin was closed with deep dermal and subcuticular 4-0 Monocryl suture.

The abdominal cavity was then copiously irrigated. Hemostasis was again checked. *The pelvic peritoneum was closed with running 3-0 Vicryl*. A disk of skin was removed in the preselected site for the ileostomy. This incision was deepened through subcutaneous tissues and muscular and fascial layers until an opening sufficient for 1.5 fingers was created. The ileum was then delivered through this opening without tension or torsion. The fascia was closed with *a running/interrupted suture of #1 looped PDS*. The skin was closed with *skin staples/subcuticular sutures of ___/other*. A dressing was applied.

The ileostomy was then matured in a Brooke fashion with multiple interrupted sutures of 3-0 Vicryl. An ostomy appliance was placed. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition. There were no intraoperative complications (*if there were, briefly describe which ones and how they were managed*).

Acknowledgment This chapter was contributed by Danny Liu, M.D., and John W. Cromwell, M.D., in the previous edition.

Laparoscopic Total Proctocolectomy with End Ileostomy

65

Chady Atallah and Sandy Hwang Fang

Indications

- Mucosal ulcerative colitis
- Crohn's disease
- Familial adenomatous polyposis

Essential Steps

1. Preoperative bowel preparation, including PO antibiotics.
2. Bilateral ureteral stent placement.
3. Lithotomy position, both arms are tucked.
4. Foley catheter and orogastric tube.
5. Pneumoperitoneum to 15 mmHg using either a Veress needle or an open Hasson technique.
6. Placement of trocars:
   - Three 5-mm trocars in the right upper, left upper, and left lower quadrants along the midclavicular line
   - One 10-mm Hasson port in the periumbilical region, depending on body habitus
   - One 10/12-mm port in the right lower quadrant in the midclavicular line
7. Place the table in Trendelenburg position, with right side down. The surgeon stands at the patient's right side with the assistant.
8. Retract the sigmoid colon anteriorly and laterally and identify the inferior mesenteric artery.
9. Score the sigmoid mesentery at the level of the sacral promontory and perform a medial to lateral dissection to identify the left ureter and isolate the inferior mesenteric artery.
10. Identify and protect the left ureter and gonadal vessels.
11. Isolate the inferior mesenteric artery and divide using a vascular stapler, an energy source, or clips, avoiding injury to the ureter.
12. Lift the mesocolon off the retroperitoneum from a medial-to-lateral approach and dissect as far as possible.
13. Identify the inferior mesenteric vein which is divided in a similar fashion.
14. Mobilize the left colon from the lateral-to-medial approach by incising the lateral attachments at the white line of Toldt (this step can precede the inferior mesenteric artery dissection in a lateral-to-medial technique).
15. Place the patient in the reverse Trendelenburg position.
16. Take down the splenic flexure by retracting the omentum cephalad, dividing the splenocolic ligament, and taking down the avascular plane between the omentum and colon. Join the dissection with the medially mobilized descending colon.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_65

17. Place the table in Trendelenburg position, with left side down. Surgeon stands on the patient's left side with the assistant.
18. Lift the cecum anteriorly and identify the ileocolic artery and vein. Open a mesenteric window on both sides of these vascular structures.
19. Perform a medial-to-lateral dissection to keep the duodenum down toward the spine and away from the ileocolic vessels.
20. Divide the ileocolic vessels using a vascular stapler, an energy source, or clips.
21. Lift the right mesocolon off the retroperitoneum and dissect bluntly in this medial-to-lateral plane toward the hepatic flexure.
22. Mobilize the ascending colon from a lateral-to-medial approach by incising the lateral attachments at the white line of Toldt.
23. Place the patient in reverse Trendelenburg position and take down the hepatic flexure by dividing the hepatocolic ligament.
24. Continue to take down the gastrocolic ligament to mobilize the transverse colon.
25. Divide the terminal ileum just proximal to the ileocecal valve using a laparoscopic Endo GIA.
26. Take down the remaining mesentery with an energy device. Identify and divide the middle colic vessels (right and left branches).
27. Place the table in Trendelenburg position again.
28. Identify the hypogastric nerves at the sacral promontory in the previously opened window. Protect the nerves.
29. If there is a cancer or suspicion for cancer, perform a posterior mesorectal dissection, in the avascular presacral plane, with an energy device or electrocautery all the way down to the levator muscles. If by endoscopic evaluation, there is no concern for cancer, then the surgeon may "cheat" on the mesorectal dissection to ensure preservation of the sacral neurovasculature (see below "note these variations" section).
30. Take down the lateral attachments of the rectum avoiding injury to the hypogastric nerves.
31. Open the peritoneal reflection anteriorly staying behind Denonvilliers' fascia, avoiding injury to the prostate and seminal vesicles in males and to the uterus and vagina in females.
32. Dissect posteriorly close to the posterior colonic wall along Waldeyer's fascia, avoiding injury of the sacral venous plexus.
33. After satisfactory mobilization of the rectum, switch to the perineal portion of the operation.
34. Close the anus with a purse-string suture.
35. Retract the wound with a Lone Star retractor.
36. If there is no evidence of a low rectal cancer or dysplasia, then an intersphincteric dissection is performed. A perineal incision within the intersphincteric groove is created. If cancer is present, then the entire sphincter complex is excised with the specimen.
37. The dissection is performed circumferentially until the levators are encountered.
38. Extract the entire colon and rectum through the perineal wound.
39. Irrigate the perineal wound and close in multiple layers.
40. Reestablish pneumoperitoneum.
41. Identify the transected end of the terminal ileum and bring out through a stomal opening at the level of the right lower quadrant trocar site or an alternative site previously marked by the ostomy nurse. Secure bowel at the level of the skin using Babcock forceps.
42. Place a 19 Fr Blake drain in the pelvis through the left lower quadrant port site.
43. Remove all trocars under direct camera visualization and close the fascia of the 12-mm right lower quadrant trocar.
44. Close the skin at the trocar sites and cover all wounds.
45. Mature an end ileostomy.
46. Cover the ileostomy with the proper appliance.
47. Remove ureteral stents and check their integrity.

Note These Variations

- Hand-assisted total proctocolectomy with a hand port is established at the beginning of the operation through either a Pfannenstiel's incision or a low midline incision.

- All five trocars can be 5 mm, if no stapling is necessary (if an energy source is used for vascular pedicle division and anorectum is extracted transanally following the perineal dissection).
- The proctectomy portion of the operation may be performed by dividing the mesorectum next to the rectal wall instead of the total mesorectal excision dissection which was described above.

Complications

- Transection of the ureter
- Perforation of the duodenum or stomach
- Laceration of the spleen or tail of the pancreas
- Small bowel enterotomy
- Transection of the hypogastric nerve trunk
- Stoma related complications
- Perineal wound complications

Template Operative Dictation

Preoperative Diagnosis Mucosal ulcerative colitis, Crohn's disease, familial adenomatous polyposis

Procedure Laparoscopic total proctocolectomy with end ileostomy

Postoperative Diagnosis Same

Indications The patient is a _____-year-old *male/female* with a history of _____. Different treatment options were discussed with the patient. The procedure of laparoscopic (possible open) total proctocolectomy with permanent end ileostomy was reviewed with the patient. The procedure, indication, alternatives, benefits, risks, and complications were reviewed with the patient. The patient verbalized understanding and wished to proceed. Informed consent was obtained.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, he/she was placed in the lithotomy position with both arms tucked.

Intravenous antibiotic and subcutaneous heparin were administered. An orogastric tube was inserted. All extremities were well padded. The rectum was irrigated with normal saline and betadine. The perineum was prepped in usual sterile fashion. Cystoscopy was performed and bilateral ureteral stents were inserted. A Foley catheter was inserted. The abdomen and perineum were shaved and prepped in the usual sterile fashion.

A Hassan port was placed for access to the peritoneal cavity and insufflated to 15 mm Hg pneumoperitoneum. Under direct visualization, a 12-mm trocar was placed in the right lower quadrant, followed by three additional 5-mm trocars in the right upper quadrant and left upper and left lower abdomen so that the ports were triangulated bilaterally around the Hasson port. The patient was placed in the Trendelenburg position with right side down. The sigmoid colon was grasped and retracted anteriorly and laterally. The inferior mesenteric artery pedicle was identified; the sigmoid mesentery was scored from the sacral promontory, superiorly to the inferior mesenteric artery. A medial-to-lateral dissection was performed to identify the left ureter and create a window between the artery and the retroperitoneum. The left ureter was identified and protected from harm's way for the entirety of the operation. The inferior mesenteric artery was isolated and divided using a *laparoscopic vascular stapler/energy device/clip*. Next the inferior mesenteric vein was identified, isolated, and divided in a similar fashion. The left mesocolon was then lifted off the retroperitoneum from a medial-to-lateral approach, and blunt dissection was carried out toward the splenic flexure. The left colon was mobilized from a lateral-to-medial approach by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg position. The splenic flexure was taken down by dividing the splenocolic ligament, lifting the omentum off the distal transverse colon and joining the dissection with the mobilized descending colon. The patient was placed in Trendelenburg position the left side down. The cecum was lifted anteriorly and the ileocolic vessels were isolated by creating mesenteric windows on each side. A medial-to-lateral dissection was performed. The duodenum was identified and protected and kept posteriorly toward the spine. The ileocolic vessels were divided with the laparoscopic vascular stapler/laparoscopic energy device. The right mesocolon was lifted off the retroperitoneum and blunt dissection was carried from a medial-to-lateral approach toward the hepatic flexure. The ascending colon was mobilized medially by incising the lateral attachments at the white line of Toldt. The patient was placed in reverse Trendelenburg, and the hepatic flexure was taken down by dividing the hepatocolic ligament. The dissection was carried on to join the mobilized transverse colon. The transverse colon was lifted anteriorly, and the remaining mesentery was taken down with the *energy device/a vascular stapler* while identifying the middle colic vessels. The terminal ileum was transected just proximal to the ileocecal valve using a laparoscopic Endo GIA.

The patient was placed in Trendelenburg position again, and the small bowel was retracted out of the pelvis. The sacral promontory was visualized and both hypogastric nerves were identified and protected. Using blunt dissection and electrocautery, the presacral avascular plane was developed close to the posterior rectal wall along Waldeyer's fascia. Dissection was carried down to the levator muscles. The lateral attachments of the rectum were divided. The peritoneal reflection was opened anteriorly, and dissection was carried posterior to Denonvilliers' fascia. Once the dissection was complete circumferentially at the level of the pelvic floor, the pelvis was irrigated.

Attention was directed to the perineal portion of the operation. The anus was closed using a 0 Vicryl purse-string. A Lone Star retractor was used for retraction of the perineal approach. Electrocautery was used to perform a perineal subcutaneous circumferential dissection around the sphincter complex (versus intersphincteric dissection) all the way to the level of the pelvic floor muscles, which were divided. The perineal dissection was connected with the peritoneal cavity, and the colon and rectum were exteriorized through the perineal wound. The wound was irrigated and closed in three layers using 0 Vicryl for the pelvic floor muscles and subcutaneous tissue and 3-0 Vicryl for the subcuticular skin closure. The wound was covered with antibiotic ointment followed by a dry dressing.

Pneumoperitoneum was reestablished. The transected end of the terminal ileum was identified and brought through the right lower quadrant trocar site which was enlarged as a stoma opening. It was secured above the skin with a Babcock clamp. Care was taken not to twist the ileostomy. A 19 Fr Blake drain was placed into the pelvis and was secured at the left lower quadrant port site using a 2-0 Nylon suture. All trocars were removed under direct camera visualization and the left lower quadrant fascial site closed with 0 Vicryl in a figure of eight fashion. The trocar site skin wounds were closed with 4.0 Biosyn suture in a subcuticular fashion. An end Brooke ileostomy was matured using 3.0 Vicryl sutures. An ostomy appliance was placed. The instrument, needle, and sponge counts were correct at the end of the case. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated, and was taken to the recovery unit in stable condition.

Acknowledgment This chapter was contributed by Maher A. Abbas, M.D., in the previous edition.

Abdominoperineal Resection

66

John Armstrong and John C. Byrn

Indication

- Low rectal adenocarcinoma; location precludes adequate distal margin for a sphincter preserving procedure.
- Melanoma of the anorectum involving the sphincters.

Essential Steps

1. Combined lithotomy–supine position.
2. Lower midline incision.
3. Explore the abdomen for metastatic disease (liver and peritoneum and ovaries in females).
4. *Rigid sigmoidoscopy/digital rectal exam to confirm level of lesion and sphincter involvement (can also be done prior to incision or at any point prior to division of colon).*
5. Incise the line of Toldt to free the rectosigmoid colon from the peritoneal attachment.
6. Identify and protect both ureters.
7. Transect the bowel proximally.
8. Ligate the mesenteric vessels.
9. Incise the peritoneum and elevate from the hollow of sacrum, circumferentially to levators.
10. Working from below, incise the skin around the anus.
11. Enter the peritoneal cavity in posterior midline; incise levators anteriorly.
12. Pass the specimen through posteriorly.
13. Complete anterior dissection.
14. *If male: Avoid injury to the urethra.*
15. *If female: May excise the back wall of the vagina with the specimen.*
16. Place drains.
17. Make an opening for the colostomy and deliver the colon.
18. Close the abdomen and perineum.
19. Mature colostomy.

Note These Variations

- Note and document any metastatic disease.
- *If female: Excision of part of the back wall of the vagina.*

Complications

- Injury to the ureters
- Injury to the urethra (male)
- Hemorrhage from the presacral venous plexus
- Non-healing perineal wound
- Sexual dysfunction

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_66

Template Operative Dictation

Preoperative Diagnosis Carcinoma of the anus/ rectum

Procedure Abdominoperineal resection of the anus and rectum with end colostomy

Postoperative Diagnosis Same *(enumerate any metastatic disease found)*

Indications This ____-year-old *male/female* with *abdominal pain/bleeding/obstructive symptoms* was found to have carcinoma of the rectum located *at ____ cm from the anal verge/involving the sphincter complex.* Workup with *computed tomography scan of the abdomen and pelvis and CXR for evaluation of metastatic disease and MRI/endorectal ultrasound for the evaluation of locoregional spread* revealed ____. Elective resection was indicated. Due to *proximity to sphincter complex/concern for functional outcome with low anastomosis/other____*, abdominoperineal resection was chosen.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and orogastric tube was placed. The patient was then placed in lithotomy position using *Lloyd-Davies/other* stirrups with care taken to pad all pressure points. The abdomen and perineum were prepped and draped in the usual sterile fashion. *Procedure was begun with digital rectal exam and/or rigid sigmoidoscopy to confirm the level of the lesion*. A lower midline incision was made from just above the umbilicus to the pubic symphysis. This was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors. A mass was palpated in the low rectum*. The liver, omentum, peritoneum, *and ovaries (if present)* were inspected for the evidence of metastatic disease. *Metastatic disease was noted ____/no metastatic disease was noted*.

The small bowel was inspected and retracted to the right using a moist towel and self-retaining retractor. Using electrocautery, the descending colon was freed from its peritoneal attachments along the line of Toldt beginning distally at the pelvic inlet and proceeding proximally to the splenic flexure. Both ureters were identified and protected.

With the descending colon and splenic flexure rotated medially, the plane anterior to the aorta was entered, and the colon with mesenteric fat was mobilized from the retroperitoneum overlying the sacral promontory and into the pelvis. The sympathetic plexus at the IMA origin was protected, as was the left ureter and gonadal vessel. The mesentery was scored and the inferior mesenteric artery identified and ligated at its origin with *2-0 silk/using a ligasure device*. A proximal point of division was selected, and the colon was divided using a linear cutting stapler.

The mesorectum was then mobilized posteriorly using sharp dissection. Care was taken not to enter the presacral venous plexus. The lateral rectal stalks were divided using medial traction and electrocautery. Anteriorly, the plane between the *bladder and rectum/prostate and rectum* (Denonvilliers fascia) was incised and the mesorectal plane mobilized anteriorly.

The lesion was palpable and the rectum was carefully elevated until the level of the coccyx/ coning of the mesentery was identified.

Attention was then turned to the perineal phase of the dissection. The bony prominences of the ischial tuberosities were marked bilaterally; the coccyx and the perineal body were marked. An elliptical incision was made connecting these points and encompassing the anus *(if female, optional) and extending up to include a portion of the back wall of the vagina*. Dissection then progressed through subcutaneous tissues circumferentially. Hemostasis was achieved with electrocautery. *If male: The transversus perinei muscle was identified, and dissection was kept posterior to this anatomic landmark to avoid injury to the prostate and urethra*. The abdomen was entered posterior to the anus in the midline and anterior to the coccyx. The levators were then divided with electrocautery beginning posteriorly and progressing anteriorly. The specimen was delivered through this posterior incision into the perineal field. The remaining anterior attachments were then severed (*in the male, care was taken to palpate the Foley catheter and avoid injury to the urethra)* and the specimen removed. Hemostasis was achieved in the pelvis and perineal wound.

The perineal skin was closed with *skin staples/ subcuticular sutures of ____/vertical mattress sutures of 3-0 nylon/Vicryl. The back wall of the vagina was carefully reapproximated and closed with a subcuticular suture of running 4-0 Monocryl*.

The abdominal cavity was then copiously irrigated. Hemostasis was again checked. A closed suction drain was passed via a separate abdominal stab incision and placed in the pelvis. A tongue of omentum was brought to lay in the pelvis over the rectal fossa. *The pelvic peritoneum was closed with running 3-0 Vicryl*. A disk of skin was removed in the preselected site for the colostomy. This incision was deepened through subcutaneous tissues, fascial layers, and rectus muscle in a muscle splitting fashion until an opening sufficient for two fingers was created. The colon was then delivered through this opening without tension or torsion. *It was tacked circumferentially to the peritoneum with interrupted 3-0 silk and laterally to the peritoneum in such a manner as to eliminate the lateral trap*. Attention was then turned to abdominal closure.

(Optional: Multiple interrupted through-and-through retention sutures of ____were placed.) The fascia was closed with *a running/interrupted suture of* ____. The skin was closed with *skin staples/sutures of ____/other*. A dressing was applied.

The colostomy was then matured with multiple interrupted sutures of 3-0 Vicryl placed in such a way as to tack the full thickness of the edge of the colon to a subcuticular layer of the skin. An ostomy appliance was placed.

The patient was repositioned in the supine position and a dressing of *kerlix fluffs/ABD pads/ mesh shorts* was applied to the perineal wound. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room after tolerating the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Eanas S. Yassa, M.D., in the previous edition.

67 Laparoscopic Abdominoperineal Resection

John Armstrong and John C. Byrn

Indications

- Low rectal adenocarcinoma; location precludes adequate distal margin for a sphincter preserving procedure.
- Melanoma of the anorectum involving the sphincters.

Essential Steps

1. Combined lithotomy-supine position with both arms tucked.
2. Place four trocars: one supraumbilical 10-mm trocar, one left lower abdomen (at the site marked for the end colostomy) 5-mm trocar, one suprapubic 5-mm trocar, and one right lower abdomen 12-mm trocar.
3. Explore the abdomen for the evidence of metastatic disease (liver and peritoneum and ovaries in female).
4. Place the patient in steep Trendelenburg position.
5. Mobilize the left colon from medial to lateral, identifying and elevating the inferior mesenteric artery (IMA) at the level of the sacral promontory so that the left ureter can be identified. Once the left ureter and the gonadal vessels are identified, sweep them back into the retroperitoneum.
6. Identify the superior rectal artery of the IMA and divide it. Alternatively, the IMA may be divided at its origin.
7. Mobilize the descending colon laterally along the white line of Toldt all the way to the splenic flexure. The degree of mobilization depends on the colon length required to create the end colostomy.
8. Lift the rectum and mesorectum anteriorly.
9. Identify the hypogastric nerves posteriorly and isolate them.
10. Start the dissection along the presacral fascia in the avascular plane and continue the dissection down to the levator muscles/pelvic floor posteriorly.
11. Proceed with the lateral dissection and take down the lateral stalks of the rectum while protecting the ureters.
12. In a female, elevate and retract the uterus with a stitch to the anterior abdominal wall if it obstructs the anterior plane of dissection.
13. Continue the anterior dissection to the levator ani muscles as the rectum is retracted posteriorly and the prostate/vagina is retracted anteriorly.
14. Divide the colon at the level of the sigmoid using the laparoscopic stapler. Exteriorize

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_67

the proximal end without tension or torsion through the left lower trocar.
15. Place pelvic drain.
16. Proceed with the perineal portion of the resection. Working from below, incise the skin around the anus.
17. Enter the peritoneal cavity in posterior midline; incise levators anteriorly.
18. Pass the specimen through posteriorly.
19. Complete anterior dissection.
20. *If male*: *Avoid injury to the urethra*.
21. *If female*: *May excise back wall of the vagina with the specimen*.
22. Close the abdominal trocar sites and perineum.
23. Mature the colostomy.

Note These Variations

- The abdomen may be entered using an open Hasson or other techniques.
- Note and document any metastatic disease.
- Level of division of vascular pedicle.

Complications

- Injury to ureters
- Injury to the urethra (male)
- Hemorrhage from the presacral venous plexus
- Non-healing perineal wound
- Sexual dysfunction

Template Operative Dictation

Preoperative Diagnosis Carcinoma of the anus/rectum

Procedure Laparoscopic abdominoperineal resection with end colostomy

Postoperative Diagnosis Same (*enumerate any metastatic disease found*)

Indications This ____-year-old *male/female* with *abdominal pain/bleeding/obstructive symptoms* was found to have carcinoma of the rectum located *at____ cm from the anal verge/involving the sphincter complex*. Workup with *computed tomography scan of the abdomen and pelvis and CXR for evaluation of metastatic disease and MRI/endorectal ultrasound for the evaluation of locoregional spread* revealed ____. Elective resection was indicated. Due to *proximity to sphincter complex/concern for functional outcome with low anastomosis/other____*, abdominoperineal resection was chosen.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and orogastric tube were placed. The patient was then placed in lithotomy position using *Lloyd-Davies/other* stirrups with care taken to pad all pressure points. The abdomen and perineum were prepped and draped in the usual sterile fashion. *Procedure was begun with digital rectal exam and/or rigid sigmoidoscopy to confirm the level of the lesion*.

At the abdomen, a Veress needle/*open Hasson/Optiview trocar* was introduced into the abdominal cavity. Insufflation was initiated and pneumoperitoneum was established with appropriate pressures. A 10-mm supraumbilical incision was made and trocar was placed. Next, two 5-mm trocars were inserted in the suprapubic area in the midline and in the left lower quadrant under direct visualization. The abdomen was explored. The liver, omentum, peritoneum, *and ovaries* (*if present*) were inspected for the evidence of metastatic disease. *Metastatic disease was noted ____/no metastatic disease was noted*. A 12-mm trocar was inserted in the right lower quadrant.

The sigmoid colon was then retracted anteriorly and the vascular pedicle was identified. The peritoneum was incised and dissection was carried through the mesentery of the sigmoid. The left ureter was identified and isolated. Dissection was carried laterally along the white line of Toldt to the splenic flexure, and the flexure was mobilized. *The sigmoidal branches and the superior rectal vessels of the IMA were then identified and divided with ______/the IMA was identified and divided at its origin with ______*. Posterior dissection of the rectum was performed in the presacral space using electrocautery to the level of the levator ani muscles. Next, lateral dissection was performed. Care was taken to avoid injury to the ureters and the iliac vessels as the lateral attachments were taken down using *electrocautery/_____*. Anteriorly the peritoneal reflection was opened up and the dissection was carried distally to the level of the levator ani muscles.

The sigmoid colon was then divided using the laparoscopic stapler after making certain that the proximal colon reached the abdominal wall stoma site freely. The completely dissected recturm was tucked into the pelvis to facilitate removal through the perineum. The proximal colon was exteriorized without tension or torsion through the left trocar site whose size was augmented to accommodate two fingers. A drain was placed into the pelvis through the right lower quadrant 12-mm trocar and exited through a lateral stab incision. All trocars were removed under vision and trocar sites were seen to be hemostatic. The fascial defect at the 12-mm trocar site was closed using ___ suture. The skin was closed using 4-0 monocryl subcuticular sutures. Dressings were applied.

Attention was then turned to the perineal portion of the procedure. The bony prominences of the ischial tuberosities were marked bilaterally, and the coccyx and the perineal body were marked. An elliptical incision was made connecting these points and encompassing the anus (*if female*, *optional*) *and extending up to include a portion of the back wall of the vagina*. Dissection then progressed through subcutaneous tissues circumferentially. Hemostasis was achieved with electrocautery. *If male*: *The transversus perinei muscle was identified, and dissection was kept posterior to this anatomic landmark to avoid injury to the prostate and urethra*. The abdomen was entered posterior to the anus in the midline and anterior to the coccyx. The levators were then divided with electrocautery beginning posteriorly and progressing anteriorly. The specimen was delivered through this posterior incision into the perineal field. The remaining anterior attachments were then severed (*in the male*, *care was taken to palpate the Foley catheter and avoid injury to the urethra*) and the specimen removed. Hemostasis was achieved in the pelvis and perineal wound.

The perineal skin was closed with *skin staples/subcuticular sutures of ____/vertical mattress sutures of 3-0 Nylon/Vicryl. The back wall of the vagina was carefully re-approximated and closed with a subcuticular suture of running 4-0 Monocryl*.

The colostomy was then matured with multiple interrupted sutures of 3-0 Vicryl placed in such a way as to tack the full thickness of the edge of the colon to a subcuticular layer of the skin. An ostomy appliance was placed.

The patient was repositioned in the supine position, and a dressing of *Kerlix fluffs/ABD pads/mesh shorts* was applied to the perineal wound. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room after tolerating the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Mohammad Khreiss, M.D., and Vassiliki Liana Tsikitis, M.D., in the previous edition.

End Ileostomy

68

Adam C. Nelson and Celia M. Divino

Indications

- Ulcerative colitis or familial adenomatous polyposis (when sphincter preservation is contraindicated or will be staged)
- Crohn's disease with pancolitis
- Toxic or fulminant colitis (e.g., due to clostridium difficile)
- Non-localizable lower GI bleeding
- Obstructed, perforated, or synchronous colon cancer

Essential Steps

1. Preoperative ostomy site marking.
2. Midline incision.
3. *Perform indicated bowel resection* (e.g., *subtotal colectomy*).
4. Mobilize terminal ileum.
5. Skin incision at ileostomy site.
6. Incise anterior sheath, rectus muscle, posterior sheath, and peritoneum.
7. Bring terminal ileum through ostomy site.
8. Verify orientation and length of ileum.
9. Closure of midline incision.
10. Excise stapled end of ileum.
11. Eversion and maturation of ileostomy.

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Note These Variations

- Indicated bowel resection can be performed laparoscopically.
- Distal segment of resected colon:
  - Left in place as a Hartmann's pouch.
  - A colonic mucous fistula is combined with the end ileostomy. This is occasionally necessary after resection of a gangrenous/perforated segment of colon and an immediate anastomosis is not advisable.

Complications

- Early
  - Ischemia
  - Mucocutaneous separation
  - Retraction
- Late
  - Small bowel obstruction
  - Stenosis
  - Prolapse
  - Parastomal hernia

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_68

Template Operative Dictation

Preoperative Diagnosis Colonic *ischemia/infection/perforation/obstruction* secondary to __________

Procedure __________ (*indicate resection performed*) with creation of end ileostomy *and mucous fistula*

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with __________ who presents for *elective/emergent* __________ (*indicate resection performed*) with end ileostomy.

Description of the Procedure Informed consent was obtained which included a discussion of the risks and benefits of surgery and the need for an ostomy. Prior to surgery, the ileostomy site was marked in the *right lower quadrant/upper abdomen* (*if obese*) with the patient in seated and standing positions. *Ostomy marking was done in consultation with an enterostomal therapist*. The patient was then brought to the operating room and placed on the table in supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced, a Foley catheter was placed, and preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

A midline incision was made and carried down to fascia using electrocautery. The fascia was divided and the peritoneal cavity was entered. The abdomen was explored. *Include details of bowel resection. Dictation begins again at proximal bowel transection*.

Attention was turned to the right lower quadrant where the terminal ileum was identified and carefully mobilized. The right ureter and duodenum were identified and kept from harm throughout the dissection. The mesentery of the terminal ileum was divided using *a vessel sealer/silk ties*. A disease-free point on the terminal ileum was selected for transection. An avascular window was developed in the mesentery adjacent to the transection point. A linear GIA stapler was inserted through the window, placed across the ileum, and fired. *The resected bowel was then removed from the field*.

A 2-cm circle of the skin was excised at the previously marked ostomy site. Dissection was carried down to anterior fascia where a 3-cm *cruciate/longitudinal* incision was made. The rectus muscle was split in the direction of its fibers. The posterior sheath and peritoneum were similarly incised in a *cruciate/longitudinal* fashion. A Babcock clamp was used to guide the ileum through the opening. The ileum was carefully inspected and found to lie at the abdominal wall without tension or twists in the mesentery. Hemostasis was adequate.

A corner of the distal colon was similarly brought through the opening to be matured as a mucous fistula. The distal colon was left in its anatomic position as a Hartmann's pouch.

Fascia was then closed with *interrupted ______/running suture of* ______. The skin was closed with *skin staples/subcuticular sutures of ______/other*. A sterile towel was placed over the midline incision to prevent contamination while maturing the ileostomy.

The staple line at the terminal ileum was excised which revealed excellent blood flow to the cut edge of bowel. The ileostomy was then everted with 3-0 absorbable sutures: first with a full thickness bite at the cut edge, then a seromuscular bite at the ostomy base, and finally a bite through the dermis of the skin. These sutures were placed circumferentially around the ostomy and then tied. The everted ileostomy was found to have adequate height. An ostomy appliance was placed. Sterile dressings were placed on the midline wound. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the recovery room and stable condition.

Acknowledgment This chapter was contributed by Emily Steinhagen, M.D., in the previous edition.

69 Loop Ileostomy

Keelin Flannery Roche and Linda P. Zhang

Indications

- Any situation that requires near-complete, temporary diversion of fecal stream.
- Protection of distal anastomosis
- Relief of obstruction

Essential Steps

1. Ostomy marking should occur before the OR, ideally with patient in both supine and erect position to determine optimal location. Ideal placement is close to the lateral edge of the rectus muscle and sheath, either above or below the umbilicus avoiding skin folds. Good placement allows ease of appliance application.
2. In cases of obstruction or perforation, a nasogastric tube should be placed and the patient should be resuscitated appropriately prior to the OR.
3. Preoperative antibiotics should be given prior to incision.
4. Make a midline incision. Length depends upon the need for associated surgical procedures (i.e., colonic resection or anastomosis).
5. Identify the terminal ileum by using the cecum as a guide.
6. Choose a freely mobile loop of distal ileum, approximately 1 ft or more from the ileocecal valve. Make sure there is enough mobility to ensure a tension-free ostomy. Allow sufficient length from the ileocecal valve to make eventual closure of the loop ileostomy easy via a side-to-side anastomosis.
7. Make an opening in the mesentery with a Kelly hemostat, avoiding mesenteric blood vessels. Encircle the loop with an umbilical tape or a Penrose drain. Mark the proximal side with an absorbable seromuscular marking stitch.
8. Re-approximate the midline with Kocher clamps so that the abdominal wall is in the appropriate orientation it will assume postoperatively.
9. At the previously marked site, excise an appropriately sized disc of skin and subcutaneous tissue. Carry incision down to the fascia, and make an adequately sized incision in the fascia and peritoneum, using either a linear or cruciate incision. The facial opening should be approximately two fingerbreadths in size.
10. Deliver intended loop through the ostomy site, taking care not to rotate the distal/proximal

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_69

orientation. Using a gentle rocking motion, this loop can be brought through the abdominal wall. The ostomy opening should be large enough for the bowel loops and one finger. The bowel should be oriented vertically.

11. Exchange the umbilical tape or Penrose drain for a plastic ostomy rod. Ensure ostomy is above the level of the skin, approximately 5 cm.
12. Confirm through the midline incision that the loop is tension-free and not twisted or kinked.
13. Confirm hemostasis, and then close the lower midline abdominal incision. Protect wound.
14. At the distal end of the loop, open the bowel two-thirds of the diameter. Achieve hemostasis with cautery as needed.
15. Mature the distal end with full-thickness ileal wall to subcuticular skin stitches of synthetic absorbable suture.
16. Remove the marking stitch. Evert the proximal end of the loop ileostomy. Use the back of a scalpel to ensure the functional end is adequately elevated from the surrounding skin. Mature the proximal end with sutures from the ileal wall to the skin, as was done with the distal end.
17. Secure the ostomy rod to the skin using nonabsorbable suture.
18. Place appliance.

Note This Variation

- Instead of carrying out a complete loop and then cutting, everting, and maturing the ileostomy, one can staple across the apex of the loop using a mechanical stapler, without violating the mesentery. The complete proximal limb and one corner of the distal limb are delivered through the ostomy site. The proximal staple line is excised, and then matured as with an end ileostomy. Only the exposed portion of the distal limb's staple line is excised, to allow for decompression; this cut end is then matured as above.

Complications

- Skin excoriation
- Ostomy ischemia or necrosis.
- Parastomal hernia
- Ostomy retraction
- Ostomy prolapse
- Mechanical obstruction at fascial opening
- Paraileostomy abscess
- Fistula

Template Operative Dictation

Preoperative Diagnosis *Obstruction/perforation* of the colon

Procedure *Resection with primary anastomosis* and diverting loop ileostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* presented with *colonic obstruction/perforation* requiring temporary fecal diversion, for which loop ileostomy was performed.

Description of Procedure After explaining the risks and benefits of the procedure and obtaining informed consent, the patient was brought to the operating room and placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. Venous compression devices and a Foley catheter were placed, and the abdomen was prepped and draped in the usual sterile fashion. A lower midline incision was made and then carried down through the subcutaneous tissue with electrocautery dissection, ensuring hemostasis. The exposed linea alba was incised, taking care not to injure underlying bowel, and the fascia and peritoneum were opened.

Associated Surgical Procedures Were Performed

Attention was then turned to the cecum, in order to identify the terminal ileum. An appropriate segment of distal ileum with adequate mesenteric length was selected. Next, a Kelly clamp was used to carefully dissect a small hole in the associated mesentery just below the apex of the loop, in order to thread a Penrose drain to hold the loop. A marking stitch was placed in order to identify the proximal end of the ostomy.

The midline was re-approximated with Kocher clamps. A circular disc of skin and subcutaneous tissue was excised from the previously determined ostomy site. Hemostasis was achieved, and the underlying fascia was incised in order to allow two fingerbreadths of space. With the guidance of the Penrose drain, the loop was delivered through the ostomy site, maintaining proper orientation of the ends of the ileostomy. Adequate space was ensured and one finger was able to traverse easily with the loop ileostomy.

After checking that the mesentery was not under tension, and the small bowel was in appropriate orientation, hemostasis was achieved and the midline abdominal incision was closed. First, the fascia was re-approximated with 2-0 running PDS, followed by 3-0 Vicryl interrupted subcutaneous sutures, and finally a 4-0 Monocryl running subcuticular suture. The wound was protected with towels to prevent contamination.

The Penrose drain was exchanged for a plastic rod to support the ostomy. A *two-thirds near-circumferential incision* was made toward the distal aspect of the ileal loop, leaving at least one centimeter of space from the incision to the skin edge. The bowel edges were sutured to the surrounding skin by taking full-thickness bites of the edges of the ileum, then to a seromuscular bite at the base of the ostomy, and then to the dermis of the skin. Attention was then turned to the proximal limb. The marking stitch was removed. The proximal bowel was everted using a blunt end of a scalpel. Again the bowel edges were sutured to the surrounding skin. This was carried out around the complete circumference of the ostomy.

The ostomy rod was sutured into place using 3-0 Nylon suture. The ostomy appliance was placed, and the midline wound was dressed with a sterile bandage. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was awoken from anesthesia and taken to the recovery room in stable condition. All instruments, needles, and towels had been accounted for.

Acknowledgment This chapter was contributed by Lauxcra Doyon, M.D., and Kaare Weber, M.D., in the previous edition.

Laparoscopic Loop Ostomy (Loop Ileostomy and Sigmoid Colostomy)

70

Anuradha R. Bhama and Robert K. Cleary

Indications

- Need for temporary or permanent diversion of the fecal stream, such as an obstructing distal cancer

Essential Steps

1. Enterostomal nurse education with stoma site marking, while patient is awake and in the upright and sitting position.
2. Obtain laparoscopic access and insufflate the abdomen. Place ports. Mobilize the *terminal ileum/sigmoid colon* as appropriate.
3. Choose location on bowel that will easily reach chosen site of stoma on the abdominal wall.
4. Create stoma site:
   - Excise skin.
   - Divide/spread anterior sheath/rectus/posterior sheath and peritoneum.
5. Grasp the terminal ileum or sigmoid colon and allow the abdomen to deflate.
6. Bring loop of the terminal ileum or sigmoid through stoma site aperture.
7. Confirm orientation.
8. Check hemostasis.
9. Close port sites.
10. Mature stoma.

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Note These Variations

- May perform either loop ileostomy or loop sigmoid colostomy.
- End colostomy may be created by completely dividing the colon with a stapler and maturing the proximal end.

Complications

- Iatrogenic injury during access to the abdomen
- Ischemia of the stoma
- Obstruction/ileus
- Stoma retraction
- Stoma prolapse
- Parastomal hernia

Template Operative Dictation

Preoperative Diagnosis *Obstructing colon/rectal cancer*

Procedure (*Specify type*) laparoscopic diverting loop *ileostomy/colostomy*

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_70

Indications The patient is a ___ -year-old *male/female* who presented with ______________. Fecal diversion is indicated at this time.

Description of the Procedure The patient was taken to the operating room and placed supine on the operating room table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After the induction of general anesthesia, one or both upper extremities were tucked with all pressure points padded appropriately. A urinary catheter was placed using sterile technique. The abdomen was prepped and draped in a sterile fashion.

The abdomen was entered in the midline above the umbilicus using the *Hasson technique/Veress needle*. The abdomen was insufflated to achieve a carbon dioxide pneumoperitoneum of 15 mmHg. A 5 mm/12 mm port was placed at the umbilicus, and a laparoscope was used to examine the abdomen for iatrogenic injury and adhesions, and none was seen. The liver was examined and revealed _______ (*metastatic disease*). A thorough abdominal laparoscopic exploration was performed.

If loop ileostomy: Two additional ports were placed under direct vision in the left lower quadrant and the suprapubic region. The small bowel was run to identify the terminal ileum. Approximately 10–20 cm proximal to the ileocecal valve, a loop of the ileum was chosen that would easily reach the abdominal wall without tension. The patient had been previously marked by enterostomal nurse, and this site in the right *lower/upper* quadrant was used for the ileostomy. A disc of the skin was excised, and dissection was carried down to the fascia. The anterior rectus sheath was incised, the underlying rectus muscle was split, and the posterior rectus sheath was incised to comfortably accommodating two fingers. Under direct vision, the loop of small bowel was brought through the abdominal wall and laid to rest until the wounds were closed. The orientation was double checked.

If sigmoid colostomy: Two additional 5 mm ports were placed under laparoscopic vision in the right lower quadrant and right upper quadrant. The patient was placed in Trendelenburg tilt with rotation to the right side. The small bowel was swept out of the pelvis, and the tumor in the sigmoid colon was visualized. Lateral to medial dissection of the sigmoid colon was carried out by retracting the sigmoid colon medially and taking down the white line of Toldt. The sigmoid colon was dissected off the retroperitoneum taking care to avoid the ureter. The descending colon and sigmoid colon were mobilized so that the colon would reach the anterior abdominal wall without tension. Attention was then turned to creation of the diverting loop colostomy. The patient had been previously marked by enterostomal nurse. The skin at this site in the left *lower/upper* quadrant was excised, and dissection was carried down to the fascia. The anterior rectus sheath was incised, the underlying rectus muscle was split, and the posterior rectus sheath was incised to comfortably accommodating two fingers. The proximal sigmoid colon was then brought up through this site for the colostomy.

All laparoscopic trocars were removed. The fascia of the midline trocar site was closed using 0 Vicryl suture (if 12 mm port was placed). The skin of the port sites was closed using 4-0 monofilament absorbable suture followed by the application of Dermabond. The ostomy was then matured in a Brooke fashion, and an appliance was placed over the stoma.

The patient tolerated the procedure well with no immediate complications. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was transferred to the recovery room in stable condition.

Closure of Loop Ileostomy

71

Walid Faraj, Hussein Nassar, and Ahmad Zaghal

Indication

- Healed distal anastomosis confirmed by endoscopic or contrast studies

Essential Steps

1. Verify anal sphincter competency by physical exam or manometric study if the index procedure involved the anal sphincter mechanism.
2. Confirm adequate healing of distal anastomosis.
3. Make an incision around the stoma.
4. Dissect circumferentially until the fascia is reached and peritoneal cavity entered.
5. Clearly identify proximal and distal limbs.
6. Debride the edges of the enterotomy.
7. Determine if primary closure is feasible or if limited resection is needed.
8. Close the enterotomy/perform primary resection and anastomosis:
   - Hand sewn.
   - Double-stapled technique.
   - Rarely, segmental resection and anastomosis are needed.
9. Close the wound:
   - Pack wound open for delayed closure.

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Note These Variations

- The stoma may be closed with sutures or staples.
- Sometimes, a limited ileal resection is required if the stoma site is in poor condition.
- Packing the wound open for delayed closure is often a prudent alternative to primary closure.

Complications

- Infection
- Bleeding
- Anastomotic leak
- Incisional hernia

Template Operative Dictation

Preoperative Diagnosis ___months status post low anterior resection with protective loop ileostomy for colon/rectal cancer

Procedure Closure of loop ileostomy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who underwent ____ with proximal diverting loop ileostomy ___ months ago. *Contrast studies revealed a securely healed distal*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_71

anastomosis/physical exam, and manometric studies revealed an acceptable anal tone.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The patient was placed in a supine position. The procedure was performed under *local/general* anesthesia. The ileostomy bag was removed, the ileostomy site was cleaned, and then the *abdomen was* prepped and draped in a sterile manner. A time-out was completed verifying correct patient, procedure, site, positioning, and implant(s) and/or special equipment prior to beginning this procedure. An elliptical skin incision about 2 mm from mucocutaneous junction, around the ileostomy, was performed. The incision was deepened in the subcutaneous tissue until the serosa of the emerging bowel appeared. Sharp dissection was continued circumferentially in this plane, dividing the fine adhesions between the bowel and its mesentery and the subcutaneous fat until the fascia was reached and the peritoneal cavity entered; after which it was feasible to bring the emerging ileal loop through the wound, the mucocutaneous junction and the rim of the skin were excised, the everted proximal end of the stoma was unfolded, and the edge of enterotomy was freshened. The stoma was inspected and found to be *suitable for primary closure without resection/unsuitable for primary closure, and therefore a limited resection of the stoma site was performed to permit safe closure*.

Choose One

If hand-sewn anastomosis: *then a formal hand-sewn end-to-end anastomosis using seromuscular interrupted absorbable sutures was done to restore the intestinal continuity*.

If stapled closure: *then a transverse stapled closure of the ileal loop was done*.

The site was checked for hemostasis, which was adequate, and the loop of the ileum was returned back to the abdominal cavity.

Hemostasis was secured, fascial defect was closed using continuous nonabsorbable suture, and the skin was *closed using interrupted nonabsorbable sutures/packed open for delayed primary closure*.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Transverse Loop Colostomy

72

Dustin R. Cummings and Scott Q. Nguyen

Indications

- Diversion of the fecal stream proximal to the splenic flexure due to obstruction or perforation

Essential Steps

- Mark the location of the colostomy.
- Perform transverse incision through planned colostomy site, making sure to create an adequate fascial opening.
- Decompress the colon if distended.
- Deliver the transverse colon through the incision.
- Mobilize the hepatic flexure if additional length is required.
- Create a mesenteric window.
- Place a rod through the mesenteric window.
- Close the fascia and skin around the colon to assure secureness of position.
- Mature colostomy and place an ostomy device.

Note This Variation

- For a markedly distended colon, it may be necessary to make a controlled colostomy in the free tenia to aspirate the colonic contents before bringing up that loop to mature into a stoma.

Complications

- Colonic ischemia, necrosis
- Parastomal hernia
- Stoma prolapse

Template Operative Dictation

Preoperative Diagnosis Obstruction of the left colon

Procedure Transverse loop colostomy

Postoperative Diagnosis Same

Indication The patient is (age) male/female with a diagnosis of colonic obstruction. The risks and benefits of surgery were discussed with the patient/health-care proxy, and the decision was made to perform a transverse loop colostomy. The patient was brought into the operating room and placed on the operating room in the supine

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_72

position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Pneumatic DVT compression stockings were placed on both lower extremities. IV access was established and the patient subsequently induced and intubated by the anesthesiologist. A Foley catheter was inserted into the urinary bladder using standard sterile technique. A perioperative dose of antibiotic was administered by the anesthesiologist. The abdomen was prepped in the usual sterile fashion.

A transverse was made in the right upper quadrant with a scalpel. The incision was carried down through the subcutaneous tissues with electrocautery. The muscular and aponeurotic layers were incised and spread with retractors. The peritoneal layer was visualized and incised sharply. Upon entering the peritoneal cavity, the transverse colon was immediately visualized and noted to be significantly distended.

For decompression: *To adequately deliver the colon through the incision*, *a decision was made to decompress it. The greater omentum was swept cephalad. A free tenia coli was identified, and a 3-0 silk was secured in a purse-string fashion through the seromuscular layer. A poole suction tip was placed obliquely through the colon wall, and the liquid stool and gas were subsequently evacuated. The purse-string suture was then tied down to prevent any further leakage of stool*.

The loop of the transverse colon was delivered through the incision. Additional length was achieved by dividing the peritoneal attachments to the colon and mobilizing the hepatic flexure. The greater omentum over the proposed colostomy site was dissected free from the colon and ligated.

A mesenteric window was created under the colon by dividing the mesentery adjacent to the colon wall. A plastic rod was inserted through the mesenteric window in order to elevate the loop of the transverse colon above the level of the skin. The loop of the colon was allowed to rest upon the skin. The fascial defect was assessed. Interrupted Vicryl sutures were placed at the edge of the fascial defect to ensure an opening that could accommodate the loop of the colon and approximately one fingerbreadth. Sterile towels were placed around the colostomy to protect the surgical field. The colon was opened with electrocautery in a transverse fashion, and the colonic contents were suctioned out. The double-barrel colostomy was then matured in the standard Brooke fashion of mucoserosal to cutaneous interrupted 3-0 Vicryl sutures. After maturation, the colostomy was noted to be pink and viable. *A 32 French Foley catheter was cut and secured to either end of the rod*, *forming a small loop to prevent the colostomy from falling into the abdominal wound*. A colostomy appliance was then placed.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure without difficulty and was extubated and taken to the postanesthesia care unit in stable condition.

Acknowledgment Gary William Swain, Jr, M.D., contributed to this chapter in the previous edition.

Closure of Transverse Loop Colostomy

73

Adam C. Nelson and Scott Q. Nguyen

Indication

- Colostomy/fecal diversion is no longer required.

Essential Steps

1. Make an incision around mucocutaneous border of colostomy.
2. Carry dissection through the fascia and into the peritoneum.
3. Free adhesions around fascial defect and mobilize bowel.
4. Assess and freshen edges of bowel.
5. *Stapled* vs. *hand-sewn closure*.
6. Abdominal wall closure.
7. Gauze packing.

Note This Variation

- Hand-sewn rather than stapled anastomosis

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Complication

- Wound infection
- Anastomotic leak
- Stricture
- Colocutaneous fistula
- Incisional hernia

Template Operative Dictation

Preoperative Diagnosis Transverse loop colostomy

Procedure Closure of transverse loop colostomy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who is status post loop transverse colostomy creation for *obstruction/perforation* secondary to ________. *He/she* now presents for colostomy closure.

Description of Procedure After informed consent was obtained, the patient was brought in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced, a Foley catheter was placed, and pre-

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_73

operative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion. A circumferential skin incision was made 3–4 mm from the mucocutaneous border of the colostomy. Allis clamps were applied to the colostomy edges to aid in retraction and help prevent contamination. The dissection was carried down, separating the bowel from subcutaneous tissue, until the bowel and mesentery were exposed to the level of anterior fascia. Adhesions to fascia were then divided using Metzenbaum scissors until the peritoneal cavity was entered. An index finger was inserted into the abdomen and gently swept around the loop of bowel to dissect any adjoining peritoneal attachments. *The remainder of the rectus muscle was divided laterally in order to better accommodate intra-abdominal adhesiolysis*. At this point the bowel was fully mobilized from the abdominal wall. The bowel was then inspected and found to have *no serosal injury or enterotomies/a serosal tear which was imbricated with interrupted 3-0 silk suture/an enterotomy which was repaired primarily with an inner layer of absorbable seromuscular stitches followed by an outer layer of permanent Lembert stitches*. The colostomy edge was freshened to healthy tissue by excising a rim of bowel containing the mucocutaneous junction and attached skin.

Choose One

Stapled closure: A linear GIA stapler was placed into the colostomy, one stapler arm into each limb of bowel. The stapler was fired along the antimesenteric surface to create a side-to-side anastomosis. Allis clamps were placed to approximate the edges of the common colotomy, and the defect was then closed with a TA stapler. The staple line was oversewn with 3-0 silk Lembert stitches, and a reinforcing crotch stitch between the two loops of bowel was placed.

Hand-sewn closure: The defect was closed transversely with two layers of suture. An inner running layer of absorbable suture was placed in a Connell pattern. This was followed by a nonabsorbable layer of interrupted seromuscular Lembert stitches. The lumen was adequate in size and the suture line was free of tension.

The bowel was returned to the abdomen. Fascia was closed with __ suture. The wound was thoroughly irrigated and packed with moist gauze. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the recovery room in stable condition.

Acknowledgment This chapter was contributed by Catherine Madorin, M.D., in the previous edition.

Sigmoid Resection and Rectopexy (Frykman-Goldberg Procedure)

74

David J. Berler

Indication

– Full-thickness rectal prolapse with constipation

Essential Steps

1. Modified lithotomy position.
2. *Optional*: ureteral stent placement.
3. Lower midline laparotomy (or *Pfannenstiel incision*).
4. Divide the lateral peritoneal reflection from the superior rectum to mobilize it from the left lateral wall.
5. Identify the ureters and gonadal vessels; sweep them posteriorly.
6. Identify, isolate, and divide the superior rectal artery.
7. Identify and dissect the presacral avascular space with preservation of the hypogastric nerves.
8. Incise the peritoneal reflection to the right of the rectum; continue dividing to unite with the previous incision, at the anterior rectum.
9. Mobilize the rectum to the level of the levators, with preservation of the lateral stalks.
10. Retract the distal sigmoid colon and rectum upward to define level of the distal resection margin, planning for an anastomosis at the level of the sacral promontory.
11. Divide the proximal sigmoid colon in a region which will easily reach the pelvis; avoid mobilizing the colon too proximally, as this might lead to further redundancy and/or recurrence. Position the EEA anvil device.
12. Divide the sigmoid mesentery with clamps and ties or energy device, staying close to the colon.
13. Divide the upper rectum with the GIA or TA stapler.
14. Create an EEA colorectal anastomosis at the level of the sacral promontory, between the rectum and proximal sigmoid margin.
15. Air-leak test the anastomosis.
16. Place and secure rectopexy sutures to the presacral fascia.
17. Irrigate the pelvis and assure hemostasis.
18. Close the abdomen.

Variations

- Use of preoperative bowel prep.
- In patients with no history of constipation who do present with prolapse with incontinence and/or diarrhea, forego sigmoid resection.
- Intraoperative placement of ureteral stents.
- Laparoscopic approach.
- Use of drains.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_74

Complications

- Recurrence
- Anastomotic leak
- Bleeding (particularly from presacral fascia during rectopexy portion)
- Inadvertent injury to the ureters and/or hypogastric nerves

Template Operative Dictation

Preoperative Diagnosis Full-thickness rectal prolapse with constipation

Postoperative Diagnosis Same

Procedure Sigmoid resection with rectopexy

Anesthesia General endotracheal

Indication This is a __-year-old man/woman who presented with full-thickness rectal prolapse and constipation. Preoperative colonoscopy was negative for malignancy. The patient agreed to undergo sigmoid resection and rectopexy for definitive management and provided informed consent after being explained the risks, benefits, and alternatives to the planned surgery.

Description of Procedure An epidural catheter was placed by the anesthesia team in the preoperative holding area. The patient was then brought to the operating room and placed supine on the operating room table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Sequential compression devices were applied and appropriate prophylactic antibiotics were administered. Following this, general anesthesia was induced and the patient was repositioned into the modified lithotomy position using Allen stirrups. A Foley catheter was placed and the patient was then prepped and draped in the usual sterile fashion.

A *lower midline/Pfannenstiel incision* was made with a scalpel and taken down to the level of the fascia with electrocautery. The peritoneal cavity was entered sharply without difficulty; exploration of the abdomen revealed: *list findings*. The small bowel was gently retracted and packed into the upper abdomen using moist lap pads.

The lateral attachments of the junction between the descending colon and sigmoid were divided with electrocautery, and the incision of the pelvic peritoneum was carried down to the pelvic floor on both sides. Both ureters were clearly identified and preserved. The redundant sigmoid colon was retracted out of the pelvis and the base of the rectosigmoid mesentery was palpated. It was found to be avascular and it was sharply dissected with preservation of the hypogastric nerves. At this point the superior rectal artery was clearly identified and isolated. The superior rectal artery was clamped and ligated with 0-Vicryl sutures and then divided with the Ligasure device. The dissection was continued in the avascular presacral plane toward the pelvic floor until the levators were identified. Limited mobilization of the lateral attachments of the rectum was performed with preservation of the lateral stalks. The mesorectum was divided with clamps and ties down to the level of the upper rectum to plan for the anastomosis at the level of the sacral promontory. The rectal wall was cleared of mesenteric fat and it was transected using a *TA–60/GIA stapler*. The mesentery of the sigmoid colon was divided with clamps and ties to the level of the proximal sigmoid colon, to accomplish a tension-free anastomosis to the upper rectum. The wall of the sigmoid colon was cleared of mesenteric fat and was transected after the application of the purse-string device. The specimen was handed off the field.

The sigmoid lumen was measured with EEA sizers and the EEA anvil was placed into the sigmoid colon. At this point the purse-string stitch was tied. A stapled EEA anastomosis was created between the upper rectum and the proximal sigmoid colon at the level of the sacral promontory. An air-leak test was performed and was negative.

Rectopexy was then accomplished with the application of ___ *sutures* between the presacral fascia in the upper rectum distal to the anastomosis. Hemostasis was confirmed and the pelvis was irrigated and suctioned. Operative instruments, suture materials, and laparotomy pack counts were all reported to be correct.

The laparotomy was closed with a running looped #1 PDS suture at the level of the fascia. The incision was irrigated and dried. The skin was closed with staples and a sterile dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was replaced into the supine position, successfully extubated in the operating room, and then transferred to the post-anesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Sergy Khaitov, M.D., in the previous edition.

Open Rectopexy

75

Joshua H. Wolf and Sandy Hwang Fang

Indication

- **Rectal prolapse**

Essential Steps

1. Position the patient in lithotomy with arms out.
2. Make a lower midline incision and enter the peritoneal cavity with care not to injure the bladder. Free the abdominal wall of adhesions and place a self-retaining retractor.
3. Place the patient in Trendelenburg position and pack the small bowel into the upper quadrants.
4. Retract the sigmoid colon superiorly and to the left. Identify the course of the superior hemorrhoidal artery, and make an incision in the peritoneum overlying the sigmoid mesentery. Carry this incision down toward the pelvis along the sacral promontory.
5. Retract the sigmoid colon medially and incise the lateral attachments. Take care to identify and preserve the left ureter and any presacral nerves.
6. Join the right- and left-sided dissection planes by making a window posterior to the superior hemorrhoidal artery. Preserve the artery by dissecting the avascular plane posterior to it, and extend this down to the level of the levator ani muscle.
7. Reduce the redundancy by pulling cephalad on the rectosigmoid, until the bowel overlying the curve of the sacral promontory is straight, but not taut.
8. Once the optimal tension is determined, identify the portion of bowel that will rest over the sacral promontory. Secure the right lateral mesorectum at this level to the sacrum with a mattress 1 Prolene suture. Repeat this so that a total of three sutures are placed on the right side. Ensure the sutures do not include rectal wall.
9. Irrigate the pelvis and ensure that adequate hemostasis has been achieved.
10. Close the abdomen in layers.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_75

Note These Variations

- Combined with sigmoid resection (resection rectopexy) for those patients who have a history of constipation and a redundant colon.
- Bilateral Prolene sutures to fixate the rectum rather than both on the same side. The risk of bilateral fixation is stenosis.

Complications

- Surgical site infection
- Presacral bleeding
- Autonomic/sexual dysfunction
- Urinary retention
- Fecal incontinence
- Ureteral injury
- Recurrent rectal prolapse
- Small bowel obstruction
- Small bowel ileus
- Obstructed defecation

Template Operative Dictation

Preoperative Diagnosis Full-thickness rectal prolapse

Procedure Laparotomy, adhesiolysis, suture rectopexy

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with a history of full-thickness rectal prolapse. Informed consent was obtained for the procedure.

Description of Procedure After obtaining informed consent, the patient was brought to the operating room. 5,000 units of subcutaneous heparin and perioperative antibiotics were administered in the preoperative area within 1 h of the surgical incision. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced and a Foley catheter and an orogastric tube were placed. He/she was positioned on the OR table in lithotomy with the bilateral upper extremities placed at a 75-degree angle. Appropriate foam padding was used to protect pressure points. After ensuring that the patient was securely positioned, the bed was leveled and the abdomen was prepped with a chlorhexidine solution and draped in a sterile fashion.

A lower midline laparotomy incision was created and the abdomen was safely entered. Adhesiolysis was performed until the undersurface of the abdominal wall was clear on both sides for a self-retaining retractor. The patient was placed in Trendelenburg, and the small bowel was carefully removed from the pelvis and placed behind a moist towel in the right and left upper quadrants. The sigmoid colon was very redundant and was retracted laterally to expose the adjacent mesentery. The peritoneum on the medial surface of the mesentery was scored with electrocautery, and this incision was carried down to the sacral promontory while avoiding the path of the superior hemorrhoidal artery. The right and left ureters were identified and protected. The lateral attachments to the distal sigmoid colon were then taken down, and a window was made to connect the two planes of dissection posterior to the superior hemorrhoidal artery. With this artery preserved, the dissection was continued caudally for full posterior mobilization of the rectum down to the level of the levator ani muscle. The lateral peritoneal attachments of the rectum were mobilized staying medial to and without injury to the lateral stalks.

The peritoneal surface of the anterior reflection was then incised and the rectum was mobilized in this plane down to the level of the pelvic floor, to meet the posterior dissection. Care was taken to protect the vagina by reflecting it anteriorly. The rectum was gently retracted cephalad to reduce the redundancy in preparation for the rectopexy. An area of rectum was selected for fixation to the sacral promontory such that the distal rectum was straight with no slack but was not taut. *Three #1 Prolene sutures* on a large needle were used to place *horizontal mattress ties through the right lateral peritoneal attachments to the presacral fascia* (*per surgeon preference*: *catching the superficial periosteum*). Great care was taken to make sure the bites did not traverse the rectal wall. Once hemostasis was achieved, the sutures were tied and secured. After ensuring correct needle and sponge counts, the abdominal fascia was closed primarily *with two running PDS sutures* and the skin was closed with a *running Monocryl*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was safely extubated and brought to the postoperative anesthesia care unit with all vital signs stable.

Laparoscopic Ventral Mesh Rectopexy

76

Joshua H. Wolf and Sandy Hwang Fang

Indication

- **Rectal prolapse**
- **Obstructed defecation syndrome with internal rectal prolapse**

Essential Steps

1. Position the patient on a beanbag in modified lithotomy with both arms tucked at the sides.
2. Place camera port and insufflate the patient, and then place three additional ports: (1) 12 mm infraumbilical, (2) 12 mm port in the right lower quadrant, (3) 5 mm in the right lateral abdomen superior to the 12 mm port, and (4) 5 mm port in the left lower quadrant.
3. Fix the uterus to the anterior abdominal wall with a temporary suture.
4. Position the patient in steep Trendelenburg with the left side up; sweep the small bowel superiorly out of the pelvis.
5. Retract the sigmoid colon laterally to expose the mesocolon and rectum.
6. Incise the peritoneum from the sacral promontory down to the pouch of Douglas. Upon completion, the incision will appear in the shape of an inverted J with the curve extending around the ventral rectum.
7. Identify and protect the right ureter, iliac vessels, and rectal wall.
8. Cut a piece of Marlex mesh into a thin rectangle (3 × 17 cm). After reducing the rectal prolapse, the mesh is placed along the line of incision.
9. Secure the mesh with Prolene sutures anteriorly, laterally, and at the level of the sacral promontory.
10. Reapproximate the peritoneum overtop the entirety of the mesh.
11. Irrigate and assess for hemostasis.
12. Deflate the abdomen and close the port sites.

Note These Variations

- Use of biologic mesh as an alternative to Marlex mesh
- Fixation of the posterior vaginal wall if vaginal prolapse is also present
- Reduction of enterocele if present in the pouch of Douglas
- Open approach in patients with significant abdominal adhesions

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_76

Complications

- Right ureteral injury
- Surgical site infection
- Intraoperative/postoperative bleeding
- Mesh detachment
- Mesh erosion
- Chronic pain
- Dyspareunia
- Proctalgia

Template Operative Dictation

Preoperative Diagnosis Rectal prolapse

Procedure Laparoscopic ventral mesh rectopexy

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with a history of full-thickness rectal prolapse. Informed consent was obtained for the procedure.

Description of Procedure After obtaining informed consent, the patient was brought to the operating room. 5,000 units of subcutaneous heparin and perioperative antibiotics were administered in the preoperative area within 1 h of the surgical incision. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of anesthesia, the patient was intubated and a Foley catheter was placed. He/she was positioned on the OR table atop of a beanbag in modified lithotomy, and both arms were tucked at his/her sides with generous use of foam padding to protect the wrists and elbows. The upper chest was secured to the bed with tape and the table was tested in steep Trendelenburg. After ensuring that the patient was securely positioned, the bed was leveled and the abdomen was prepped with a chlorhexidine solution and draped in sterile fashion.

A 5 mm/12 mm infraumbilical incision was made and a *Veress needle/Hasson trocar* was inserted. The abdomen was insufflated to a pressure of 15 mmHg and a 5 mm/10 mm 30°-angled laparoscope inserted for visualization. The abdomen was inspected for any signs of injury to the intraperitoneal structures related to trocar insertion. Three additional ports were inserted – a 12 mm port was placed in the right lower quadrant, a 5 mm port was placed in the left lower quadrant, and a 5 mm port was placed in the right abdomen approximately one handbreadth superior to the 12 mm port.

The patient was then placed in steep Trendelenburg with the left side up, and an atraumatic grasper was used to retract the small bowel from the pelvis. A 2-0 Vicryl suture was placed through the uterine fundus and secured to the anterior abdominal wall to provide continuous retraction and visualization. The sigmoid colon was retracted anterolaterally, exposing the mesocolon. A 5 mm LigaSure device was used to incise the peritoneum at the level of the sacral promontory and continue along the right lateral edge of the rectum to the peritoneal reflection ventral to the rectum. Care was taken to identify and preserve the right ureter and iliac vessels, preserve the lateral stalk, and avoid injury to the rectal wall. The incision was continued across the anterior rectum, down to the level of the rectovaginal septum. The rectum was gently retracted to reduce any redundancy.

A rectangular piece of Marlex mesh (*specify size*) was then inserted into the abdomen, carefully unfurled, and placed across the peritoneal incision. *2-0 Prolene sutures* were placed through the 12 mm port and used to secure the mesh to the anterior rectum, the lateral rectum, and sacral promontory. *2-0 Vicryl suture* was then used to reapproximate the peritoneum over the mesh for the full length of the repair. After careful inspection to ensure adequate hemostasis, the bed was leveled and the abdomen was deflated. Sponge, instrument, and needle counts were correct. The two 12 mm ports were closed at the level of the fascia with Vicryl sutures and all skin incisions with closed with Monocryl.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was safely extubated and brought to the postanesthesia care unit in stable condition.

77 Altemeier Procedure (Perineal Rectosigmoidectomy)

Ira Lewis Leeds and Sandy Hwang Fang

Essential Steps

1. Prone jackknife or dorsal lithotomy positioning.
2. Prep and drape.
3. Digital rectal exam prior to instrumentation.
4. Prolapse the rectum.
5. Obtain exposure with self-retaining retractor.
6. Injection of epinephrine compound into the rectal mucosa.
7. Circumferential, full-thickness incision of the rectum immediately above the dentate line.
8. Ligate and divide lateral rectal vessels within the mesorectum.
9. Amputate prolapsed segment.
10. Plicate the levator muscles.
11. Create coloanal anastomosis of proximal *rectum/sigmoid colon* to distal rectal stump.

Possible Variations

- Positioning (prone, left lateral, dorsal lithotomy)
- Surgical prep solution
- Anesthesia modality (diverse given relatively less invasive approach)
- Local anesthetic block (perianal field block, pudendal nerve block)

Complications

- Anastomotic dehiscence
- Recurrent prolapse (15 %)
- Chronic constipation
- Chronic incontinence

Operative Note

Preoperative Diagnosis Rectal prolapse

Procedure Altemeier procedure/perineal rectosigmoidectomy

Postoperative Diagnosis Same

Indications This _______-year-old *male/female* has a history of rectal prolapse complicated by *constipation/incontinence [or both]*. The patient was found to be a poor surgical candidate to tolerate a transabdominal approach to surgical repair of *his/her* condition and was counseled that a perineal approach was better suited to *his/her* surgical risks. The patient presented today on (date), for definitive surgical repair of *his/her* rectal prolapse.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_77

Description of Operation

Choose One

The patient completed a mechanical bowel prep the day prior to surgery. The patient was brought to the operating room, and while on the transport cart, cardiopulmonary monitors were placed and vital signs were stable. The patient was transferred to an operating table covered with a gel mat and secured in supine positioning. Time-outs were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General endotracheal anesthesia [see possible variations above]* was smoothly induced. The legs were placed in Allen stirrups in **lithotomy position**. All pressure points were properly padded. The surgical field was prepped with *4 % chlorhexidine soap/povidone-iodine* and draped appropriately.

OR

The patient completed a mechanical bowel prep the day prior to surgery. The patient was brought to the operating room, and while on the transport cart, cardiopulmonary monitors were placed and vital signs were stable. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General endotracheal anesthesia [see possible variations above]* was smoothly induced. The patient was converted from supine position on the transport cart to **prone jackknife positioning** using gel chest rolls for positioning. All pressure points were properly padded. The surgical field was prepped with *4 % chlorhexidine soap/povidone-iodine* and draped appropriately.

Digital rectal examination was performed. A self-retaining retractor was placed over the anus with skin hooks placed immediately distal to the dentate line. Anesthesia induced a Valsalva maneuver via an expiratory hold on the ventilator to induce complete prolapse of the rectum.

Choose One

10 cc of 2 % lidocaine with epinephrine (1:200,000) was infiltrated into the prolapsed rectal mucosa 2 cm proximal to the dentate line.

OR

40 cc of 0.25 % Marcaine was injected as a perianal field block.

A circumferential transmural incision of the rectum 2 cm proximal to the dentate line was made. Dyed 0 Vicryl® was used as orienting stay sutures at the distal cut edge. Allis clamps were applied to the proximal cut surface and used to externalize the redundant rectum *(*and sigmoid colon*)*. To mobilize the rectum, mesorectal adhesions and bands were ligated and divided with electrocautery and 2-0 Vicryl® suture/LigaSure Impact™ until no further redundancy was noted. The mesorectal blood supply was identified, ligated, and divided with 2-0 Vicryl®/LigaSure Impact™. The redundant resection was amputated and submitted to pathology. 0 Vicryl® sutures were placed at the proximal rectosigmoid resection.

Prior to suturing, the orientation of the proximal colon was confirmed to ensure proper alignment for an untwisted, tension-free anastomosis. 2-0 Vicryl® suture was used to perform a hand-sewn coloanal anastomosis. Sutures were placed circumferentially without tension and without gaps between mucosal surfaces.

Hemostasis was achieved. A gentle digital rectal exam was performed to confirm patency. Needle, sponge, and instrument counts were correct. The patient was repositioned from dorsal lithotomy/prone jackknife position to supine position and extubated in the OR without complication. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well without any known intraoperative complications.

Delorme Procedure

78

Anuradha R. Bhama and Robert K. Cleary

Indications

- Partial thickness, mucosal rectal prolapse
- Recurrent full-thickness rectal prolapse, especially in high-risk patients

Essential Steps

1. Rectal exam.
2. *Lithotomy/prone jackknife position.*
3. Grasp the mucosa of the rectum and prolapse mucosa and submucosa to fullest extent.
4. Score rectal mucosa approximately 2 cm cephalad to dentate line.
5. Circumferentially dissect mucosa proximally, leaving the terminal 2 cm in situ.
6. Place plicating sutures in muscular wall of the rectum.
7. Excise redundant mucosa and reapproximate it.

Complications

- Recurrence
- Urinary retention
- Bleeding
- Anal stenosis
- Injury to rectovaginal septum causing fistula

Template Operative Dictation

Preoperative Diagnosis *Partial thickness, mucosal rectal prolapse/others*

Procedure Delorme procedure

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with *partial thickness, mucosal rectal prolapse/others*

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After the induction of *general/spinal anesthesia/sedation*, the patient was positioned in the *prone jackknife/lithotomy* position. The perineum was prepped and draped in the usual sterile fashion.

A digital rectal exam was performed and revealed ______. Examination of the anal canal revealed redundant rectal mucosa and submucosa in all four quadrants. There *were/were not* any other anorectal abnormalities.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_78

Using Allis clamps, recreation of rectal prolapse was attempted.

Choose One

Full-thickness prolapse was not possible, and only the mucosa and submucosa were able to be prolapsed, so the decision was made to proceed with the Delorme procedure.

Full-thickness prolapse was created, and given the patient's many comorbidities, the decision was made to proceed with Delorme procedure in order to avoid creation of a high-risk anastomosis.

A self-retaining retractor system was used to provide exposure of the anal canal. Using electrocautery, the rectal mucosa was scored approximately 2 cm proximal to the dentate line circumferentially. This was deepened into the submucosa. The mucosa and submucosa were dissected away from the circular muscle circumferentially and 5–6 cm cephalad or as far as technically possible. This was carried out until no further submucosa could be prolapsed. The muscular layer was then plicated with interrupted sutures of 2-0 Vicryl to eliminate the rectal prolapse. The excess mucosa was excised circumferentially. The mucosa was then reapproximated with interrupted 3-0 Vicryl suture. Throughout the procedure, the rectovaginal septum was repeatedly examined to ensure no injury to the vagina. Hemostasis was excellent at the end of the operation.

The patient tolerated the procedure well without any immediate complications. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then returned supine on the transport stretcher and taken to the recovery room in stable condition.

Implantation of Sacral Nerve Stimulator

79

Joshua H. Wolf, Steven D. Wexner,
and Sandy Hwang Fang

Indication

- Fecal incontinence

Essential Steps

Note: This procedure is usually performed in two stages. In Stage 1, a temporary stimulator is percutaneously placed. If the patient experiences > 50 % improvement of symptoms during a 2-week trial period, the temporary stimulator is exchanged for a subcutaneously implanted permanent one during Stage 2.

Stage 1

1. Place patient in prone position. Keep patient awake for this stage of the procedure.
2. Prep the lower back/perineum, upper thighs, and buttocks. An adhesive iodine drape is used to allow visualization of the bellows response.
3. Identify the right and left third sacral foramen using fluoroscopy with a C-arm (PA and lateral) and palpation of bony landmarks. Mark the overlying skin.
4. Administer local anesthesia and insert test needles through the marked skin at an angle of 60° with the skin surface. Advance needle under fluoroscopic imaging to the level of the sacral foramen. Verify optimal test needle placement. Insert the quadripolar lead under fluoroscopic guidance along the path of the test needle using Seldinger technique, until the most superficial electrode is in line with the anterior cortex of the sacrum.
5. Adjust the quadripolar lead in order to determine the most effective position (the position that elicits the best sensory/motor response with the least stimulating voltage).
6. After positioning the distal portion of the lead, tunnel the proximal end into a pocket under the gluteus fascia and connect to a temporary wire. This lead is tunneled to another site more lateral site where it is fixed to an external pulse generator.

Stage 2

1. ≥50 % symptom resolution (as judged by either incontinence score or number of incontinent episodes per week) during a 2-week trial period using the temporary stimulator is an indication for implantation of a permanent device.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_79

2. Position the patient prone. In Stage 2, the patient is sedated.
3. Open the subcutaneous pocket and identify the junction between the temporary generator and the lead. Carefully remove the temporary wire.
4. Introduce a permanent stimulator (Medtronic Inc, Minneapolis, MN) to the field. Connect the stimulator to the lead and position the stimulator superficial to the lead in the pocket created.
5. Program the stimulator for stimulation.
6. Irrigate the pocket and close with two layers of absorbable suture.

Note These Variations

- Bilateral SNS placement has been advocated by some groups in cases of unilateral failure, but has not been shown to be more efficacious and is not FDA approved for fecal incontinence.
- Variable angles of needle insertion have been reported, ranging from 50 to 90 °.

Complications

- Surgical site infection
- Site pain
- Pain related to stimulation
- Lack of efficacy during trial period – does not progress to Stage 2
- Loss of efficacy after implantation of permanent device
- Need for mesh explantation

Template Operative Dictation

Stage 1

Preoperative Diagnosis Fecal incontinence

Procedure Implantation of right third sacral tined lead under fluoroscopic guidance

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with a Cleveland Clinic incontinence score of __.

Description of Procedure The patient was placed in a prone position on the operating room table. In order to assess response to lead stimulation, the patient was kept awake for the procedure. Time-outs were performed using pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The lower back, buttocks, perineum, and anal area were prepped and draped in the usual sterile manner and covered with an antimicrobial adhesive (Ioban, 3M; St Paul, MN). The right and left third sacral foramina were identified using PA and lateral radiographic imaging with a C-arm and by palpation of bony landmarks to mark the overlying skin.

Local anesthesia was administered to the marked area with a solution of 0*.5 % Xylocaine*, *0.25 % Marcaine*, *including 1:400,000 units of epinephrine for a total of 40 cc*. Bilateral test needles were inserted through the skin at approximately a *60*° angle and, then under fluoroscopic guidance, were further advanced into both the right and left third sacral foramina. A superior response was achieved on the (left/right) side, and accordingly, the quadripolar lead was placed on that side under fluoroscopic guidance using the Seldinger technique until the most superficial electrode was lined up with the level of the anterior sacral cortex. The lead was stimulated in order to test for sensory and/or motor responses (bellows response and plantar flexion of the great toe) in different positions. Adequate sensory and motor responses were noted with stimulation ranging from (__) *to* (__) *volts in* (#) *of the leads on the* (*right/left*) *side*.

Imaging confirmed excellent placement with the typical “hockey stick” configuration at the S3 level. Radiographic images were taken in the PA and lateral positions for confirmation. An incision was made to create a pocket in the (right/left) lateral buttock, and the lead was tunneled into the pocket and assembled to the temporary connector, which was then in turn re-tunneled to a (right/left) skin exit. After copious antibiotic irrigation of all wounds, wounds were closed in layers with __ suture and covered with sterile dressings.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then discharged to room in stable condition without evidence of any apparent operative complications. Total fluoroscopic time was ____.

Stage 2

Preoperative Diagnosis Fecal incontinence

Procedure Implantation of InterStim II sacral nerve stimulator with intraoperative programming

Postoperative Diagnosis Same

Indications The patient is ______-year-old *male/female* with a history of fecal incontinence who is now ____ (time) status post implantation of a tined quadripolar lead for sacral stimulation. The patient’s recent Cleveland Clinic Florida incontinence score is ___.

Description of Procedure The patient was carefully positioned in the prone position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After adequate sedation was administered, the lower back, buttocks, perineum, and anal area were prepped and draped in the usual sterile manner. The incision overlying the right-sided temporary connector was re-incised, and the temporary connector was removed from the electrode lead. After copious irrigation and verification of meticulous hemostasis, the lead was placed into the stimulator, and a single screw was appropriately tightened. After copious antibiotic irrigation, the pocket was closed in layers with *Vicryl suture* and covered by a dry dressing. Intraoperative programming was then undertaken.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then discharged to the recovery room in stable condition without evidence of any apparent operative complications.

Part VI

General Surgery: Perianal Region

Drainage of Perirectal Abscess

80

Shauna Lorenzo-Rivero

Indication

- Perirectal or perianal abscess

Essential Steps

1. Rectal exam.
2. Inject local anesthetic.
3. Proctoscopy.
4. Aspirate the abscess.
5. Incise and drain.
6. Break loculations *digitally/with hemostat*.
7. Irrigate.
8. Pack open.

Note These Variations

- Submucosal or supralevator abscess requires internal drainage.
- In extremely favorable circumstances, fistulotomy may be done simultaneously.

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Complications

- Bleeding/hematoma formation
- Recurrent abscess
- Fistula formation
- Urinary retention

Template Operative Dictation

Preoperative Diagnosis *Perirectal/perianal/submucosal* abscess

Procedure Anoscopy, drainage of perirectal/perianal abscess

Postoperative Diagnosis *Perirectal/perianal/submucosal* abscess

Indications This ___-year-old *male/female* was found to have *palpable/suspected perirectal/perianal/submucosal* abscess.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General/spinal/monitored care* anesthesia was induced. The patient was then repositioned in *lithotomy/left lateral decubitus position*. Digital rectal

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_80

examination was performed and the abscess/mass identified and confirmed to be *infralevator/submucosal*. The patient was prepped and draped in the usual sterile fashion. Local anesthetic was injected *as a perianal/pudendal nerve block*. Anoscopy was performed. The area of swelling was aspirated using an 18-gauge needle and the presence of pus confirmed.

Choose One

If infralevator perirectal or perianal*: An incision was made through the skin over the abscess as close as possible to the anal verge. The surrounding structures were dissected using a hemostat until the abscess cavity was encountered. The hemostat was then used to break up loculations, pus was suctioned from the cavity, and a finger was introduced to confirm the absence of remaining loculations. The abscess was irrigated. Hemostasis was achieved with electrocautery and the cavity packed open with gauze*.

If submucosal*: The overlying mucosa was incised and pus allowed to drain into the rectum. Loculations were broken with a hemostat. The cavity was irrigated and left open (or a Penrose drain was placed in the cavity).*

If horseshoe*: An incision was made through the skin over the abscess as close as possible to the anal verge bilaterally. The surrounding structures were dissected using a hemostat until the abscess cavity was encountered. The hemostat was then used to break up loculations, pus was suctioned from the cavity, and a finger was introduced to confirm the absence of remaining loculations. The abscess was irrigated. Anoscopy was performed paying close attention to the posterior midline of the dentate line looking for the internal opening. Once found, a crypt hook was used to enter the internal opening and could be palpated on the skin of the posterior midline. Here a small incision was made, and a vessel loop or Penrose drain was attached to the crypt hook bringing it out through the internal opening and tying onto itself (__times) to create a Seton. Hemostats or fistula probes were then used to connect the posterior midline incision to the bilateral incisions and Setons placed in the same fashion to complete the Henley procedure. Hemostasis was achieved with electrocautery*.

A gauze pad was tucked between the buttocks. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was *extubated and* taken to the postanesthesia care unit in stable condition.

Rubber Band Ligation of Internal Hemorrhoids

81

Shauna Lorenzo-Rivero

Indication

- Internal hemorrhoids with prolapse or bleeding, refractory to medical management

Essential Steps

1. Rectal exam.
2. Anoscopy.
3. Identification of internal hemorrhoids.
4. For each of three pedicles:
   - Clamp applied to the proximal redundant mucosa
   - Rubber band applied
   - Mucosa inspected
5. Withdraw anoscope.

Note These Variations

- Number of pedicles varies, but, in general, three can be defined at the left lateral, right posterior, and right anterior locations.
- A pair of bands, rather than a single band, may be used.

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Complications

- Pain due to rubber band application too close to dentate line
- Bleeding
- Sepsis
- Recurrence
- Urinary retention

Template Operative Dictation

Preoperative Diagnosis First- to second-degree hemorrhoids

Procedure Anoscopy, rubber band ligation of hemorrhoids

Postoperative Diagnosis Same

Indications This___-year-old *male/female* was found to have internal hemorrhoids that did not respond to bulk-forming agents.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, positioning, implant(s), and additional critical information prior to beginning the procedure. The patient was placed in the prone jackknife position *and given sedation*. Digital rectal exam was performed. A generously lubricated

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_81

anoscope was inserted into the anal canal. The three hemorrhoidal pedicles were identified and the redundant rectal mucosa just above the largest internal hemorrhoid grasped with a clamp. The patient did not complain of excessive pain. Using the applicator, *a rubber band was/two rubber bands were* placed around this tissue and the clamp was released. The *band was/bands were* noted to be in good position. This procedure was repeated on the other two pedicles. The mucosa was inspected for bleeding prior to withdrawal of the anoscope.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well *and was taken to the postanesthesia care unit in stable condition (if sedation used)*.

82 Surgical Hemorrhoidectomy

Shauna Lorenzo-Rivero

Indications

- Second-degree hemorrhoids resistant to medical management or band ligation.
- Third- and fourth-degree hemorrhoids
- Hemorrhoids complicated by ulceration, fissures, fistulae, large hypertrophied anal papillae, or excessive skin tags
- Incarcerated grade IV hemorrhoids
- Acute bleeding when suture ligation fails

Essential Steps

1. Rectal exam.
2. Inject local anesthetic.
3. Dilate the anus and place anoscope.
4. Identify three hemorrhoidal pedicles.
5. Clamp pedicles at the external base.
6. Retract the anal skin externally.
7. Excise the skin and mucosa with elliptical incision.
8. Dissect the hemorrhoidal tissue free of surrounding structures taking care not to injury the sphincter muscles.
9. Clamp and ligate the pedicle at the apex.
10. Secure hemostasis.
11. Close incisions.
12. Repeat for other pedicles.

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Note These Variations

- Prone jackknife position vs. lithotomy position.
- Number of hemorrhoids varies but is in general, three: left lateral, right posterior, and right anterior locations.

Complications

- Bleeding/hematoma
- Anal incontinence
- Sphincter spasm/obstructive defecation and constipation
- Sepsis
- Urinary retention
- Recurrence

Template Operative Dictation

Preoperative Diagnosis *Second-/third-/fourth-degree* hemorrhoids

Procedure Anoscopy, *one-/two-/three*-quadrant hemorrhoidectomy

Postoperative Diagnosis Same

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DOI 10.1007/978-3-319-44797-1_82

Indications This ___-year-old *male/female* was found to have symptomatic grade (_) hemorrhoids *refractory to medical management/ complicated by (specify).*

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, and additional critical information prior to beginning the procedure. G*eneral/spinal/ caudal* anesthesia was induced. *He/she* was placed in the *prone jackknife lithotomy* position. The buttocks were taped apart.

The perineum was prepped and draped in standard sterile fashion. Local anesthetic was injected *as a perianal/pudendal nerve block*. The anus was carefully dilated until two fingers could be introduced. An anoscope was introduced and the three hemorrhoidal pedicles were identified. A Kelly clamp/perforated towel clip was placed near the base of each pedicle near the dentate line and retracted externally to exteriorize the hemorrhoidal pedicles.

Each pedicle was excised in turn in the following fashion. An elliptical incision was made extending from perianal skin to hemorrhoidal pedicle including both internal and external hemorrhoids and excising a minimum amount of anoderm. Flaps were developed on both aspects of the incision, taking care to elevate only the skin and mucosa. The dilated venous mass was dissected using Metzenbaum scissors from the underlying sphincter muscle. The base was secured with a Kelly clamp. The pedicle was amputated from the base and secured with a 2-0 Vicryl suture ligature. Hemostasis was achieved using electrocautery.

Following hemostasis, the skin and mucosal incisions were closed with a running lock stitch of 2-0 Vicryl on the mucosal aspect and converted to subcuticular once skin was encountered. A gauze pad was tucked between the gluteal folds. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was *extubated and* taken to the postanesthesia care unit in stable condition.

83 Stapled Hemorrhoidectomy

Shauna Lorenzo-Rivero

Indications

- Second-degree hemorrhoids with or without multiple failures with rubber band treatment
- Third- or fourth-degree hemorrhoids
- Rectal mucosal prolapse

Essential Steps

1. General anesthesia.
2. Lithotomy position or prone jackknife position.
3. Examine rectum.
4. Place dilator in anal canal and secure to perineum.
5. Place purse-string suture.
6. Open circular stapler and position head proximal to purse-string and tie.
7. With traction on purse-string, tighten device and hold for 60 s.
8. Fire stapler and keep closed for 60 s.
9. Remove stapler and send specimen to pathology.
10. Examine staple line for hemostasis.
11. Secure hemostasis.

Note These Variations

- Suture over staple line
- Packing with Surgicel or Xylocaine post-procedure

Complications

- Rectovaginal fistula
- Anal stenosis
- Bleeding
- Short- or long-term dysfunction
- Fecal incontinence
- Pelvic sepsis

Template Operative Dictation

Preoperative Diagnosis *Hemorrhoids/rectal mucosal prolapse*

Procedure PPH hemorrhoidal stapling

Postoperative Diagnosis Same

Indications Patient is a ___-year-old *male/female* with grade___ hemorrhoids that are *painful/bleeding/prolapsing* and presents for a PPH hemorrhoidal stapling.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_83

Description of Procedure Patient was brought into the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was administered. The patient was then placed in the *lithotomy/prone jack knife* position. The surgical site was prepped with *Betadine/Chlorhexidine* and draped in the usual sterile fashion.

The perineal and rectal areas were examined. The patient was found to have *prolapsing grade _ internal hemorrhoids and/or external hemorrhoids*. The hemorrhoidal stapling kit was opened and the clear plastic retractor and obturator were placed in the anal canal. The obturator was removed. The circular retractor was secured to the perineum using 3-0 silk suture. The dentate line was identified and protected by the retractor. The fenestrated anoscope was placed through the retractor. Approximately 4 cm above the dentate line (marking on the anoscope), a 2-0 Prolene purse-string suture was placed. Next the stapling gun was fully opened and the anvil was placed above the purse-string suture. The purse-string suture was tied taut around the shaft of the stapler. The two ends of the suture were brought through the eyelet of the stapler device using the crochet hook provided and tied again. With traction on the purse-string, the stapling gun was closed until the green indicator was present in the center of window markings. The stapling gun was kept in the closed position for 60 s. The stapler gun was fired and kept in position for 60 s. The device was then removed. The staple line was examined for hemostasis. *There was one bleeding point at ___o'clock and that was sutured using 4-0 Vicryl suture. After hemostasis, a piece of Surgicel and Xylocaine lubricant* was placed in the rectum. Mesh undergarments with ABD were applied. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was brought to the PACU in stable condition.

Acknowledgment This chapter was contributed by Susan Skaff Hagen, M.D., MSPH in the previous edition.

84 Anorectal Fistulotomy

Shauna Lorenzo-Rivero

Indication

- Fistula-in-ano

Essential Steps

1. Rectal exam.
2. Identify the external opening.
3. Inject local anesthetic.
4. *Anoscopy/anal retraction*.
5. Identify the internal opening.
6. Pass the probe from the external to internal opening.
7. Unroof the fistula.
8. Identify any sidetracks and unroof.
9. Biopsy the tract and send to pathology.
10. Hemostasis.

Note These Variations

- Penrose drain or seton for:
  - Complex fistulae
  - Multiple tracts
  - Crohn's disease

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Complications

- Recurrent abscess/fistula
- Incontinence
- Bleeding
- Urinary retention

Template Operative Dictation

Preoperative Diagnosis Fistula-in-ano

Procedure Anoscopy, fistulotomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed fistula-in-ano *after previous incision and drainage of perirectal abscess*.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General/spinal/monitored care* anesthesia was induced. The patient was then positioned in the *prone jackknife/lithotomy/left lateral decubitus* position. The perineum was prepped and draped in the usual sterile fashion. The external opening(s) of the fistula(e) *was/were* identified.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_84

Local anesthetic was injected *as a perianal/pudendal nerve block*. The anus was gently dilated and a Hill-Ferguson retractor was inserted, exposing the anal crypts. These were explored using a crypt hook until the internal opening of the fistula was identified. The tract was cannulated from the external opening and the flexible probe passed through to the internal opening with care and without resistance. Electrocautery was used to divide the overlying soft tissues. This was accomplished in stages. A portion of the margin was resected as a biopsy and sent to pathology. *All tracts were unroofed/a Penrose drain/seton was placed through the defect and tied to itself (__times) where more than two thirds of the internal sphincter muscle was involved.*

Hemostasis was achieved using electrocautery. A gauze pad was tucked between the buttocks. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was *extubated and* taken to the postanesthesia care unit in stable condition.

85 Lateral Internal Sphincterotomy

Shauna Lorenzo-Rivero

Indication

- Chronic anal fissure

Essential Steps

1. Rectal exam.
2. Inject local anesthetic.
3. Anoscopy.
4. Identify the fissure and curet the base.
5. Identify the intersphincteric groove and make an incision.
6. Elevate and divide fibers of the internal sphincter.
7. Achieve hemostasis.
8. Close the wound.

Note These Variations

- Prone jackknife vs. lithotomy position vs. left lateral decubitus
- Longitudinal incision into the anal canal (open technique) on occasion used

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Complications

- Bleeding/hematoma formation
- Incontinence
- Recurrence
- Urinary retention

Template Operative Dictation

Preoperative Diagnosis Chronic anal fissure

Procedure Lateral internal sphincterotomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had anal fissure of duration refractory to medical management. Lateral internal sphincterotomy was elected for management.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General/spinal/monitored care* anesthesia was induced. The patient was placed in the *prone jackknife/lithotomy/left lateral decubitus* position. The perineum was prepped and draped in the usual sterile fashion. Local anesthetic was injected *as a*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_85

perianal/pudendal nerve block. The anus was gently dilated and anoscopy performed to identify the fissure. The anoscope was replaced with a Hill-Ferguson retractor and the base of the fissure scraped with a curet.

The intersphincteric groove was identified. A short, 4- to 5-mm incision was made directly over the intersphincteric groove on the *right/left* side. A hemostat was used to dissect the internal sphincter free of anoderm and external sphincter. Fibers were then elevated into the wound using a right-angle clamp and divided with *electrocautery/sharp dissection* until the hypertrophic sphincter felt relaxed on digital exam. Hemostasis was achieved by holding pressure. The incision was left open to drain. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was *extubated and* taken to the postanesthesia care unit in stable condition.

86 Anal Fistula Plug

Shauna Lorenzo-Rivero

Indication

- Complex fistula-in-ano

Essential Steps

1. Rectal exam.
2. Identify the external opening.
3. Inject local anesthetic.
4. *Anoscopy/anal retraction*.
5. Inject the external opening. Identify the internal opening.
6. Pass the probe from the external to internal opening.
7. Prepare the fistula plug and attach to the fistula probe.
8. Withdraw the probe and insert the plug.
9. Trim internal portion of plug and close opening.
10. Leave external opening open and apply 5 % Flagyl topical ointment.

Note This Variation

- None currently recommended for best results

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Complications

- Recurrence
- Pain
- Infection
- Dislodgement of plug
- Bleeding
- Urinary retention

Template Operative Dictation

Preoperative Diagnosis Fistula-in-ano

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed fistula-in-ano *after previous incision and drainage of perirectal abscess*. A Seton has been in place for 6–8 weeks and all sepsis controlled.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General/spinal/monitored care* anesthesia was induced. The patient was then positioned in the *prone jackknife/lithotomy/left lateral decubitus* position. The perineum was prepped and draped in the usual sterile fashion. The external opening(s)

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DOI 10.1007/978-3-319-44797-1_86

of the fistula(e) *was/were* identified. Local anesthetic was injected *as a perianal/pudendal nerve block*. The anus was gently dilated and a Hill-Ferguson retractor was inserted, exposing the anal crypts.

A 1:1 mixture of hydrogen peroxide and saline was injected from the external opening to both identify the internal opening and flush the tract. The tract was cannulated from the external opening, and the flexible probe passed through to the internal opening with care and without resistance. The fistula plug which had already been soaking in saline was then prepared by suturing with a 2-0 Vicryl through the apex of the plug and tying it to the internal end of the fistula probe. It was brought out through the external opening until the plug fit snuggly but without excessive resistance. The probe was removed from the stitch. The plug was removed from the internal opening to cut the base (large end) so that it lies just beneath the mucosa. A 2-0 Vicryl suture was placed through the base of the plug and the external suture was pulled to secure the plug in place. The internal stitch that was still attached to the base was used to perform a figure-of-eight stitch to cover the base with mucosa. Any visible plug at the external opening was trimmed.

Hemostasis was achieved using electrocautery. The patient was cleaned and dried. Five percent Flagyl topical ointment was applied to the external opening followed by a gauze pad tucked between the buttocks. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated and taken to the postanesthesia care unit in stable condition.

Endorectal Mucosal Advancement Flap

87

Ira Lewis Leeds and Sandy Hwang Fang

Indications

- Second-stage procedure for anal fistula repair after adequate drainage by seton.

Essential Steps

1. Prone jackknife positioning.
2. Prep and drape.
3. Digital rectal exam prior to instrumentation.
4. Expose and identify the fistula tract with a fistula probe.
5. Raise a broad-based, trapezoid-shaped mucosal, submucosal, and circular muscularis flap.
6. Excise the internal opening of fistula in the anal canal or rectum.
7. Debride or excise the fistula tract.
8. Advance the mucosal flap beyond the fistula tract opening.
9. Tension-free suturing of the flap to the distal anal canal.
10. Return patient to supine position.

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Note These Variations

- Positioning prone versus dorsal lithotomy
- Surgical prep solution
- Local anesthetic block (perianal field block, pudendal nerve regional block)
- Fixed versus bivalve speculum for exposure
- Tubular/sleeve advancement flap (circumferential flap) for complex fistula disease
- Thickness of flap
- Drain placement through external opening of fistula
- Level of advancement distally
- Temporary fecal diversion
- Hemostatic packing agent

Complications

- Recurrence of fistula
- Fistula tract abscess
- Dehiscence of advancement flap
- Fecal incontinence

Template Operative Dictation

Preoperative Diagnosis Fistula-in-ano

Procedure Endorectal mucosal advancement flap

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_87

Indications This _______-year old *male/female* has had a history of recurrent perirectal abscesses. On (date), an examination under anesthesia was performed with incision and drainage of perirectal abscess followed by seton placement. The patient presented today for definitive repair of *his/her* anal fistula.

Description of Operation The patient was brought to the operating room, and while on the transport cart, cardiopulmonary monitors were placed and vital signs were stable. Time-outs were performed using both preinduction and preincision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

General endotracheal anesthesia was smoothly induced. The patient was converted from supine position to prone jackknife position using gel chest rolls to off-load pressure points. The arms were placed cephalad by abducting, rotating anteriorly, and securing them to arm boards with the elbows at 90°. Axillary rolls were placed. The buttocks were taped apart to ensure adequate exposure. The surgical field was prepped with *4 % chlorhexidine soap/povidone iodine* and draped appropriately.

Choose One

A **perianal field block** of 40 cc 0.25 % bupivacaine local anesthetic was injected.

A **pudendal block of** 10 cc of 0.25 % bupivacaine each was injected bilaterally.

Digital rectal examination was performed demonstrating seton at ___ [describe location]. Anoscopy was performed with a medium Hill-Ferguson retractor to visualize all four quadrants of the anal canal with identification of the internal opening at ___ [describe location].

A lubricated *extra-large Hill-Ferguson retractor/Pratt bivalve rectal speculum/Fansler operating speculum* was inserted to expose the internal fistula opening. A trapezoid-shaped flap was made in the following manner. A distal incision was created just above the dentate line. A flap containing mucosa, submucosa, and part of the muscularis propria was raised so that the distal aspect of the flap was further distal than the internal opening. The width of the distal flap apex created was two to three times that of the length from the internal opening to the distal aspect. The width of the proximal base of the flap was two times the width of the distal apex of the flap.

The fistula opening remaining on the mucosal flap was excised and submitted to pathology. A figure-of-eight 2-0 Vicryl stitch was placed to close the remaining internal opening. Approaching from the external opening, the remaining fistula tract was *debrided with simple curettage/excised*.

It was confirmed that the remaining flap would cover the mucosal defect without tension and with adequate blood supply. The flap was advanced and secured to the mucosa first at the apex and then subsequently along the entire mucosal incision with *interrupted 2-0 Vicryl® sutures*.

Hemostasis was achieved, and the anal canal was packed with *Surgicel®/Gelfoam®*. Needle, sponge, and instrument counts were correct. The patient was repositioned from prone jackknife to supine position with transfer to a transport stretcher. The patient was extubated in the OR without complication. A debriefing checklist was completed to share information critical to postoperative care of the patient. Transport to the PACU ensued with confirmation of hemodynamic stability prior to handoff to the PACU care team. The patient tolerated the procedure well without any known intraoperative complications.

Ligation of Intersphincteric Fistula Tract (LIFT) Procedure

88

Ira Lewis Leeds and Sandy Hwang Fang

Essential Steps

1. Prone positioning
2. Prep and drape
3. Digital rectal exam prior to instrumentation
4. Curvilinear incision at the intersphincteric groove overlying fistula
5. Intersphincteric dissection
6. Ligation of internal opening of fistula
7. Curettage of fistula tract
8. Closure of external opening approaching from intersphincteric groove incision
9. Re-aproximation of mucosa
10. Flip patient

Possible Variations

- Positioning prone versus dorsal lithotomy
- Surgical prep solution
- Local anesthetic block (perianal field block, pudendal nerve block)
- Fixed versus bivalve speculum for exposure
- Drain placement through external opening of fistula
- Temporary fecal diversion
- Hemostatic packing agent

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Complications

- Recurrence of fistula
- Intersphincteric abscess
- Fecal incontinence

Operative Note

Preoperative Diagnosis Fistula-in-ano

Procedure Ligation of intersphincteric fistula tract procedure

Postoperative Diagnosis Same

Indications This _______-year-old *male/female* has had a history of recurrent perirectal abscesses. On (date), an examination under anesthesia was performed with incision and drainage of perirectal abscess followed by seton placement. The patient presents today for definitive repair of *his/her* anal fistula.

Description of Operation

The patient was brought to the operating room, and while on the transport cart, cardiopulmonary monitors were placed by the anesthesiologist and vital signs were stable. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_88

patient, procedure, site, and additional critical information prior to beginning the procedure.

Choose One:
General endotracheal anesthesia *was smoothly induced. The patient was converted from supine position to prone-jackknife position using gel chest rolls to offload pressure points. The arms were placed cephalad by abducting, rotating anteriorly, and securing them to arm boards with the elbows at 90°. Axillary rolls were placed.*

OR

The patient placed in prone-jackknife position on the operating room table. ***Conscious sedation*** *was administered with monitored anesthesia care. All pressure points were properly padded.*

The buttocks were taped apart to ensure adequate exposure. The surgical field was prepped with *4 % chlorhexidine soap/povidone iodine* **and draped appropriately.**

Choose One:
A **perianal field block** of 40 cc 0.25 % bupivacaine local anesthetic was injected.

OR

A **pudendal block of** 10 cc of 0.25 % bupivacaine each was injected bilaterally.

Digital rectal examination was performed demonstrating the seton at [describe location]. Anoscopy was performed with a medium Hill-Ferguson retractor to visualize all four quadrants of the anal canal with identification of the internal opening at [describe location].

A lubricated *extra-large Hill-Ferguson retractor/Pratt bivalve rectal speculum/Fansler operating speculum* was inserted to expose the internal fistula opening. A fistula probe was placed into the fistula tract. The intersphincteric groove externally at the skin level was identified. A 2 cm curvilinear incision was made with electrocautery at the intersphincteric groove. The external and internal sphincters were identified. The incision was deepened with electrocautery dissection of the intersphincteric plane between the two sphincter muscles.

The fistula tract crossing the intersphincteric plane was identified and dissected. The intersphincteric tract was doubly ligated at both the internal sphincter and external sphincter aspects with 2-0 Vicryl® sutures. Figure-of-eight stitch 2-0 Vicryl® suture was also placed to close the fistula tract. The fistula probe was removed upon tying down the sutures that ligated the fistula tract. The fistula tract between the internal and external sphincter was excised and submitted to pathology for further analysis. The remaining extrasphincteric fistula tract was curetted via the external opening. The walls of dissection between the intersphincteric grooves were approximated with 3-0 Vicryl® sutures in a manner that the ligated fistula tracts were not opposed to each other. The intersphincteric skin incision was loosely re-approximated with interrupted 3-0 absorbable suture.

Hemostasis was achieved, and the anal canal was packed with *Surgicel®/Gelfoam®*. At the end of the case, the needle, sponge, and instrument counts were correct. The patient was repositioned from prone-jackknife to supine position with transfer to a transport stretcher. The patient was extubated in the OR. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well without any known intraoperative complications.

Transanal Minimally Invasive Surgery (TAMIS)

89

Joshua H. Wolf and Sandy Hwang Fang

Indications

- Tumors should meet the following criteria:
  - <3 cm in size
  - <1/3 of the lumen's circumference
  - Benign pathology or at most a T1 lesion
  - Low risk histopathologic features (no lymphovascular invasion; well or moderately differentiated)
- Lesions should be no more than 8–10 cm from the anal verge.

Essential Steps

1. Position the patient in either lithotomy, lateral decubitus, or prone positioning depending on the location of the tumor. In general, the lesion should be at the inferior aspect of the operative field – position prone for anterior lesions and lithotomy for posterior lesions.
2. Perform a digital rectal examination to confirm the location of the tumor.
3. Lubricate a GelPOINT® path transanal access platform (Applied Medical, Rancho Santa Margarita, CA, USA) and insert it into the anal canal.
4. Insert three 5 mm ports into the gel matrix such that the ports mark the apices of the triangular grooves on the device.
5. Connect the GelPOINT to an Airseal device and establish pneumorectum using warm carbon dioxide. The goal insufflation pressure is the least amount required to complete the surgical procedure, usually falling between 5 and 25 mmHg (start at 15 mmHg).
6. Use a bariatric length 5-mm, 30-degree laparoscope to visualize the rectum and define a 1-cm resection margin surrounding the targeted lesion with hook electrocautery.
7. Excise a full-thickness specimen along the marked boundaries. When the specimen is removed, carefully orient it on a marking board and send to pathology.
8. Close the defect with intraluminal suturing technique. It is often helpful to use a lower insufflation pressure for this step.
9. Deflate the rectum and remove the port.

Note These Variations

- A single-incision laparoscopic surgery (SILS) platform may be used instead of a GelPOINT platform. This is based on surgeon preference,

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_89

but the SILS platform is usually reserved for patients with small diameter anal canals in which the GelPOINT will not seat properly.

- The GelPOINT path long channel transanal access platform may be used to reach lesions as proximal as 15 cm from the anal verge.
- A flexible endoscope can be used as opposed to a rigid laparoscope for visualization.
- A hybrid approach with laparoscopic assistance can aid with exposure of a proximal defect or can be employed to close full-thickness intraperitoneal defects.
- Some data have suggested safe outcomes without closure of the defect if it is extraperitoneal. However, patients will have bleeding per rectum and tenesmus, while the defect heals by secondary intention.
- A flexible sigmoidoscopy is performed after the TAMIS is complete to ensure that there is no luminal stenosis.

Complications

- Intraoperative bleeding
- Urinary retention
- Perforation into peritoneum (either discovered intraoperatively or presenting as a late complication)
- Aborted operation
- Delayed bleeding

Template Operative Dictation

Preoperative Diagnosis Rectal mass

Procedure Examination under anesthesia; transanal minimally invasive approach for excision of rectal mass

Postoperative Diagnosis Same as preoperative diagnosis

Indications This is a __-year-old *male/female* with a recently discovered __ (*size*) *cm* (*location*: *anterior*, *right lateral*, *left lateral*, *posterior*) rectal mass approximately __ (*distance*) *cm* from the anal verge. Workup to this point has suggested (*diagnosis*: *a benign rectal mass/an early-stage adenocarcinoma*).

Description of Procedure After obtaining informed consent, the patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *Five thousand units of subcutaneous heparin* and intravenous __ (*antibiotic*) were administered within 1 h of the surgical incision. After induction of general endotracheal anesthesia, a Foley catheter and orogastric tube were placed. Because of the *anterior/posterior* location of the tumor, the patient was positioned on the OR table in *lithotomy*, *lateral decubitus*, *or prone position*. Appropriate foam padding was used to protect pressure points. The patient was then prepped and draped in usual sterile fashion.

A digital examination under anesthesia was performed to confirm the location of the tumor. A GelPOINT path multichannel access port was prepared by inserting three 5-mm ports into the apices of the triangular groove in the GelSeal Cap®. GelPOINT access channel was lubricated and inserted into the anal canal with the assistance of the introducer. The Airseal device was connected to the GelPOINT, and the rectum was insufflated with warm carbon dioxide to a pressure of 15 mmHg. A bariatric 5-mm 30-degree laparoscope was inserted, and the target lesion was visualized approximately __ (*distance*) cm above the anal verge on the (*location*: *anterior*, *posterior*, *right lateral*, *left lateral*) rectal wall. Hook electrocautery was used to mark a *1-cm* margin surrounding the tumor. A laparoscopic grasper was used to provide traction on the rectal wall, and a full-thickness excision along the marked boundary was performed using an energy device (*electrocautery*, *LigaSure*, *harmonic ultrasonic scalpel*). The specimen was removed and carefully oriented on a marking board and sent to pathology for permanent sectioning.

The insufflation was lowered to *5 mmHg* and the rectal defect was closed with __suture using an intra-corporeal suturing technique (*the author prefers a 2-0 V-lock suture*). After full closure of the defect, the rectum was deflated and the GelPOINT removed. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was safely extubated and brought to the postoperative unit for recovery.

90 Anoplasty

Shauna Lorenzo-Rivero

Indication

- Fibrotic stricture of the anal canal

Essential Steps

1. Rectal exam.
2. Gently dilate the anus.
3. Hill-Ferguson retractor.
4. Incision from the dentate line upward into rectum 1.5 cm.
5. Y-extension through the anoderm.
6. Elevate the flaps.
7. *Internal sphincterotomy* (*if necessary*).
8. Perform Y-V advancement and suture.

Note This Variation

- Internal sphincterotomy

Complications

- Recurrence
- Anal ulcer
- Urinary retention
- Fecal Incontinence

Template Operative Dictation

Preoperative Diagnosis Anal stricture

Procedure Anoplasty *with lateral internal sphincterotomy*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed anal stricture *after previous hemorrhoidectomy/other*.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General/spinal* anesthesia was induced. The patient was then positioned in the *prone jackknife/lithotomy* position. The perineum was prepped and draped in the usual sterile fashion. The anus was gently dilated and a Hill-Ferguson retractor was inserted, exposing the dentate line. An incision was made commencing distal to the stenosis and extending proximal to rectal mucosa for 1.5 cm. It was then extended through the

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_90

anoderm in a Y-fashion. Flaps were elevated by sharp dissection taking care to avoid injury to the internal sphincter. Hemostasis was achieved by electrocautery sparingly.

If internal sphincterotomy**:** *It was noted that incising the anoderm and associated fibrosis did not completely release the stricture*; *therefore*, *an internal sphincterotomy was performed in such a manner as to completely release the stricture*.

The Y-flap was advanced in a V-fashion and sutured in place with a running suture of 4-0 PDS/PG.

Hemostasis was rechecked. A gauze pad was tucked between the buttocks. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was *extubated and* taken to the postoperative care unit in stable condition.

Acknowledgment This chapter was contributed by Carol E. H. Scott-Conner, M.D., in the previous edition.

Marsupialization of Pilonidal Sinus

91

Shauna Lorenzo-Rivero

Indications

- Recurrent infected pilonidal cyst
- Pilonidal sinus with secondary tracts encountered

Essential Steps

1. Prone jackknife position.
2. Identify and cannulate tracts.
3. *Inject with methylene blue and hydrogen peroxide* (*optional*).
4. Incise the skin overlying the probe with electrocautery.
5. Remove a narrow wedge of adjacent skin.
6. Curet base.
7. Suture skin to the base of the tract with interrupted sutures of 3-0 Vicryl.
8. Pack.

Note These Variations

- Injection with methylene blue/hydrogen peroxide optional.
- All tracts must be identified and laid open; number and location varies.

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Complications

- Delayed healing
- Recurrence
- Osteomyelitis

Template Operative Dictation

Preoperative Diagnosis Chronic infections of pilonidal *cyst/sinus*

Procedure Marsupialization of pilonidal *cyst/sinus*

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who has *chronic infections/secondary sinus tracts* of a pilonidal *cyst*, which is chronic of ___ duration *requiring incision and drainage*. Marsupialization was indicated for definitive management.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. All appropriate monitoring devices were in place. The patient was then placed in the prone jackknife

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_91

position, and the buttocks were gently spread with tape. All pressure points were padded, and then the presacral region was prepped and draped in the usual sterile fashion.

Optional Variation *An opening was/several openings were evident on the midline. The largest was cannulated with a small plastic intravenous cannula and injected with a mixture of methylene blue and hydrogen peroxide. This bubbled from the secondary openings, but all staining remained midline.*

A probe was inserted and the main tract along the midline readily identified. Electrocautery was used to open the skin overlying the probe. Secondary tracts were identified and opened in a similar fashion. The skin edges were grasped with Allis clamps, and a narrow band of skin was excised from the lateral aspect of *each/the* incision using electrocautery. *All blue-stained tissue was exposed*. The base of the tracts was curetted free of all granulation tissue.

The skin edges were then brought down and sutured to the tract margin with interrupted 2-0 Vicryl stitches to prevent premature closure. Hemostasis was checked. The wound was irrigated copiously with saline and packed.

The patient tolerated the procedure well and was extubated and reversed from general anesthesia. A debriefing checklist was completed to share information critical to postoperative care of the patient. *He/she* was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Daniel Calva-Cerqueira, M.D., in the previous edition.

Excision and Primary Closure of Pilonidal Sinus

92

Shauna Lorenzo-Rivero

Indications

- Pilonidal *cyst/sinus* without infection or secondary tracts

Essential Steps

1. Prone jackknife position.
2. Identify and cannulate the tract.
3. *Inject with methylene blue and hydrogen peroxide* (*optional*).
4. Excise ellipse of skin overlying the tract, including all midline openings.
5. Deepen the incision to *the periosteum of the sacrum*, *well below probe*.
6. Completely excise the pilonidal sinus with adequate margins.
7. Achieve hemostasis.
8. Develop flaps.
9. Close the wound.

Note These Variations

- Injection with methylene blue/hydrogen peroxide is optional.
- All tracts must be identified; if secondary tracts are encountered, convert to marsupialization.

Complications

- Wound breakdown
- Recurrence

Template Operative Dictation

Preoperative Diagnosis Chronic pilonidal *cyst/sinus*

Procedure Excision and primary closure of pilonidal *cyst/sinus*

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who has chronic pilonidal *cyst/sinus* of ___ duration *requiring incision and drainage* limited to the midline and currently without evidence of infection. Excision and primary closure was elected for management.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_92

to beginning the procedure. General endotracheal anesthesia was induced. All appropriate monitoring devices were in place. The patient was then placed in the prone jackknife position, and the buttocks were gently spread with tape. All pressure points were padded, and then the presacral region was prepped and draped in the usual sterile fashion after all hair was removed from the area.

Optional Variation *An opening was/several openings were evident on the midline. The largest was cannulated with a small plastic intravenous cannula and injected with a mixture of methylene blue and hydrogen peroxide. This bubbled from the secondary openings*, *but all staining remained midline*.

A probe was inserted and the midline tract readily identified. An elliptical incision was made around the *opening/openings* and the entire tract with a __cm margin. This was deepened through subcutaneous tissue using electrocautery. The incision was continued until *the sacral periosteum/normal tissue* deep to the tract was encountered. The pilonidal sinus tract *and all blue-stained tissue* were thus excised cleanly in its entirety.

Hemostasis was achieved with electrocautery. After ensuring that there is no infection and that the wound was clean, flaps were developed until the skin and subcutaneous tissues could be approximated in the midline without tension. The incision was then closed with interrupted vertical mattress sutures of 3-0 Nylon, placed in such a fashion as to completely close the dead space by incorporating a bite of *fascia/deep tissue*. The wound was dressed. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, was extubated, and was reversed from general anesthesia. *He/she* was taken to the post anesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Daniel Calva-Cerqueira, M.D., in the previous edition.

Part VII

General Surgery: Hepatobiliary

Open Cholecystectomy

93

Angela Stork and Jennifer Shanklin

Indications

- Symptomatic cholelithiasis
- Acute or chronic cholecystitis
- Choledocholithiasis
- Gallstone pancreatitis (resolved)
- Gallbladder polyps
- Biliary dyskinesia
- Conversion from laparoscopic cholecystectomy
- As part of another procedure
- Contraindications to laparoscopic cholecystectomy:
  - Cholecystobiliary or cholecystoenteric fistula
  - Confirmed/suspicion for gallbladder cancer
  - Trauma
  - Unable to obtain laparoscopic access
  - Unable to tolerate general anesthesia/pneumoperitoneum
  - Third trimester pregnancy
- Relative contraindications to laparoscopic cholecystectomy:
  - Generalized peritonitis
  - Gangrenous gallbladder or empyema
  - Cirrhosis/portal hypertension
  - Coagulopathy Prior operations/adhesions

Essential Steps

1. Right subcostal (Kocher) incision two fingerbreadths below costal margin.
2. Divide the falciform ligament.
3. Inspect the abdomen.
4. *Decompress the gallbladder* (*avoid performing this if confirmed/suspicion for gallbladder cancer to prevent spillage of bile*).
5. Dissect adhesions to gallbladder and pack colon down for exposure.
6. Grasp fundus with Kelly clamp.
7. Identify and encircle the cystic duct and cystic artery.
8. Dissect the gallbladder off the liver bed from the fundus down.
9. *Perform cholangiogram* (*in cases where anatomy of the Calot's triangle isn't well defined*, *elevated preoperative liver enzymes*, *known choledocholithiasis, or a history of gallstone pancreatitis. Avoid in patients with confirmed/suspicion for gallbladder cancer to prevent bile spillage*).
10. Ligate and divide the cystic duct and cystic artery.
11. Obtain hemostasis.
12. Close the abdomen.

Note These Variations

- Back wall of the gallbladder may be left in situ if there is severe inflammation.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_93

- "Dome-down" dissection (described below) vs. starting at Calot's triangle.
- Cholangiogram is optional.
- Drain placement is optional.
- Liver resection and regional lymphadenectomy (radial cholecystectomy) may be indicated in cases of gallbladder cancer.

Complications

- Injury to the common bile duct
- Injury to other adjacent structures, bowel
- Postoperative bile leak
- Subhepatic abscess
- Retained common bile duct stones

Template Operative Dictation

Preoperative Diagnosis *Symptomatic cholelithiasis/cholecystitis/choledocholithiasis/gallstone pancreatitis/trauma/cancer of the gallbladder/other*

Procedure Open cholecystectomy *with intraoperative cholangiogram*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with *right upper quadrant pain/nausea/vomiting/fever/leukocytosis/other* was found on workup to have *cholelithiasis with a normal common duct/cholecystitis/choledocholithiasis/gallstone pancreatitis/possible early cancer of gallbladder/other. The patient was not a candidate for laparoscopic cholecystectomy due to ___. Laparoscopic cholecystectomy was attempted but was unable to be completed due to* ___. Open cholecystectomy was therefore indicated.

Description of Procedure Patient was taken to the operating room and placed on the table in supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was initiated and patient intubated. *Lines/tubes* (i.e., *Foley catheter*, *OG/NG*, *SCDs*, *arterial line*) were placed and all pressure points appropriately padded. Patient was then prepped and draped in a sterile fashion.

If laparoscopic approach attempted first, describe port placement and reason for conversion to open.

A right subcostal incision was made two fingerbreadths below the costal margin, extending from midline to the anterior axillary line. This was deepened through the subcutaneous, fascial, and muscular layers with electrocautery, and the peritoneal cavity was entered. The falciform ligament was doubly ligated with 2-0 silk and divided. Inspection of the abdomen showed:

An inflamed gallbladder, *extensive adhesions of omentum and bowel to the region of the gallbladder*, *a tensely distended gallbladder*, etc. [*Adhesions were lysed sharply under direct vision with Metzenbaum scissors.*] [*The gallbladder was opened for evacuation of bile and stones.*]

A(n) *Omni/Bookwalter* retractor was placed and the colon packed inferiorly for exposure. The gallbladder fundus was grasped with a clamp and elevated. The peritoneum was incised over the fundus and the gallbladder dissected off the liver bed. The cystic duct and cystic artery were identified and dissected circumferentially to confirm that these were the only structures entering the gallbladder.

If cholangiogram: *A clip was placed on the cystic duct close to the neck of the gallbladder. A nick was made in the cystic duct and a cholangiogram catheter inserted. A cholangiogram was obtained showing good flow of bile into the duodenum*, *an intact biliary tree*, *and absence of any filling defects/other*.

The cystic duct and cystic artery were ligated with *3-0 silk/clips/other* and divided, and the gallbladder was passed off the field. Field was irrigated and hemostasis achieved. *A closed-suction drain was placed in the gallbladder fossa*, *externalized through a separate stab incision*, *and* *secured to the skin with 3-0 nylon*. Incision was closed in layers with *running/interrupted* ___. Skin edges were re-approximated with *staples/running subcuticular* _____*/other and Dermabond/Steri-Strips/sterile dressing applied*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the OR and transferred to PACU in stable condition.

Acknowledgment This chapter was contributed by Jennifer E. Hrabe, M.D., in the second edition.

94 Laparoscopic Cholecystectomy

Angela Stork and Jennifer Shanklin

Indications

- Symptomatic cholelithiasis
- Acute or chronic cholecystitis
- Biliary dyskinesia
- Choledocholithiasis
- Gallstone pancreatitis (resolved)
- Gallbladder polyp (malignancy not suspected)

Essential Steps

1. Induce pneumoperitoneum (Veress or Hasson technique), place umbilical port and insert laparoscope.
2. Inspect the abdomen for injury and pathology.
3. Position the patient in reverse Trendelenburg with right side up.
4. Place additional ports.
5. Decompress gallbladder (if gallbladder is severely distended and difficult to grasp).
6. Grasp and elevate the fundus of the gallbladder over the liver.
7. Take down adhesions from the omentum/colon/duodenum to the gallbladder.
8. Incise the peritoneum over the infundibulum.
9. Dissect Calot's triangle, and obtain critical view of safety.
10. *Perform cholangiogram*.
11. Clip and divide the cystic artery and cystic duct.
12. Dissect the gallbladder from the liver with electrocautery.
13. Obtain hemostasis.
14. Remove gallbladder.
15. Remove ports and deflate abdomen.
16. Close port sites.

Note These Variations

- Initial access via Hasson vs Veress needle technique.
- Various trocar types and sizes are available.
- Ten millimeter vs 5 mm and 0 vs 30° laparoscope (angled scope allows for better visualization of the critical view of safety).
- Site of gallbladder removal (umbilical versus subxiphoid).
- Cholangiogram in selected cases.
- Drain placement (usually not indicated).
- Fundus-down dissection is a feasible alternative.
- Fascia closure at large trocar sites, open vs laparoscopic with suture passer.

Complications

- Injury to the common bile duct
- Injury to adjacent structures (bowel, liver)

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_94

- Trocar/Veress needle injury
- Postoperative bile leak
- Subhepatic abscess
- Retained common bile duct stones
- Need for conversion to open cholecystectomy (note: this is not a complication but rather a sign of sound judgment when conditions are not favorable)

Template Operative Dictation

Preoperative Diagnosis *Symptomatic cholelithiasis/cholecystitis/choledocholithiasis/gallstone pancreatitis/others*

Procedure Laparoscopic cholecystectomy *with intraoperative cholangiogram*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with *right upper quadrant pain/nausea/vomiting/fever/leukocytosis/other* was found on workup to have *cholelithiasis with a normal common duct/cholecystitis/choledocholithiasis/gallstone pancreatitis/other*. Cholecystectomy was therefore indicated.

Description of Procedure Patient was taken to the operating room and placed on the table in supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was initiated and patient intubated. *Specific lines/tubes* (i.e., *Foley catheter*, *OG/NG*, *SCDs*, *arterial line*) were placed and all pressure points appropriately padded. Patient was then prepped and draped in a sterile fashion. A periumbilical incision was then made.

[Choose One:]
For Veress needle: *A skin incision was made and the Veress needle inserted. Proper position was confirmed by aspiration and saline meniscus test.*

For Hasson cannula: *The fascia was elevated and incised, followed by incision of the peritoneum. Atraumatic entry into the peritoneum was confirmed visually. Two anchoring sutures were placed through the fascia. The Hasson cannula was inserted under direct vision and secured with the stay sutures.*

The abdomen was then insufflated with carbon dioxide to a pressure of 12–15 mmHg. The patient tolerated insufflation well. (*Veress technique*: *A 5-mm trocar was then inserted at the umbilicus.*) The laparoscope was inserted and the abdomen inspected to ensure no injuries occurred with initial port placement. Additional ports were then placed as follows: a 5-mm/12-mm subxiphoid port and two 5-mm ports along the right subcostal margin. Inspection of the abdomen showed [*state findings/gallbladder appearance*]. The table was placed in reverse Trendelenburg with right side up.

Due to significant distention, *the gallbladder required decompression* via *needle aspiration*. The gallbladder fundus was grasped and retracted cephalad over the liver. *Adhesions between the gallbladder and omentum/duodenum/transverse colon were taken down carefully*. The infundibulum was then retracted inferior-laterally to expose Calot's triangle. Peritoneum overlying the infundibulum was incised and stripped inferiorly. The cystic duct and artery were identified and dissected circumferentially until the critical view of safety was obtained.

If cholangiogram performed: *A clip was placed on the cystic duct close to the neck of the gallbladder. A nick was made in the cystic duct and a cholangiogram catheter inserted. A cholangiogram was obtained under dynamic fluoroscopy showing good flow of bile into the duodenum*, *an intact biliary tree*, *and absence of any filling defects/other*.

The cystic duct and artery were then doubly clipped and divided. The gallbladder was then dissected off the liver bed using electrocautery. Hemostasis was achieved. The gallbladder was placed in an endoscopic retrieval bag and removed through the *subxiphoid/periumbilical* incision. *Irrigation was performed and any spilled stones/bile was suctioned. A*

GraNee/Carter-Thomason needle was used to pass an 0-Vicryl under direct vision to close the fascia at the subxiphoid/umbilical port site. Ports were removed under direct vision with *no bleeding noted/trocar site bleeding controlled by electrocautery* and the abdomen deflated. The skin of all incisions was re-approximated with *subcuticular 4-0 Monocryl and Dermabond/Steri-Strips applied*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the OR and transferred to PACU in stable condition.

Acknowledgment This chapter was contributed by Jennifer E. Hrabe, M.D. in the second edition.

95 Laparoscopic Subtotal Cholecystectomy

Angela Stork and Jennifer Shanklin

Indications

- Similar to that for laparoscopic cholecystectomy but unable to safely proceed with total cholecystectomy
- Symptomatic cholelithiasis
- Acute or chronic cholecystitis
- Choledocholithiasis
- Gallstone pancreatitis (resolved)
- Biliary dyskinesia
- Gallbladder polyp (malignancy not suspected)

Essential Steps

1. Induce pneumoperitoneum (Veress or Hasson technique), place umbilical port, and insert laparoscope.
2. Inspect the abdomen for injury and pathology.
3. Position the patient in reverse Trendelenburg and turn the table with the right side tilted up.
4. Place additional ports.
5. Decompress the gallbladder (if gallbladder is severely distended and difficult to grasp).
6. Grasp and elevate the fundus of the gallbladder over the liver.
7. Take down adhesions from the omentum/colon/duodenum to the gallbladder.
8. Incise the peritoneum over the infundibulum.
9. Dissect Calot's triangle, obtaining the critical view of safety. ***When this step cannot be completed safely, proceed to subtotal approach.*
10. Open anterior wall with hook cautery and drain bile/stones into an Endo Catch bag.
11. Resect the anterior wall of the gallbladder, ending with the least remaining stump that can safely be achieved.
12. Ablate mucosa of the remaining posterior wall and stump with electrocautery or argon beam.
13. Management of the remnant stump:
    - Leave remnant stump open with drainage – higher chance of persistent bile leak that can be managed conservatively versus postoperative endoscopic retrograde cholangiopancreatography (ERCP).
    - Close remnant stump with Endo GIA stapler, suture ligation, or Endoloop – creates a remnant gallbladder which may result in recurrence of symptom.
14. Obtain hemostasis.
15. Remove resected gallbladder wall via endoscopic retrieval bag.
16. *Drain placement (usually recommended due to higher rate of postoperative cystic duct leak).*
17. Remove ports and deflate the abdomen.
18. Close port sites.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_95

Note These Variations

- Partial posterior wall resection via fundus-down approach is an option.
- Gallbladder neck can be left open or transected and closed using Endo GIA stapler, suture ligation, or Endoloop.
- Drain placement is optional but recommended.

Complications

- Injury to the common bile duct
- Injury to other adjacent structures – the liver, bowel
- Trocar/Veress needle injury
- Bile leak requiring postoperative endoscopic retrograde cholangiopancreatography (ERCP)
- Subhepatic abscess
- Retained common bile duct stones
- Stump cholecystitis; need for reoperation and completion cholecystectomy

Template Operative Dictation

Preoperative Diagnosis *Symptomatic cholelithiasis/cholecystitis/choledocholithiasis/gallstone pancreatitis/others*

Procedure Laparoscopic subtotal cholecystectomy *with intraoperative cholangiogram*

Postoperative Diagnosis Same as laparoscopic cholecystectomy, *with severe inflammation/fibrosis/others, preventing safe identification of Calot's triangle/ductal anatomy*

Indications This ___-year-old *male/female* with *right upper quadrant pain/nausea/vomiting/fever/leukocytosis/others* was found on workup to have *symptomatic cholelithiasis/cholecystitis/choledocholithiasis/gallstone pancreatitis/others*. Laparoscopic cholecystectomy was therefore indicated.

Description of Procedure Patient was taken to the operating room and placed on the table in supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was initiated and patient intubated. *Lines/tubes* (i.e., *Foley catheter, OG/NG, SCDs, arterial line,* etc.) were placed and all pressure points appropriately padded. Patient was then prepped and draped in a sterile fashion. A time-out was completed verifying correct patient, procedure, antibiotics, and/ or special equipment prior to beginning the procedure. A periumbilical incision was then made.

[Choose One:]
For Veress needle: *A skin incision was made and the Veress needle inserted. Proper position was confirmed by aspiration and saline meniscus test.*

For Hasson cannula: *The fascia was elevated and incised, followed by incision of the peritoneum. Atraumatic entry into the peritoneum was confirmed visually. Two anchoring sutures were placed through the fascia. The Hasson cannula was inserted under direct vision and secured with the stay sutures.*

The abdomen was then insufflated with carbon dioxide to a pressure of 12–15 mmHg. The patient tolerated insufflation well. (*Veress technique: A 5-mm trocar was then inserted at the umbilicus.*)

The laparoscope was inserted and the abdomen inspected to ensure no injuries occurred with initial port placement. Additional ports were then placed as follows: a 5-mm/12-mm subxiphoid port and two 5-mm ports along the right subcostal margin. Inspection of the abdomen revealed [*state findings/gallbladder appearance*]. The table was placed in reverse Trendelenburg with the right side up.

Due to significant distention, the gallbladder required decompression via needle aspiration. The gallbladder fundus was grasped and retracted cephalad over the liver. *Adhesions between the gallbladder and omentum/duodenum/transverse colon were taken down carefully.* The infundibulum was then retracted inferior-laterally to expose

Calot's triangle. Peritoneum overlying the infundibulum was incised and stripped inferiorly. Due to *severe inflammation/fibrosis/others*, critical view of safety was unable to be achieved. Therefore, any further dissection within Calot's triangle was aborted and decision made to proceed with subtotal cholecystectomy.

Hook cautery was used to open the anterior gallbladder wall at the *fundus/infundibulum region*. Contents were evacuated via suction and any stones placed in an Endo Catch bag. The anterior gallbladder wall was then resected with cautery, leaving the posterior wall attached to the liver. Resection of anterior wall at the infundibulum region was continued in the direction of the cystic duct as far as was deemed safe. The mucosa of the posterior gallbladder wall and stump was ablated with *electrocautery/argon beam*. The gallbladder stump *was left open/closed with Endo GIA stapler/suture ligation/Endoloop/others*. Hemostasis was achieved. The partially resected gallbladder and contents were placed in an endoscopic retrieval bag and removed through the *subxiphoid/umbilical* incision. *Irrigation was performed, and any spilled stones/bile was suctioned.* Closed-suction drain was left in the gallbladder fossa and externalized via *the most lateral port site/a separate stab incision* and secured to the skin with 3-0 nylon. *A GraNee/Carter-Thomason needle was used to pass a 0-Vicryl under direct vision to close the fascia at the subxiphoid/umbilical port site.* Ports were removed under direct vision with *no bleeding noted/trocar site bleeding controlled by electrocautery* and the abdomen deflated. Skin of all incisions was re-approximated with *subcuticular 4-0 Monocryl and Dermabond/Steri-Strips applied.* A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the OR and transferred to PACU in stable condition.

Single Incision Laparoscopic Cholecystectomy

96

Katie M. Leick and Hui Sen Chong

Indications

- Symptomatic cholelithiasis
- Acute or chronic cholecystitis
- Choledocholithiasis (resolved)
- Biliary pancreatitis (resolved)

Essential Steps

1. Establish pneumoperitoneum.
2. Place laparoscope through the umbilical site.
3. Inspect the abdomen.
4. Reverse Trendelenburg position.
5. Grasp and elevate the gallbladder fundus.
6. Gently dissect any present adhesions.
7. Incise the peritoneum overlying the infundibulum.
8. Define the cystic duct and cystic artery entering the gallbladder.
9. *Perform cholangiogram.*
10. Clip and divide the cystic duct and cystic artery.
11. Remove the gallbladder from the liver bed with electrocautery.
12. Check hemostasis.
13. Remove the gallbladder from the peritoneal cavity.
14. Close the abdomen.

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Note These Variations

- Type of single incision laparoscopic port.
- Cholangiogram is optional.
- Drain placement (usually not indicated).
- Additional trocar placements are optional.
- Conversion to open is optional.

Complications

- Injury to the common bile duct or right hepatic duct
- Bile leak
- Subhepatic abscess
- Retained common bile duct stones
- Umbilical port-site hernia
- Need for additional trocar placement or conversion to open cholecystectomy

Template Operative Dictation

Preoperative Diagnosis *Symptomatic cholelithiasis/choledocholithiasis/gallstone pancreatitis*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_96

Procedure Single incision laparoscopic cholecystectomy *with operative cholangiogram*

Postoperative Diagnosis: Same

Indications This ___-year-old *male/female* with *right upper quadrant pain/nausea/vomiting/other* was found on workup to have *symptomatic cholelithiasis/cholecystitis/choledocholithiasis/gallstone pancreatitis* on workup. *Laparoscopic single incision cholecystectomy was indicated.*

Description of Procedure The patient was placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. Preoperative antibiotics were administered. *Specific lines/tubes* (i.e., *Foley catheter, OG/NG, SCDs*, etc.) were placed and all pressure points appropriately padded. The abdomen was prepped and draped in the usual sterile fashion.

A midline umbilical incision was made. This was deepened through the subcutaneous tissues down to the fascia. A __cm incision was made in the abdominal wall fascia, and the peritoneal cavity was entered. A *SILS*™ *Port/Olympus TriPort*™*/others* were placed through the umbilical incision, and pneumoperitoneum was established. The laparoscope and two atraumatic graspers were inserted through the single-port device, and the abdomen was inspected. The gallbladder anatomy was identified.

[Choose One for Retraction of the Gallbladder Fundus Superiorly]:

A stab incision was made in the right upper quadrant, and the fundus of the gallbladder was elevated with a pediatric alligator retractor.

(or) A Keith needle was used to pass a suture through the fundus of the gallbladder. The suture was then brought out through the anterior abdominal wall with a GraNee needle, allowing for gallbladder retraction superiorly.

The infundibulum was retracted inferior-laterally to expose Calot's triangle. Peritoneum overlying the infundibulum was incised and stripped inferiorly. The cystic duct and artery were identified and dissected circumferentially until the critical view of safety was obtained.

If cholangiogram performed: *A clip was placed on the cystic duct close to the neck of the gallbladder. A nick was made in the cystic duct and a cholangiogram catheter inserted. A cholangiogram was obtained under dynamic fluoroscopy showing good flow of bile into the duodenum, an intact biliary tree, and absence of any filling defects/other.*

The cystic duct and cystic artery were doubly clipped and divided sharply. The gallbladder was dissected off of the liver bed using electrocautery. Hemostasis was achieved. The gallbladder was placed in an endoscopic retrieval bag and removed through the umbilical incision. The abdomen was deflated. The fascial incision was then closed with *figure-of-eight/simple interrupted* ___ suture. The wound *was irrigated*, and the skin was closed with running subcuticular sutures of ___. *Steri-Strips/Dermabond* was applied to the incisions.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the OR and transferred to PACU in stable condition.

Open Common Bile Duct Exploration

97

James P. De Andrade and Zoe Ann Stewart

Indications

1. Choledocholithiasis detected during open cholecystectomy
2. Unsuccessful laparoscopic CBD exploration and endoscopic expertise unavailable or there are anatomical preclusions to endoscopic management (e.g., prior Roux-en-Y)
3. Adjunct to complex biliary tract surgery

Essential Steps

1. Right upper quadrant incision.
2. Kocherize the duodenum.
3. Place two stay sutures in the common bile duct.
4. Longitudinal incision in the common bile duct.
5. Aspirate bile and culture.
6. Explore duct with scoops, biliary Fogarty catheters, baskets, and/or choledochoscope.
7. Close bile duct in a watertight fashion around T-tube.
8. Perform completion cholangiogram.
9. Place closed-suction drain in the subhepatic space.
10. Ensure hemostasis.
11. Place omentum in the field.
12. Close abdomen.

Note These Variations

1. Cholecystectomy and cholangiogram if not already done.
2. Different instruments may be used to clear the common bile duct.
3. Use of a rigid versus fiber optic choledochoscope.

Complications

1. Retained common bile duct stones
2. Bile leak
3. Common bile duct stricture
4. Pancreatitis

Template of Operative Dictation

Preoperative Diagnosis Choledocholithiasis

Procedure *Cholecystectomy with* common bile duct exploration and cholangiogram

Postoperative Diagnosis Choledocholithiasis

Indications This is a ___-year-old male/female who was found to have choledocholithiasis.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_97

Endoscopic clearance was *unsuccessful/unavailable*; therefore, open common bile duct exploration was indicated.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation.* The patient was placed in a supine position on the operating room table. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general endotracheal anesthesia, a Foley catheter *and orogastric/nasogastric tube* were placed. The abdomen was prepped and draped in the usual sterile fashion.

A right subcostal incision was made two fingerbreadths below the costal margin extending from the subxiphoid region to the anterior axillary line. The subcutaneous tissues were divided using electrocautery, and the peritoneal cavity was entered. The falciform ligament was doubly ligated with *0 silk* ties and divided.

[Choose One:]

If performing a cholecystectomy:

The gallbladder was elevated, and the peritoneum overlying Calot's triangle was incised. The cystic duct and cystic artery were identified and encircled with *2-0 silk* ties. The cystic duct was cannulated with a ___ catheter, and a cholangiogram was obtained demonstrating a dilated common bile duct containing ___ stones. The cystic duct and cystic artery were then ligated proximally and distally and divided. The gallbladder was taken off the liver bed using electrocautery and sent to pathology for permanent section.

If cholecystectomy has already been performed:

The common bile duct was identified. A ___ butterfly needle was used to cannulate the duct, and a cholangiogram was performed demonstrating a dilated common bile duct containing ___ stones.

A Kocher maneuver was performed by incising the peritoneal attachments lateral to the duodenum and gently rotating the duodenum and head of the pancreas medially. The common bile duct and head of the pancreas were palpated and *was without obvious abnormality/ stones were palpated in the common duct.* The hepatoduodenal ligament overlying the common bile duct was incised to expose the anterior wall of the common bile duct 2 cm proximal to the pancreas. Two *4-0 silk* stay sutures were placed on the anteromedial wall of the common bile duct, and a 1.5-cm incision between these sutures was made with a #15/#11 blade. Bile was aspirated and sent for culture and Gram stain.

Stones were gently milked from the distal duct and removed via the choledochotomy. *Scoops/stone forceps/biliary Fogarty catheter* was passed proximally and distally, and stones were retrieved. Remnant debris was then irrigated from the duct. A ___ French *coude catheter/Bakes dilator* was then successfully passed via the choledochotomy through the ampulla.

A completion choledochoscopy was performed, and *no additional stones or debris was noted/additional debris was retrieved.* Patency of the ampulla was confirmed by noting the ampulla dilating when irrigated with saline.

A ___ French T-tube was then placed in the common bile duct, and the choledochotomy was closed using interrupted *5-0 PDS* suture *below/above* the T-tube. The choledochotomy was tested with saline, and a single figure-of-eight *5-0 PDS* was used to completely approximate the choledochotomy edges *inferior to/superior to* the T-tube. Air was then flushed from the long limb of the T-tube with saline.

A completion cholangiogram was then obtained.

Choose One

The contrast was noted enter the duodenum.

The contrast did not initially enter the duodenum; however, after administration of 1 mg Glucagon intravenously, a repeat cholangiogram showed free passage of contrast in the duodenum. No residual stones were noted.

The T-tube was brought out through a separate incision inferior to the subcostal incision and fastened to the skin with a nylon suture. A closed-suction drain was placed in the subhepatic space and brought out through a separate incision lateral to the T-tube and likewise fastened to the skin with a nylon suture. Hemostasis was obtained, and the abdomen was irrigated with saline. Omentum was placed over the choledochotomy.

The abdominal fascia was closed with *running/interrupted* ____, and the skin was closed with *staples/___subcuticular sutures/packed open.* The T-tube was placed to gravity drainage. The subhepatic drain was placed to bulb suction.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was wheeled to the recovery unit in stable condition. There were no immediate complications noted.

Acknowledgment This chapter was contributed by Christopher Bunch, M.D. in the previous edition.

98 Laparoscopic Exploration of Common Bile Duct

Walid Faraj, Hussein Nassar, and Ahmad Zaghal

Indications

- Symptomatic common bile duct stone(s)
- Dilated common bile duct
- Common bile duct stones found during laparoscopic cholecystectomy
- Common bile duct injury

Essential Steps

1. Check the availability of a digital C-arm unit with real-time fluoroscopy in the operating room.
2. Skin incisions and trocars placement as for laparoscopic cholecystectomy.
3. Calot's triangle dissection and identification of cystic duct and artery.
4. Cholangiography.
5. IV glucagon.
6. Flush of cholangiogram catheter with saline.
7. *Transcystic exploration*: *choledochoscope and basket retrieval*.
8. *Laparoscopic choledochotomy*.
9. Completion cholangiography.
10. Cholecystectomy, if not previously performed.
11. Secure hemostasis.
12. *Close the cystic duct stump/place T-tube*, *close choledochotomy*, *place closed-suction drains*.
13. Wound closure.

Note These Variations

- Laparoscopic transcystic exploration (most common method)
- Laparoscopic choledochotomy, by performing a vertical ductotomy for about 5 mm on the anterior surface of the common bile duct and distal to the cystic–common bile duct junction
- Cholecystectomy, if not previously performed.
- Use of Fogarty catheter instead of basket.
- Retrieval may be guided by fluoroscopy or by choledochoscope.

Complications

- Transient hyperamylasemia/pancreatitis
- Retained common bile duct stones
- Bleeding
- Bile leak
- Duodenal injury

Template Operative Dictation

Preoperative Diagnosis *Choledocholithiasis/CBD injury*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_98

Procedure *Laparoscopic cholecystectomy*, *with* intraoperative cholangiogram, and laparoscopic common bile duct exploration

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who presented with a history of right upper quadrant pain, fever, jaundice, and leukocytosis, workup revealed elevated serum liver function test and choledocholithiasis, and ERCP failed to clear the biliary tract, so the decision was to perform *laparoscopic cholecystectomy*, *with* intraoperative cholangiogram, and CBD exploration.

Description of Procedure Time-outs were performed using both pre-induction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Under general anesthesia, with the patient placed in the supine position, the whole abdomen was prepped and draped in the usual sterile fashion. A time-out was completed verifying correct patient, procedure, site, positioning, and implant(s) and/or special equipment prior to beginning this procedure.

A Veress needle was placed and the abdomen insufflated to 15 mmHg. A 10-mm trocar was placed in the supraumbilical location and the abdomen inspected. A second 10-mm trocar was placed in an epigastric location under direct vision. Two additional 5-mm trocars were then placed in the right upper quadrant.

Choose One

The gallbladder was retracted cephalad using a ratcheted grasper, *exposing the peritoneum overlying the Calot's triangle that was incised using electrocautery*, *the cystic artery and cystic duct were identified*, *then the cystic duct was skeletonized at the gallbladder–cystic duct junction after which a hemoclip was applied proximally and then a small cystic duct ductotomy was made*.

If cholecystectomy previously performed: *Adhesions were carefully lysed and a cystic duct remnant identified and grasped*.

A cholangiogram catheter was then introduced *into the abdomen percutaneously and fed into the cystic duct/through the right lateral trocar using a cholangiogram clamp*. A cholangiogram was then obtained that showing a dilated CBD containing ___ filling defects.

The patient was then given 10 mg of glucagon intravenously (to relax the sphincter of Oddi), and ___ ml of normal saline/ ___ was vigorously flushed through the cholangiogram catheter under fluoroscopic guidance. Cholangiography was repeated to evaluate whether the stone has passed.

[Choose One:]

If the filling defect in the CBD disappeared: *The procedure was concluded at this stage*, *and attention was turned toward completion of the cholecystectomy in the usual fashion after withdrawing the cholangiography catheter*.

If the filling defect persisted: *The decision was to proceed with a choledochoscopy* (*transcystic exploration*).

Choledochoscopy was performed by dissecting the cystic duct within 1 cm of the junction with the CBD, *a cystic duct ductotomy was then performed*, *and a guide wire was advanced into the cystic duct through a 3-mm introducer in the right subcostal trocar*. (*Alternatively*, *if the cholangiogram catheter was placed percutaneously*, *the site would be dilated*, *and a cystic duct introducer would be placed to pass the choledochoscope*). *The choledochoscope was then advanced over the guide wire into the dilated duct after it was dilated using balloon dilator*.

Continuous saline irrigation through the choledochoscope under pressure no greater than 50–100 mmHg was used to facilitate visualization as the choledochoscope was being advanced.

A stone was visualized, *a stone basket was passed through the working channel of the choledochoscope*, *the basket was then opened so that the middle of the basket was aligned with the middle of the stone*, *careful manipulation of the basket in an in-and-out manner aided in the stone capture*, *then the stone was brought within the basket wires*, *the basket was closed around the stone*, *and the stone was pulled to the tip of the scope*; *both the scope and basket were then withdrawn as one unit*.

The maneuver was repeated ___ times to retrieve all the stones from the CBD. The stones were placed in a plastic collection sac for retrieval at the completion of bile duct exploration.

After the duct was cleared of stones, the scope passed easily into the duodenum.

Completion cholangiography was then performed, showing no filling defects in the CBD, and dye was able to reach the duodenum, then the cystic duct was closed with a pre-tied ligature, and cholecystectomy was completed in the usual fashion and *the gallbladder removed* and hemostasis secured.

***If the stone was inaccessible*, *transcystic exploration was abandoned in favor of laparoscopic choledochotomy/postoperative ERCP*.**

Laparoscopic choledochotomy: *The gallbladder was retracted cephalad; the CBD was dissected down to approximately 1–2 cm distal to the junction of the cystic duct; then two stay sutures were placed in the CBD; an additional 5-mm trocar was placed in the right lower quadrant for insertion of an additional needle driver; a vertical choledochotomy was then made using curved microscissors; on the anterior aspect of the duct while the stay sutures were elevated, the duct was then flushed with saline to remove any loose stones; the choledoscope was then introduced directly into the CBD through the choledochotomy; and stones were removed with a basket retrieval technique similar to transcystic choledochoscopy. After clearing the duct of stones, a (12/14)Fr T-tube was inserted into the choledochotomy, and the ductal defect was closed with interrupted absorbable sutures, the T-tube was brought out through the subcostal port, and a __F closed-suction drain was brought out through the most lateral port.*

Cholecystectomy was completed as the usual fashion and the gallbladder removed and hemostasis secured.

The skin incisions were closed in layers: ___ sutures for the fascia and 4-0 Monocryl subcuticular sutures for the approximation of the skin.

The T-tube drain was connected to gravity drainage, the closed-suction drain was connected to closed bulb suction, and both were fixed to the skin using 3/O nylon sutures.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the operation very well and was transferred to the postanesthesia care unit in a stable condition.

Roux-en-Y Hepaticojejunostomy or Choledochojejunostomy

99

Fadi S. Dahdaleh

Indications

- Bile duct strictures, primary sclerosing cholangitis
- Palliation of malignant biliary obstruction
- Iatrogenic injury to bile duct
- Bile duct tumors
- Choledochal cyst disease

Essential Steps

1. Right subcostal incision and possible vertical extension.
2. Release adhesions.
3. Identify hepatic artery/ replaced right hepatic artery.
4. *Perform cholecystectomy (if not already done)*.
5. Identify bile duct.
6. *Cholangiogram*.
7. Dissect the hepatoduodenal ligament
8. Identify the ligament of Treitz.
9. Create the Roux limb.
10. Bring the Roux limb through the transverse mesocolon.
11. *Stapled or hand-sewn* jejunojejunostomy.
12. Construct *end-to-side/side-to-side* hepaticojejunostomy or choledochojejunostomy anastomosis.
13. Place *T-tube/stent*.
14. Place closed suction drain.
15. Close abdomen.

Note These Variations

- Epidural catheter
- Anatomic variations of hepatic arterial supply; replaced right hepatic artery
- Level of anastomosis (hepatic duct (hepatico) vs. common duct (choledocho))
- Cholecystectomy (if not previously done)
- Retrocolic vs. antecolic
- T-tube/stent

Complications

- Leak
- Stricture

Template Operative Dictation

Preoperative Diagnosis Biliary stricture/injury/tumor/other

Procedure Roux-en-Y hepaticojejunostomy/choledochojejunostomy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_99

Postoperative Diagnosis Same

Indications Patient is a ___-year-old *male/female* who was found to have a *biliary stricture/injury/tumor/other* which was not amenable to endoscopic treatment. Bypass using a biliary enteric anastomosis was necessary to reestablish continuity.

Description of Procedure *An epidural catheter was placed prior to the start of the operation*. The patient was brought into the operating room and placed on the table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was administered. Preoperative antibiotics were administered. A Foley catheter and orogastric tube were placed. All bony prominences were padded. The patient was prepped with *Betadine/Chlorhexidine* and draped in the usual sterile fashion. *A right subcostal incision was made two finger breadths below the costal margin from the right of the xiphoid to the anterior axillary line*. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The fascial and aponeurotic layers of the abdominal wall were divided with electrocautery and the peritoneal cavity entered. The abdomen was explored and (*detail findings*). The falciform ligament was doubly ligated with 2-0 silk and divided.

The *Thompson/Omni-Tract* retractor was introduced to allow exposure of the porta hepatis. Meticulous dissection of the area between the undersurface of the right lobe and the duodenum was undertaken. The location of the hepatic artery was then identified to prevent injury. The vessel was localized *by palpation/with the aid of intraoperative sonography/aspiration with 25-gauge needle* over the left side of the hepatoduodenal ligament. The artery then looped anteriorly in the porta hepatis. *No replaced right hepatic artery was palpable/ (describe findings)*. Following that, the common bile duct was clearly identified and isolated.

[Choose Any of the Following Options if Performed/Encountered Intraoperatively]:
If cholecystectomy:
The gallbladder was grasped, and the peritoneum overlying the fundus was incised. A dome-down approach was utilized to achieve safe dissection of Calot's triangle. The cystic duct and cystic artery were isolated. The cystic duct was then cannulated with a ___ catheter and a cholangiogram was obtained that demonstrated ___. The cholecystectomy was then completed in the usual fashion and the gallbladder removed.

If cholangiogram: A cholangiogram was performed by injecting contrast through the existing biliary stent/ describe other methods. This *demonstrated ___*.

If intact common bile duct with stent preoperatively: *The common bile duct stent was palpable in the hepatoduodenal ligament. The distal common bile duct was identified and was of normal caliber just above the duodenum*.

If unusual location of common bile duct: *The common bile duct was not found in the usual anterolateral portion of the hepatoduodenal ligament. Upon further exploration, it appeared the common bile duct was clipped and likely transected. The area of injury was identified at* (*describe findings*). *The distal common bile duct was identified and was of normal caliber just above the duodenum*.

The common bile duct was then examined, and the area of obstruction/injury was delineated. It was found to _____ (describe fully). Two 4-0 Prolene traction sutures were then placed above the stricture/level of injury. Distally, the common duct was ligated with two 4-0 Prolene sutures. The hepatic plate was then dropped by incising the peritoneal layer between the liver capsule and the hepatoduodenal ligament just above the hepatic duct. This further exposed the proximal common hepatic duct towards its bifurcation. The cut edge of the duct was trimmed slightly, and healthy bleeding was seen around the duct. Undue dissection was avoided to maintain good vascular supply of the duct. The duct opening was then extended to the left along the anterior surface of the left hepatic duct until the opening was 15 mm in length. Stones/debris were removed with normal saline irrigation using a soft rubber catheter. Again patency of both the left and right hepatic arteries was confirmed by *palpation/Doppler interrogation*.

Attention was then turned to creation of the Roux limb. The ligament of Treitz was located, and the jejunum was divided with a GIA stapler ___ cm from the ligament where a loop of jejunum easily approximates the liver. The divided distal end of jejunum was then brought through a window in the transverse mesocolon.

If stapled: The jejunojejunostomy anastomosis was performed approximately 40 cm distal to the Roux limb. This anastomosis was performed in side-to-side functional end-to-end fashion. Two limbs of jejunum were approximated with 3-0 silk sutures. Enterotomies were made, and the GIA stapler was introduced and fired. The staple line was checked for hemostasis and the enterotomy closed with *a linear stapler/two layers of sutures*. The staple line was inspected for hemostasis. *The staple line was inverted using interrupted 4-0 silk Lembert sutures*. The defect in the mesentery was then closed using *running 3-0 Vicryl suture/ interrupted 3-0 silk sutures*.

If sutured: A hand-sewn two-layer end-to-side anastomosis was then performed between the proximal jejunal limb and the jejunum 40 cm distal to the Roux limb using 3-0 Vicryl and 3-0 silk sutures. The anastomosis was palpated and noted to be widely patent. The mesenteric defect was re-approximated with *running 3-0 Vicryl suture/ interrupted 3-0 silk sutures*. The Roux limb was fixed to the mesocolon with interrupted silks.

Next, attention was turned to the biliary tract. Interrupted 5-0 PDS sutures were placed at 3 and 9 o'clock in the bile duct. An enterotomy was made in the Roux. The back wall of the end-to-side *hepaticojejunostomy/choledochojejunostomy* was fashioned using interrupted *5-0 PDS* suture at 2–3 mm intervals.

If stent: *A stent was fashioned from a 5-French pediatric feeding tube and placed across the anastomosis into the hepatic duct. The stent was fixed to the Roux limb with a chromic stitch/ not sutured in place*. If T-tube: *A T-tube was placed across the anastomosis. The vertical limb was brought out of the duct 1 cm proximal to the anastomosis. This was then brought out of the abdominal wall through a stab incision and secured using 3-0 Nylon stitches*.

The anastomosis was then completed with interrupted 5-0 PDS on the anterior wall. The abdomen was copiously irrigated.

The hepatic artery was again interrogated with Doppler and found to have normal triphasic signal. The liver had *normal color and was soft/describe other findings*. No further bilious drainage was evident. Attention was turned to closure.

A *19-round Blake/Jackson-Pratt* drain was placed posterior to the biliary anastomosis and brought through a separate skin incision. *An additional drain was placed anterior to the biliary anastomosis*. The *drain(s) was*/were sutured to the skin with 3-0 Nylon and connected to closed bulb suction. The subcostal fascia was closed in a single layer with running #1 *PDS/Prolene*. The wound was irrigated and the skin re-approximated with staples. A dry sterile dressing was applied. The patient tolerated the procedure well. There were no intraoperative complications. All instrument and sponge counts were correct at the end of the case. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transferred to the recovery room in stable condition.

Acknowledgment This chapter was contributed by Susan Skaff Hagen, M.D., in the previous edition.

100 Resection of Carcinoma of Hepatic Duct Bifurcation

Thomas E. Collins

Indication

- Cholangiocarcinoma (Klatskin tumor)

Essential Steps

1. Preoperative assessment and planning:
   - Imaging: cholangiogram and axial imaging (MRI or CT) to determine resectability, the type of liver resection required (right or left trisegmentectomy), and liver remnant volume.
   - Preoperative placement of percutaneous transhepatic cholangiocatheters may be considered if surgery is not scheduled within 1–2 weeks.
   - Preoperative assessment of liver function by history and laboratory studies.
2. Bilateral or right subcostal ("chevron" or "roof top") incision.
3. Complete mobilization of the liver.
4. Carefully evaluate for evidence of metastatic disease by palpation and intraoperative ultrasound of liver including the caudate lobe, subhilar, retroduodenal, gastrohepatic ligament, and periaortic areas.
5. Examine all peritoneal surfaces.
6. Perform a complete Kocher maneuver.
7. Dissect the porta hepatis:
   - Circumferential dissection of the portal vein and hepatic artery
   - Dissection of the segmental branches of the portal vein and hepatic artery (right or left) depending on planned liver resection
   - Division of the common bile duct at the level of the duodenum
   - Inclusion of all hepatoduodenal lymph nodes and tissue (excluding the portal vein and hepatic artery) with the liver specimen to be resected
8. Transect the liver parenchyma to complete either a right or left trisegmentectomy utilizing cautery, and obliterate the parenchyma by ultrasound or waterjet. Central venous pressure maintained at five or below during transection.
9. Place or reposition transhepatic stent.
10. Complete biliary reconstruction utilizing retrocolic Roux-en-Y hepaticojejunostomy.
11. Place drain(s) if necessary and close.

Note These Variations

- Use of preoperative biliary decompression.
- Use of preoperative contralateral lobar portal vein embolization to treat inadequate residual liver volume.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_100

- Perform cholecystectomy by top-down technique (only performed for left trisegmentectomy)
- Extent of liver resection.
- Stapled vs. sutured jejunojejunostomy.
- Running vs. interrupted biliary anastomosis.
- Use of fibrin glue on cut surface of liver.

Complications

- Hemorrhage
- Bile leak
- Cholangitis
- Subhepatic abscess
- Tumor recurrence

Template Operative Dictation

Preoperative Diagnosis Carcinoma of the hepatic duct bifurcation

Procedure
1. Exploratory laparotomy with intraoperative ultrasound
2. Liver resection (right or left trisegment ectomy)
3. Roux-en-Y hepaticojejunostomy to intrahepatic bile duct
4. Percutaneous transhepatic cholangiocatheter placement

Postoperative Diagnosis Same

Indications This ___-year-old *male/ female* developed obstructive jaundice, and workup revealed Klatskin tumor. Resection with biliary enteric anastomosis was elected for definitive management. Preoperative imaging indicated the tumor would best be resected with a (right/left) trisegmentectomy.

Description of Procedure The patient was placed in the supine position and general endotracheal anesthesia was induced. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Appropriate arterial and venous access was obtained for monitoring and resuscitation. Preoperative antibiotics were given prior to incision. Foley catheter and nasogastric tubes were placed. The abdomen was prepped and draped in the usual sterile fashion.

A right/bilateral subcostal incision (roof top) was made two finger breadths below the costal margins with superior xiphoid vertical extension if necessary. This was deepened through the subcutaneous tissues and fascial and muscular layers of the abdominal wall with electrocautery. The peritoneal cavity was entered and a self-retaining retractor was placed for exposure. The falciform ligament was divided and ligated with 2-0 silk. Exploration was begun with careful bimanual palpation of the liver for any unsuspecting masses. The gastrohepatic ligament was incised, taking care not to injure an accessory or replaced left hepatic artery if present. The caudate lobe was examined and palpated. A Kocher maneuver was performed to access the retroduodenal lymph nodes. The liver was completely mobilized by taking down both right and left triangular ligaments and dividing the inferior right lobe retroperitoneal attachments. The entire liver was examined with intraoperative ultrasound to ensure no tumor was present in the planned residual liver. No evidence of metastatic disease was found, and resection was therefore elected.

Next the portal dissection was carried out to evaluate for vascular involvement of the vessels supplying the planned residual liver segments. The hepatic artery and portal vein were identified and circumferentially dissected. The remaining lymph tissue in the porta hepatis was kept in continuity with the bile duct to be resected en bloc with the planned liver specimen. Next the segmental vascular structures were dissected into the liver in preparation for parenchymal transection.

Choose One
Left trisegmentectomy: *The right posterior hepatic artery and portal vein were dissected circumferentially.*

Right trisegmentectomy: *The left hepatic artery and vein were dissected to the umbilical fissure*. Once the vascular dissection revealed no evidence of vascular invasion precluding resection, the common bile duct was transected at the superior aspect of the duodenum. The distal bile duct margin was then excised and sent for frozen section *which returned negative/which revealed the presence of tumor. Additional bile duct was/was not resected* (*if not*, *give reason*). The distal common bile duct stump was suture ligated.

Next attention was turned to transection of the liver. The central venous pressure was monitored and was five or less throughout the resection.

[Choose One:]

If left trisegmentectomy: *The liver was further mobilized by ligating the venous branches draining into the vena cava. The right anterior portal vein*, *left portal vein, and hepatic arteries were ligated and divided. The resulting demarcation on the surface of the liver was then scored with cautery to a depth of 1 cm. The parenchymal transection device was then used to transect the parenchyma in the sectoral plane between the anterior* (*segments 5 and 8*) *and posterior* (*segments 6 and 7*) *sectors. Visible bile ducts and vessels were ligated or clipped. Once the dissection reached the bile duct, it was sharply transected and the distal margin sent for frozen section. The caudate lobe was included in the specimen. The GIA stapler was used to transect the posterior aspect containing large venous branches*.

If right trisegmentectomy: *The liver was further mobilized by ligating the venous branches draining into the vena cava. The right portal vein and hepatic arteries were ligated and divided. Early portal and arterial branches to segment 4 were also divided and ligated. The surface of the liver was then scored with cautery to a depth of 1 cm approximately*, *about 1 cm to the right of the falciform ligament. The junction between the caudate and the left lateral segment was scored with cautery to facilitate removal of the caudate lobe. The parenchymal transection device was then used to transect the parenchyma. Visible bile ducts and vessels were ligated or clipped. The caudate lobe was included in the specimen. Once the dissection reached the bile duct, it was sharply transected and the distal margin sent for frozen section. The GIA stapler was used to transect the posterior aspect of the specimen*.

Next hemostasis was obtained on the cut surface of the liver with cautery and suture ligature. Additionally, bile leaks on the cut surface were identified and suture ligated.

If no stent was placed preoperatively: *a transhepatic stent was brought through the abdominal wall above the incision*. A Bakes dilator was used to probe the open bile duct into the liver. The dilator was then pushed though the surface of the liver, and the stent was tied to the dilator to be brought through the liver and out the cut bile duct. The side holes on the stent were placed in the liver, and an absorbable purse-string suture was placed around the tube to secure it to the liver surface and prevent bile leakage.

Next, attention was turned to biliary reconstruction. The jejunum was divided 30–40 cm distal to the ligament of Treitz with a GIA stapler. The distal staple line was oversewn with interrupted 3-0 silk sutures. The transverse mesocolon was incised to the left of the middle colic vessels, and the distal staple line was brought through the mesocolon and in proximity to the open hepatic duct. The Roux limb was secured to the mesocolon with interrupted 3-0 silk sutures. An antimesenteric enterotomy was performed 5 cm proximal to the end of the distal Roux limb, about one half of the length of the bile duct. An end-to-side, single layer, interrupted, anastomosis was performed using *5-0 PDS* suture. The anastomosis was first created by approximating the posterior wall of the duct to the posterior wall of the jejunum. The distal portion of the biliary stent was then guided into the Roux limb prior to completion of the anastomosis. Bowel continuity was restored by a jejunojejunostomy 30–40 cm distal on the Roux limb using a stapling device or a two-layer handsewn closure. The resulting mesenteric defect was re-approximated with interrupted 3-0 silk sutures.

The abdomen was copiously irrigated with saline. The cut surface of the liver was again examined and treated for bleeding or bile leak. Closed suction drains were placed under the biliary anastomosis and proximate to the cut liver surface and brought through separate stab incisions below the subcostal incision. The drains and transhepatic stent were sutured to the abdomen with __ suture. The fascia was closed in two layers with monofilament absorbable suture. The subcutaneous tissues were irrigated and hemostasis ensured. The skin was closed with staples and a dry sterile dressing applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Rajesh Shetty, M.D., in the previous edition.

101 Hepatic Wedge Resection

Fadi S. Dahdaleh

Indication

- Peripheral, small, primary, or metastatic tumors

Essential Steps

1. Right subcostal incision/midline laparotomy.
2. Explore the abdomen and assess for metastasis.
3. Mobilize the liver by dividing its ligamentous attachments.
4. Establish margins of resection around the lesion by cauterizing Glisson's capsule.
5. Transect the parenchyma using *cautery*, *finger fracture*, *or other device of choice*.
6. Obtain hemostasis and bile stasis by *clipping or ligating* vessels and bile ducts >2 mm encountered.
7. Irrigate.
8. *Place drain* (*optional*).
9. Close the abdomen.

Note These Variations

- Method of parenchymal transection
- Use of drain

Complications

- Recurrence
- Bile leak
- Bleeding

Template Operative Dictation

Preoperative Diagnosis Primary/metastatic ____ cancer involving segment ___ of the liver

Procedure Wedge resection of segment ____ of the liver

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female who is known to have* a peripheral lesion in segment ____ of the liver requiring resection. Wedge resection was indicated.

Description of Procedure *An epidural catheter was placed prior to the start of the operation*. The patient was brought into the operating room and placed on the table in the supine

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_101

position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was administered. Preoperative antibiotics were administered. A Foley catheter and orogastric tube were placed. All bony prominences were padded. The patient was prepped with *Betadine/Chlorhexidine* and draped in the usual sterile fashion. A right subcostal incision was made two fingerbreadths below the costal margin from the right of the xiphoid to the anterior axillary line. This was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The fascial and aponeurotic layers of the abdominal wall were divided with electrocautery and the peritoneal cavity entered. The abdomen was explored and (*detail findings*). The ligamentum teres was doubly ligated with 2-0 silk and divided.

Inspection revealed the mass to be in segment ___ of the liver. Perihepatic adhesions were divided, and the liver was mobilized by dividing the falciform and triangular ligaments with electrocautery. The planned margin of resection was estimated by palpation, and the liver capsule was scored using cautery to outline at least a 1-cm margin from the lesion.

The parenchyma was transected using *cautery/finger fracture/ultrasonic aspirator*. Bile ducts and vessels were identified and secured with *clips/ligatures. Hemostasis at the liver edge was established by placing figure-of-eight sutures using ____ in an interrupted fashion along the length of the resection*. The area was copiously irrigated with saline and re-inspected for hemostasis. There was no evidence of active bleeding or bile leakage.

A round Blake/Jackson-Pratt drain was placed in the operative field and brought through a separate skin incision. The drain was sutured to the skin with 3-0 Nylon and connected to closed bulb suction. The fascia was closed in a single layer with running #1 *PDS/Prolene*. The wound was irrigated and the skin re-approximated with staples. A dry sterile dressing was applied. The patient tolerated the procedure well. There were no intraoperative complications. All instrument and sponge counts were correct at the end of the case. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transferred to the recovery room in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D., in the previous edition.

Left Hepatic Lobectomy: Intrahepatic Glissonian Approach

102

Jessica Maxwell and Hisakazu Hoshi

Indications

- Primary liver carcinoma confined to the left liver lobe
- Metastatic cancer localized to the left liver lobe

Essential Steps

1. Upper midline incision with (optional) right lateral extension/right Chevron incision/bilateral subcostal incision.
2. Explore the abdomen to rule out extrahepatic disease.
3. Mobilize the left lobe of the liver.
4. Intraoperative ultrasound.
5. Identify middle hepatic vein and mark transection plane with electrocautery.
6. Cholecystectomy.
7. Incise capsule and divide hepatic parenchyma.
8. Divide segment IV branches of middle hepatic vein.
9. Staple or ligate left hepatic Glisson pedicle.
10. Staple left hepatic vein.
11. Close the abdomen.

Note These Variations

- Right Chevron skin incision/bilateral subcostal incision
- Extra hepatic ligation of inflow and outflow vasculature (Chap. 103)
- En bloc caudate lobe resection

Complications

- Bleeding
- Bile leak
- Injury to contralateral hepatic ducts
- Postoperative liver failure

Template Operative Dictation

Preoperative Diagnosis *Primary liver/metastatic ___ cancer confined to the left liver lobe.* TNM stage ________

Procedure Left hepatic lobectomy

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_102

Indications This is ___-year-old *male/female* with stage ___carcinoma. The tumor was discovered on a *CT scan/MRI*. The tumor was confined to the left lobe of the liver, and thus the patient was selected for a left hepatic lobectomy.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

An upper abdominal midline incision was made from just below the xiphoid to the umbilicus / a right-sided Chevron incision was made / a bilateral subcostal incision (rooftop) was made two fingerbreadths below the costal margins. The subcutaneous tissue was divided using electrocautery down to the abdominal fascia. The fascia was incised sharply and the peritoneal cavity was entered.

A self-retaining abdominal retractor was placed. The abdomen was explored, and there was no evidence of tumor on the peritoneal surface, within the small bowel, or in the colon.

The liver was palpated and examined with ultrasound to identify all of the lesions, which were located in segments _______. No additional lesions were seen in right lobe of the liver. The left hemiliver was mobilized by ligating and dividing the *round ligament / falciform ligament / left triangular ligament / coronary ligament*. The common trunk of the left and middle hepatic veins was identified.

A cholecystectomy was performed in a dome-down approach. The hepatoduodenal ligament was encircled with vessel loop. By utilizing ultrasound, the transection plane was marked with electrocautery over the middle hepatic vein. The liver capsule was incised with an energy device. The hepatic parenchyma was divided with *a crushing technique / Cavitron ultrasound aspirator / bipolar cautery* until the hepatic veins and portal structures were encountered. Small intraparenchymal branches of the hepatic veins and bile ducts were ligated or controlled with bipolar coagulation, and the Pringle maneuver was intermittently applied. Segment IV veins draining into the middle hepatic vein were isolated, ligated, and divided. Liver parenchyma was divided toward *the lesser omental attachment to the liver / ductus venosus / inferior vena cava*. The left portal pedicle was isolated and divided with a vascular stapler. The left hepatic vein was isolated in the liver parenchyma at its junction with the middle hepatic vein. This was ligated and divided with vascular stapler.

If caudate lobe is resected en bloc: *the short hepatic veins from the caudate lobe to the inferior vena cava were ligated and divided*.

The specimen was passed off the field and sent to pathology. The remnant liver was inspected with Doppler ultrasound and found to be well perfused. Valsalva maneuver was performed and hemostasis at the transection surface was confirmed. The omentum was placed over the transected surface.

The abdomen was irrigated and inspected for hemostasis. The posterior fascia of the rectus abdominis and internal oblique was closed using *0 Vicryl / other suture* in a running fashion, while the anterior fascia and external oblique fascia were closed with *#1 PDS / other suture* in a running fashion. The midline incision was closed with *#1 PDS / other suture* in a running fashion. The incision was irrigated and staples were used to close the skin. The instrument and sponge counts were correct.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room and taken to the PACU in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D., in the previous edition.

Left Hepatic Lobectomy: Extrahepatic Ligation

103

Jessica Maxwell and Hisakazu Hoshi

Indications

- Primary liver carcinoma confined to the left lobe
- Metastatic cancer to the left lobe of the liver

Essential Steps

1. Upper midline incision with (optional) right lateral extension/right Chevron incision/bilateral subcostal incision.
2. Explore the abdomen to rule out presence of extrahepatic disease.
3. Mobilize the left lobe of the liver.
4. Divide ductus venosus and isolate left hepatic vein.
5. Ligate and divide left hepatic artery and left portal vein.
6. Ligate and divide left hepatic vein.
7. Identify middle hepatic vein and mark transection plane with electrocautery.
8. Divide liver parenchyma.
9. Divide segment VI branches of middle hepatic vein.
10. Close the abdomen.

Note These Variations

- Right Chevron skin incision/bilateral subcostal incision
- Intrahepatic Glissonian approach (Chap. 102)
- En bloc caudate lobe resection

Complications

- Bleeding
- Bile leak
- Injury to contralateral hepatic ducts
- Postoperative liver failure

Template Operative Dictation

Preoperative Diagnosis *Primary liver/metastatic ___ cancer confined to the left liver lobe.* TNM stage _____

Procedure Left hepatic lobectomy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_103

Postoperative Diagnosis Same

Indications This is ___ -year-old *male* / *female* with stage ___ carcinoma. The tumor was discovered on a *CT scan*/*MRI*. The tumor was confined to the left lobe of the liver, and thus the patient was selected for a left hepatic lobectomy.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

An upper abdominal midline incision was made from just below the xiphoid to the umbilicus / a right-sided Chevron incision was made / a bilateral subcostal incision (*rooftop*) *was made two fingerbreadths below the costal margins*. The subcutaneous tissue was divided using electrocautery down to the abdominal fascia. The fascia was incised sharply and the peritoneal cavity was entered.

A self-retaining abdominal retractor was placed. The abdomen was explored, and there was no evidence of tumor on the peritoneal surface, within the small bowel, or in the colon.

The liver was palpated and examined with ultrasound to identify all of the lesions, which were located in segments _______. No additional lesions were seen in the right lobe of the liver. The left hemiliver was mobilized by ligating and dividing the *round ligament / falciform ligament / left triangular ligament / coronary ligament*. The lesser omentum was divided at the attachment to the ductus venosus. The ductus venosus located at the groove between left lateral segment and caudate lobe was isolated, ligated, and divided. *Retraction on the cephalad portion of the ductus venosus exposed the common trunk of middle and left hepatic veins*; *these were isolated with a vessel loop / the left hepatic vein was isolated and encircled.*

If caudate lobe was removed en bloc: The caudate lobe was mobilized from the inferior vena cava by ligating the short hepatic veins.

Attention was turned to the gallbladder and cholecystectomy proceeded in a dome-down approach. The anterior serosa of the hepatoduodenal ligament was opened near its hepatic attachment, and the proper hepatic, right hepatic, and left hepatic arteries were identified and isolated. The common bile duct was isolated with a vessel loop. The main portal vein was identified posterior to the common bile duct and dissected toward the hilum of the liver. The portal vein bifurcation was identified and the left portal vein was encircled with vessel loop. The left hepatic artery and left portal vein were occluded with bulldog clamps, and the demarcation line between the right and left lobes was marked on the surface of the liver with electrocautery.

The left hepatic artery was ligated with 2-0 silk ties and the proximal stump was suture ligated with 4-0 Prolene. The left portal vein was then ligated and divided with a vascular stapler. The left hepatic vein was also divided with a vascular stapler.

The liver capsule was incised with an energy device, and the hepatic parenchyma was divided with *a crushing technique* / *Cavitron ultrasound aspirator* / *bipolar cautery* until the hepatic veins and portal structures were encountered. Small intraparenchymal branches of the hepatic veins and bile ducts were ligated or controlled with bipolar coagulation. The segment IV branches of the middle hepatic vein were identified, ligated, and divided. Once liver parenchyma was divided toward the ductus venosus, the left hilar plate containing the left hepatic duct was isolated, stapled, and divided.

If caudate was removed en bloc: *Once the liver parenchyma was divided toward the inferior vena cava*, *the short hepatic veins from the caudate lobe to the inferior vena cava were ligated and divided*.

The specimen was then passed off the field and sent to pathology. The remnant liver was inspected with Doppler ultrasound and found to be well perfused. Valsalva maneuver was performed and hemostasis at the transection surface was confirmed. The omentum was placed over the transected surface.

The abdomen was irrigated and inspected for hemostasis. The posterior fascia of the rectus abdominis and internal oblique was closed using *0 Vicryl* / *other suture* in a running fashion, while the anterior fascia and external oblique fascia were closed with #*1 PDS* / *other suture* in a running fashion. The midline incision was closed with #*1 PDS* / *other suture* in a running fashion. The incision was irrigated and staples were used to close the skin. The instrument and sponge counts were correct.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room and taken to the PACU in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D., in the previous edition.

104 Right Hepatic Lobectomy: Intrahepatic Glissonian Approach

Jessica Maxwell and Hisakazu Hoshi

Indications

- Primary liver carcinoma confined to the right liver lobe
- Metastatic cancer localized to the right liver lobe

Essential Steps

1. Upper midline incision with (optional) right lateral extension/right Chevron incision/bilateral subcostal incision.
2. Explore abdomen to rule out extrahepatic disease.
3. Mobilize the right lobe of the liver.
4. Intraoperative ultrasound.
5. Identify middle hepatic vein and mark transection plane with electrocautery.
6. Cholecystectomy.
7. Incise capsule and divide hepatic parenchyma.
8. Divide segment VIII and VII branches of middle hepatic vein.
9. Staple or ligate right hepatic Glissonian pedicle.
10. Divide short hepatic veins and right IVC ligament.
11. Divide right hepatic vein.
12. Close the abdomen.

Note These Variations

- Right Chevron incision/bilateral subcostal incision
- Extrahepatic ligation of inflow and outflow vasculature (Chap. 105)
- Separate division of the right anterior and posterior Glissonian pedicles

Complications

- Bleeding
- Bile leak
- Injury to contralateral hepatic ducts
- Postoperative liver failure

Template Operative Dictation

Preoperative Diagnosis *Primary liver/metastatic ___ cancer of the liver*. TNM stage ______

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_104

Procedure Right hepatic lobectomy

Postoperative Diagnosis Same

Indications This is ___ -year-old *male/female* with stage ___ carcinoma. The tumor was discovered on a *CT scan / MRI*. The tumor was confined to the right lobe of the liver and thus the patient was selected for a right hepatic lobectomy.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

An upper abdominal midline incision was made from just below the xiphoid to the umbilicus / a right-sided Chevron incision was made / a bilateral subcostal incision (*roof top*) *was made two fingerbreadths below the costal margins*. The subcutaneous tissue was divided using electrocautery down to the abdominal fascia. The fascia was incised sharply and the peritoneal cavity was entered.

A self-retaining abdominal retractor was placed. The abdomen was explored and there was no evidence of tumor on the peritoneal surface, within the small bowel, or in the colon.

The liver was palpated and examined with ultrasound to identify all of the lesions, which were located in segments ___. No additional lesions were seen in the left lobe of the liver. The right hemiliver was mobilized by ligating and dividing the *round ligament / falciform ligament / right triangular ligament / coronary ligament. The right adrenal gland was dissected off the liver*.

A cholecystectomy was performed in a dome-down approach. The hepatoduodenal ligament was encircled with vessel loop. The right and middle hepatic veins were identified using ultrasound, and the transection plane was marked with electrocautery over the middle hepatic vein. The liver capsule was incised with an energy device. Intermittent Pringle maneuver was applied throughout the parenchymal transection. The hepatic parenchyma was divided with *a crushing technique / Cavitron ultrasound aspirator / bipolar cautery* until the hepatic veins and portal structures were encountered. Small intraparenchymal branches of the hepatic veins and bile ducts were ligated or controlled with bipolar coagulation. The segment V and VIII hepatic vein branches were clearly identified, ligated, and divided. Once the parenchyma was divided toward hilum of the liver, *the anterior sectoral Glissonian pedicle was identified*, *isolated*, *stapled*, *and divided. This was repeated for the posterior sectoral Glissonian pedicle/the right Glissonian pedicle was isolated and divided with stapler*.

The caudate lobe was divided down to the anterior surface of the retrohepatic IVC. The short hepatic veins between the caudate lobe and IVC were ligated and divided. The hepatocaval ligament was divided with a vascular stapler and the right hepatic vein was isolated at its junction with the IVC. This was transected with vascular stapler. The specimen was passed off the field and sent to pathology. The remnant liver was inspected with Doppler ultrasound and found to be well perfused. Valsalva maneuver was performed and hemostasis at the transection surface was confirmed. The omentum was placed over the transected surface.

The abdomen was irrigated and inspected for hemostasis. The posterior fascia of the rectus abdominis and internal oblique was closed using *0 Vicryl / other suture* in a running fashion, while the anterior fascia and external oblique fascia were closed with *#1 PDS / other suture* in a running fashion. The midline incision was closed with #*1 PDS* / *other suture* in a running fashion. The incision was irrigated and staples were used to close the skin. The instrument and sponge counts were correct.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room and taken to the PACU in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D. in the previous edition.

Right Hepatic Lobectomy: Extrahepatic Ligation

105

Jessica Maxwell and Hisakazu Hoshi

Indications

- Primary liver carcinoma confined to the right liver lobe
- Metastatic cancer localized to the right liver lobe

Essential Steps

1. Upper midline incision with (optional) right lateral extension/right Chevron incision/bilateral subcostal incision.
2. Explore abdomen to rule out extrahepatic disease.
3. Mobilize the right lobe of the liver.
4. Intraoperative ultrasound.
5. Divide right hepatocaval ligament.
6. Ligate right hepatic vein.
7. Cholecystectomy.
8. Ligate right hepatic artery and right portal vein.
9. Trace the line of demarcation with electrocautery and divide liver parenchyma.
10. Divide and ligate right hepatic duct.
11. Check for hemostasis of the remnant liver and cover transected surface with omentum.
12. Close the abdomen.

Note These Variations

- Right Chevron skin incision / bilateral subcostal incision
- Intrahepatic Glissonian approach (Chap. 104)
- Separate division of right anterior and posterior hepatic ducts

Complications

- Bleeding
- Bile leak
- Injury to contralateral hepatic ducts
- Postoperative liver failure

Template Operative Dictation

Preoperative Diagnosis *Primary liver / metastatic ___ cancer of the liver*. TNM stage ________

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_105

Procedure Right hepatic lobectomy

Postoperative Diagnosis Same

Indications This ___ -year-old *male / female* with stage ___ _______ carcinoma. Tumor was discovered in the liver on a *CT scan / MRI*. The tumor was confined to the right lobe of the liver and thus the patient was selected for a right hepatic lobectomy.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

An upper abdominal midline incision was made from just below the xiphoid to the umbilicus / a right-sided Chevron incision was made/a bilateral subcostal incision (roof top) was made two fingerbreadths below the costal margins. The subcutaneous tissue was divided using electrocautery down to the abdominal fascia. The fascia was incised sharply and the peritoneal cavity was entered.

A self-retaining abdominal retractor was placed. The abdomen was explored and there was no evidence of tumor on the peritoneal surface, within the small bowel, or in the colon.

The liver was palpated and examined with ultrasound to identify all of the lesions, which were located in segments _______. No additional lesions were seen in the left lobe of the liver. The right hemiliver was mobilized by ligating and dividing the *round ligament / falciform ligament / right triangular ligament / coronary ligament. The right adrenal gland was dissected off the liver*. The infrahepatic portion of the vena cava was dissected along its anterior surface. The short hepatic veins from the *right lobe / paracaval portion of the caudate lobe* were serially ligated and divided. The right hepatocaval ligament was isolated and divided with a vascular stapler. The right hepatic vein was identified, dissected, and isolated with vessel loop.

Attention was turned to the gallbladder, and cholecystectomy proceeded in a dome-down approach. The anterior serosa of the hepatoduodenal ligament was opened near its hepatic attachment and the proper hepatic, right and left hepatic arteries were identified and isolated. The common bile duct was isolated with a vessel loop. The main portal vein was identified posterior to the common bile duct and dissected toward the hilum of the liver. The portal vein bifurcation was identified and the right portal vein was encircled with a vessel loop. The right hepatic artery and right portal vein were occluded with bulldog clamps and the demarcation line between the right and left lobes was marked on the surface of the liver with electrocautery.

The right hepatic artery was ligated with 2-0 silk ties and the proximal stump was suture ligated with 4-0 Prolene. The right portal vein was then ligated and divided with a vascular stapler. The right hepatic vein was divided with a vascular stapler.

The hepatic parenchyma was divided using *the crushing technique / Cavitron ultrasound aspirator / bipolar cautery* until the hepatic veins and portal structures were encountered. Small intraparenchymal branches of the hepatic veins and bile ducts were ligated or controlled with bipolar coagulation. The segment V and segment VIII branches of the middle hepatic vein were clearly identified, ligated and divided. Once the parenchyma was divided toward hilum of the liver, *the anterior sectoral Glissonian pedicle was identified*, *isolated*, *stapled*, *and divided. This was repeated for the posterior sectoral Glissonian pedicle / the right hilar plate containing the right hepatic duct was isolated and divided with stapler*. The specimen was passed off the field and sent to pathology. The remnant liver was inspected with Doppler ultrasound and found to be well perfused. A Valsalva maneuver was performed and hemostasis at the transection surface was confirmed. The omentum was placed over the transected surface.

The abdomen was irrigated and inspected for hemostasis. The posterior fascia of the rectus abdominis and internal oblique was closed using *0 Vicryl/other suture* in a running fashion, while the anterior fascia and external oblique fascia were closed with #1 *PDS / other suture* in a running fashion. The midline incision was closed with #*1 PDS / other suture* in a running fashion. The incision was irrigated and staples were used to close the skin. The instrument and sponge counts were correct.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room and taken to the PACU in stable condition.

Acknowledgment This chapter was contributed by Georgios Tsoulfas, M.D. in the previous edition.

Open Liver Ablation

106

Jessica Maxwell and James R. Howe

Indications

- Hepatocellular carcinoma confined to a single lobe
- Metastatic tumor to the liver that can be completely treated or substantially debulked

Essential Steps

1. Right subcostal/midline incision.
2. Explore the abdomen and identify the lesion(s).
3. Mobilize the liver.
4. Intraoperative ultrasound.
5. Ablate lesion(s).
6. Close the abdomen.

Note These Variations

- Radiofrequency versus microwave ablation system
- Cholecystectomy

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Complications

- Bleeding
- Injury to the bile ducts
- Bile leak
- Hepatic abscess

Template Operative Dictation

Preoperative Diagnosis *HCC/metastatic ___ cance*r of the liver

Procedure Open liver ablation

Postoperative Diagnosis Same

Indications This ___ -year-old *male/female* with a history of stage ___ carcinoma of ___. Computed tomography *and positron emission tomography scan* revealed metastatic lesions (*describe location in liver*). This led to the decision to proceed with an open liver ablation.

Description of Procedure An epidural catheter was placed by anesthesia prior to the start of the operation. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_106

position and general endotracheal anesthesia was induced. A Foley catheter and *oro-/nasogastric tube* were placed. All bony prominences were padded. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

An *upper midline/right subcostal* incision was made with a scalpel from the *xiphoid to just below the umbilicus/xiphoid to the anterior axillary line*. Fascia was opened with electrocautery. *If adhesions are present from previous surgery, the fascia was elevated with Kochers and the peritoneal cavity was entered sharply. Adhesiolysis was carried out using a combination of sharp dissection and electrocautery*. The ligament of Treitz was identified and the small bowel was run to the cecum. There were no masses palpated. The colon was palpated and no lesions were noted. The pelvis was explored and was free of masses. The peritoneal surface was also free of tumors.

The triangular ligaments of the liver were divided up to the level of the diaphragm using electrocautery and the liver was rotated into the operative field. A self-retaining retractor was placed and the small bowel, stomach, and colon were packed out of the operative field. Intraoperative ultrasound was used to systematically identify the hepatic tumors and their relation to the portal triad and hepatic veins. ____ lesions were identified (*describe the location of the tumors*). The *RFA/microwave* probe was inserted into the first lesion under direct vision using a needle guide and heated using the standard algorithm and track ablation was performed. The ablation site was cauterized with the argon beam. This procedure was repeated for each lesion. A post-ablation ultrasound was performed, which demonstrated adequate treatment of the lesions targeted. In all, ____ lesions were treated, which were located in *describe the location of tumors treated*.

If cholecystectomy is to be performed, the dome of the gallbladder was grasped and the peritoneum overlying it was incised. The gallbladder was dissected off the liver in a dome-down fashion. The cystic artery was identified and suture ligated with 3-0 silk. The cystic duct was identified and ligated with a 3-0 Vicryl stick tie as well as a medium clip. The gallbladder was passed off as a specimen. Hemostasis was achieved on the surface of the liver with argon beam coagulation.

The abdomen was irrigated and hemostasis was achieved with electrocautery. The abdominal fascia was closed with a *#1 PDS* and the subcutaneous tissues were irrigated. The skin was approximated with staples. A sterile dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated in the operating room and taken to the post-anesthesia care unit in stable condition.

107 Laparoscopic Liver Ablation

Jessica Maxwell and James R. Howe

Indications

- Hepatocellular carcinoma
- Tumor metastatic to the liver that can be completely treated or substantially debulked
- Second-line therapy for patients who are not candidates for open debulking

Essential Steps

1. Place ports: 10 mm supraumbilical, 12 mm subcostal along the anterior axillary line, and 5 mm paramedian along the midclavicular line.
2. Examine the abdomen to rule out extrahepatic metastatic disease.
3. Identify hepatic lesions with ultrasound.
4. Ablate lesion(s).
5. Close the abdominal fascia for 10- and 12-mm port sites.

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Note These Variations

- Radiofrequency versus microwave ablation system

Complications

- Bleeding
- Injury to the bile ducts
- Bile leak
- Hepatic abscess

Template Operative Dictation

Preoperative Diagnosis *HCC/metastatic* ___ *cance*r of the liver

Procedure Laparoscopic liver ablation

Postoperative Diagnosis Same

Indications This ___ -year-old *male/female* with a history of stage ___ carcinoma of ___. Computed tomography *and positron emission tomography scan* revealed metastatic lesions (*describe location in liver*). This led to the decision to proceed with a laparoscopic liver ablation.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_107

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. A footboard was placed on the bed. A Foley catheter and orogastric tube were placed. All bony prominences were padded. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

The infraumbilical space was infiltrated with 0.25 % Marcaine. A 1-cm incision was made and a *10-mm/12-mm* port was placed under direct vision using the standard Hasson technique. The abdomen was insufflated to 15 mmHg and a 10-mm camera was inserted and the abdomen was inspected for extrahepatic disease. There were no peritoneal implants seen and so we proceeded by placing the remainder of our ports.

If right lobe/left medial segment lesions: A 5-mm trocar was placed in the right paramedian space along the midclavicular line, and a 12-mm trocar was placed in the right lower quadrant along the anterior axillary line. Both trocars were placed under direct vision after injecting the skin and subcutaneous tissues with 0.25 % Marcaine.

If left lobe/right medial segment lesions: A 5-mm trocar was placed in the left paramedian space along the midclavicular line, and a 12-mm trocar was placed in the left subcostal space along the anterior axillary line. Both trocars were placed under direct vision after injecting the skin and subcutaneous tissues with 0.25 % Marcaine.

The laparoscopic ultrasound probe was introduced and the entire liver was scanned, confirming the location(s) of the lesion(s) seen on preoperative imaging. The tumor(s) *was/were* located in segment(s) (*describe locations*). The lesion(s) to be treated was brought into the center of view and a ____-mm *RFA/microwave ablation* probe was introduced and inserted into the center of the lesion under ultrasound guidance. The lesion was ablated using the standard algorithm and track ablation was performed. Hemostasis was achieved at the puncture site using electrocautery. *This procedure was repeated for the remaining tumors*. A post-ablation US was performed, which demonstrated adequate treatment of the lesion(s) targeted.

The abdomen was checked for hemostasis. The 10-mm ports were removed and the fascia was closed using the 0 Vicryl stay sutures and a GraNee needle. The fascia was also closed in the 12-mm port site. Then the 5-mm port was removed. The skin was closed at all port sites with running 4-0 Monocryl. *Skin glue was then applied/a sterile dressing was applied*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated in the operating room and taken to the post-anesthesia care unit in stable condition.

Packing of Liver Injury with Damage Control Laparotomy

108

Mohammad Khreiss and Bellal A. Joseph

Indications

- Penetrating abdominal injury with major liver injury and hemodynamic instability
- Blunt liver injury with hemodynamic instability

Essential Steps

1. Supine position with both arms abducted.
2. Prep the chest, abdomen, and both lower extremities to the table.
3. Establish central venous catheter access through the neck and insert Foley, IV antibiotics.
4. Activate massive transfusion protocol.
5. Perform trauma laparotomy, midline incision from xiphoid to above pubic tubercle.
6. Evacuate hemoperitoneum and bowel contents (if present).
7. Pack all four quadrants with laparotomy pads (RUQ, LUQ, LLQ, and RLQ).
8. Apply direct pressure to sources of bleeding, bimanual compression of liver.
9. Allow anesthesia to catch up through transfusion of warm blood and blood products (use Level 1 transfuser).
10. Remove packs, inspect for sources of bleeding, and control spillage from bowel injury if present (when removing packs, start with lower quadrants then LUQ and RUQ; if spillage from bowel is not present, then an autotransfusion device is used).
11. Remove RUQ packing and inspect for liver injury (visual and tactile).
12. Mobilize liver and identify injury (divide falciform, round, coronary, and triangular ligaments and mobilize the liver only on side of injury).
13. If bleeding is not controlled with manual compression, perform a Pringle maneuver by encircling the portal triad between the thumb and index fingers (may use vascular clamp).
14. Inspect the injury site and perform hepatotomy to expose bleeding vessels (may use finger fracture technique, Kelly fracture technique, or stapler device).
15. Suture ligate bleeding vessels using 3-0 Prolene sutures.
16. Use hemostatic adjuncts such as thrombin-soaked gel foam, Tisseel, etc.
17. Release Pringle maneuver and reinspect.
18. Damage control packing of the liver if bleeding continues and patient develops acidosis, coagulopathy, and hypothermia.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_108

19. Apply packs between the liver and kidney and the liver and diaphragm in a clockwise fashion making a sandwich (avoid applying pack over IVC or portal vein to prevent compression of either one).
20. Temporary closure of the abdomen (may use towel clips, skin closure only, use of Bogota bag, application of wound VAC).
21. Transfer patient to ICU for further resuscitation.

Note These Variations

- Carefully document findings and management of any additional injuries.
- The incision may be extended to the right subcostal area for further exposure, and an abdominal wall retractor may be applied (we prefer the Thompson retractor).
- Cholecystectomy may be needed if gallbladder is damaged or ischemic – not recommended routinely.
- The right hepatic artery may arise from the SMA.
- Failure of the Pringle maneuver to control bleeding may indicate hepatic veins or suprahepatic IVC injury.
- Adequate packing of the liver should not need more than seven laparotomy pads if done correctly.
- A sterile plastic drape may be applied against the liver parenchyma before applying the packs (this will prevent rebleeding upon removal of the packs in direct contact with raw liver surface).
- Avoid inserting the packs into the laceration. This will increase the degree of injury.
- Always keep count of the number of pads used and document in the chart and in the operative dictation.

Complications

- Injury to the CBD upon performing Pringle maneuver.
- Iatrogenic injury to the spleen upon inspection.
- Hepatic necrosis and abscess formation.
- Biloma formation.
- Acidosis, hypothermia, and coagulopathy.
- Abdominal compartment syndrome may develop in the ICU.
- Death.

Template Operative Dictation

Preoperative Diagnosis Penetrating abdominal injury with hemodynamic instability

Procedure Damage control laparotomy, packing of segment ___ stellate liver injury (*list any additional procedures*), and temporary abdominal closure with wound VAC

Postoperative Diagnosis Stellate liver injury to segment ___ (*list any additional injuries*)

Indications The patient is ___ -year-old *male/female* who sustained injury due to ___. Patient was brought to the ED by EMS. He/she underwent intubation and resuscitation in the emergency department according to ATLS protocols; however, the patient was a transient responder and was rushed to the operating room for exploration. Type and cross match was drawn.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Under general anesthesia and with the patient in the supine position with both upper extremities abducted, the chest abdomen and both lower extremities were prepped and draped in the usual sterile manner. Foley catheter was inserted and IV antibiotics were infused. At the same time, an arterial line and large bore central venous access were accomplished by the anesthesia team. Massive transfusion protocol was activated.

A midline skin incision extending from the xiphoid to above the pubic tubercle was performed. Dissection was carried through the skin and subcutaneous tissue, until the peritoneal cavity was entered. ___ liters of hemoperitoneum were evacuated. There was *evidence of/no evidence of bowel contents and the autotransfusion device was applied*. Laparotomy pads were carefully applied to pack the right upper quadrant, left upper quadrant, left lower quadrant, and right lower quadrant, respectively. Packs were placed deep behind the spleen and liver. Bimanual compression to the liver was applied due to profuse bleeding. The anesthesia team was allowed to catch up by transfusion of blood and blood products. After restoring hemodynamic stability, the lower abdominal packs were removed. The ligament of Treitz was identified and a complete small bowel inspection was performed. There *was/was no* evidence of injury to the small bowel (*detail injuries and management*). The colon was then inspected and *was found to be injured in ___/no evidence of injury was present* (*detail injuries and management*). There was no evidence of any mesenteric hematomas. No central or lateral retroperitoneal hematomas were identified. The left upper quadrant packing was removed. The spleen appeared *intact/was injured* (*detail management*). There *was no/was* evidence of left perinephric hematomas (*detail management*). The right upper quadrant packs were removed. There was evidence of profuse bleeding from the dome of the liver secondary to a stellate lesion of segments ___. Packs were reapplied. *The incision was extended to the right subcostal margin*. The round and falciform ligaments were divided along with the right triangular and coronary ligaments, while bimanual compression was applied by an assistant.

The liver was mobilized and delivered into the midline. *The porta hepatis was isolated and a Pringle maneuver was performed using a vascular clamp*. The packing was removed. It was noticed that the bleeding decreased markedly yet was still present. Hepatotomy was performed using finger fracture technique, and several bleeding vessels were identified and suture ligated using 3-0 Prolene sutures. The Pringle maneuver was released and it was noticed that bleeding resumed. The anesthesia team reported that the patient has received ___ units of blood, his temperature was ___, and his INR was ___. Decision was taken at this time to perform damage control and packing of the liver and transfer the patient to the ICU for further resuscitation and management. A folded sterile plastic drape was applied against the surface of the liver. Laparotomy pads were applied between the liver and the kidney laterally and between the liver and the diaphragm superiorly to control the bleeding between 7 o'clock and 5 o'clock in a clockwise fashion. No pads were applied above the IVC or portal vein to avoid compression of these structures. A total of seven pads were used. After that temporary closure of the abdominal cavity was done using a wound VAC. A debriefing checklist was completed to share information critical to postoperative care of the patient. Patient was transferred to the ICU in a ___ condition. The gravity of the situation was communicated to the family.

Part VIII

General Surgery: Pancreas

Laparoscopic Pancreas Enucleation

109

Jessica Maxwell and James R. Howe

Indication

- Small lesions of the pancreas not in continuity with the pancreatic duct, such as small neuroendocrine tumors
- Larger lesions originating from the edge of the pancreas that do not require nodal dissection

Essential Steps

1. Place ports.
2. Explore the abdomen and rule out extrapancreatic disease
3. Expose the body and tail of the pancreas via a window in the gastrocolic ligament
4. Identify the lesion with ultrasound
5. Enucleate the lesion
6. Place 10-French JP drain in the lesser sac
7. Remove ports and close abdominal fascia in 10-mm and 12-mm port sites

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Note These Variations

- Supine, lithotomy or left semilateral decubitus position for lesions in the head of the pancreas.
- Lithotomy, right lateral decubitus, or supine position for lesions in the body and tail of the pancreas.

Complications

- Pancreatic fistula, abscess
- Injury to the common bile duct, superior mesenteric vein, splenic vein, stomach, or spleen

Template Operative Dictation

Preoperative Diagnosis *Neuroendocrine tumor/other* of the pancreas located in the *head/uncinate process/body/tail* and amenable to enucleation.

Procedure Laparoscopic enucleation of pancreatic neuroendocrine tumor

Postoperative Diagnosis Same.

Indications This ___-year-old *male/female* developed symptoms of _____ and on evaluation was found to have a *neuroendocrine tumor/other*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_109

of the *body/uncinate process/body/tail* of the pancreas. After evaluation, this was felt to be amenable to enucleation.

Description of Procedure The patient was placed in supine position. Timeouts were performed using both pre-induction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. The patient was then transitioned into *supine/lithotomy/left semilateral decubitus/right semilateral decubitus* position. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A 10-mm trocar was placed infraumbilically using a standard Hasson approach and the abdomen was insufflated to 15 mmHg. A laparoscope was inserted and the abdomen was inspected to rule out extrapancreatic disease. No peritoneal implants or hepatic lesions were seen and so the following ports were placed under direct vision: a 5-mm port in the right paramedian space along the midclavicular line, a 5-mm port in the subxiphoid space, and a 10-mm port in the left paramedian space along the midclavicular line at the level of the umbilicus. *Adhesions were lysed sharply/using electorcautery*. ***If the lesion is in the head of the pancreas***: *a 5-mm port in the left lower quadrant along the midclavicular line*. 0.25 % Marcaine was injected prior to all skin incisions.

The body of the stomach was elevated and a window was created in the gastrocolic ligament with an energy device to enter the lesser sac and expose the body and tail of the pancreas. *The head and uncinate were exposed in the lesser sac by dividing the omentum overlying the transverse mesocolon on the right. The site of the middle colic vein/SMV confluence was noted*, *as was the gastroduodenal artery running over the pancreas*. Pancreatic ultrasound was performed to locate the lesion and to rule out additional lesions. The lesion was found in the pancreatic *head/uncinate process/body/tail*, and the pancreatic duct appeared to be ____ mm away from this. The peritoneum overlying the pancreas was opened and the lesion was dissected free from surrounding structures including *the common hepatic artery/gastroduodenal artery/superior pancreaticoduodenal artery/superior mesenteric vein/splenic vein/splenic artery/left gastric artery*. Once the tumor was freed from all nearby vessels and confirmed not to involve the pancreatic duct, it was excised with *electrocautery/energy device* along its edge with a small rim of normal pancreas. The specimen was sent to pathology. Hemostasis of the tumor bed was achieved using *electrocautery/suture ligation* of small vessels. (*Describe lymph node sampling*, *if performed*: *lymph nodes were identified in the region of* ______, *excised*, *and sent to pathology for analysis*).

The abdomen was irrigated with warm saline and hemostasis was assured. A 10-French JP drain was placed through a stab incision in the left abdomen and laid in the lesser sac. The omentum was freed from the transverse colon and laid over the pancreas. The sponge, needle, and instrument count were correct. The abdominal fascia was closed with *0 Vicryl/other suture* in the 10-mm and 12-mm port sites. The skin was closed with *staples/4-0 monocryl subcuticular sutures*. The JP drain was secured in place with a 3-0 nylon stitch and bulb suction applied. A sterile dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room and transported to the post anesthesia care unit in stable condition.

110 Open Redundant Enucleation of Pancreatic Lesion

Jessica Maxwell and James R. Howe

Indication

- Small lesions of the pancreas not in continuity with the pancreatic duct
- Larger lesions originating from the edge of the pancreas that do not require nodal dissection

Essential Steps

1. Upper midline incision.
2. Explore the abdomen and confirm pathology and stage.
3. Open lesser sac.
4. Dissect tumor free from surrounding attachments.
5. Enucleate tumor using electrocautery or energy device.
6. Place drain in lesser sac.

Note These Technical Variations

- Lymph node sampling

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Complications

- Pancreatic fistula, abscess
- Injury to the common bile duct, superior mesenteric vein, splenic vein, or spleen

Template Operative Dictation

Preoperative Diagnosis *Neuroendocrine tumor/IPMN* of the pancreas located in the *head/uncinate process/body/tail*

Procedure Open enucleation of pancreatic tumor

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed symptoms of _____ and on evaluation was found to have a *neuroendocrine tumor/other* of the *body/uncinate process/body/tail* of the pancreas amenable to simple enucleation.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was

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DOI 10.1007/978-3-319-44797-1_110

induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from the xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. The abdomen was explored. The ligament of Treitz was identified and the small bowel was run to the cecum. The colon was palpated and *no* masses were found. The liver was palpated and *no liver metastasis/liver metastases* were seen. No metastatic disease was noted in the peritoneal cavity.

A self-retraining retractor was positioned to expose the stomach and transverse colon. The gastrohepatic ligament was incised and the lesser sac was entered. The dissection was carried laterally to the splenic flexure and medially to the middle colic vein. The omentum was further dissected off to expose the pancreatic head. Pancreatic ultrasound was performed to locate the lesion and to rule out additional lesions. The lesion was found in the pancreatic *head/uncinate process/body/tail*, and the pancreatic duct appeared to be ____ mm away from this. The peritoneum overlying the pancreas was opened, and the lesion was dissected free from surrounding structures including *the common hepatic artery/gastroduodenal artery/superior pancreaticoduodenal artery/superior mesenteric vein/splenic vein/splenic artery/left gastric artery*. Once the tumor was freed from all nearby vessels and confirmed not to involve the pancreatic duct, it was excised with *electrocautery/energy device* along its edge with a small rim of normal pancreas. The specimen was sent to pathology. Hemostasis of the tumor bed was achieved using *electrocautery/suture ligation* of small vessels. (*Describe lymph node sampling*, *if performed*: *lymph nodes were identified in the region of* ______, *excised*, *and sent to pathology for analysis*).

The abdomen was irrigated with warm saline and hemostasis was assured. A 10-French JP drain was placed through a stab incision in the left abdomen and laid in the lesser sac. The omentum was freed from the transverse colon and laid over the pancreas. The sponge, needle, and instrument count were correct. The abdominal fascia was closed with *looped #1 PDS/other suture* in a running fashion. The incision was irrigated and the skin was closed with *staples/4-0 monocryl subcuticular sutures*. The JP drain was secured in place with a 3-0 nylon stitch and bulb suction applied. A sterile dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated in the operating room and transported to the postanesthesia care unit in stable condition.

111 Distal Pancreatectomy

Carlos H.F. Chan

Indications

- Trauma
- Tumor of the pancreatic body or tail
- Pseudocyst of the tail of the pancreas

Essential Steps

1. *If tumor*: *Diagnostic laparoscopy may be indicated since the risk of occult metastatic disease is higher in pancreatic cancer involving the body and tail*.
2. Midline or left subcostal/chevron incision.
3. If tumor: Explore for disease outside resection field (liver metastasis, peritoneal nodules, ascites, or lymph nodes).
4. Place appropriate mechanical retraction device, e.g., Bookwalter, Omni-Tract, Thompson, etc.
5. Widely divide the gastrocolic and gastrosplenic ligaments to enter the lesser sac.
6. If tumor: Confirm pathology and resectability (optional: intraoperative ultrasound to evaluate the tumor location and extension).
7. *In case of splenic vein thrombosis and resulting portal hypertension*, *it is beneficial to dissect and isolate the splenic artery origin with a vessel loop early in the operation. The splenic artery can be ligated*, *if excessive bleeding occurs during subsequent dissection*.
8. *If splenectomy*:
   - Gently apply traction on the spleen medially and divide the lienorenal ligament.
   - Divide the splenocolic ligament to free the left colon inferiorly.
   - Ligate the short gastric arteries.
   - Retract the stomach superiorly and medially.
   - Mobilize the spleen and pancreas from retroperitoneal attachments.
   - Ligate and divide the inferior mesenteric vein, if it drains into the splenic vein.
   - Dissect the spleen and pancreas medially to identify origin of the splenic artery and vein at the superior mesenteric vein–splenic vein junction.
   - Ligate and divide the splenic artery and splenic vein.
   - *If splenic preservation*: *Develop plane deep to the pancreas but superficial to the splenic vessels*.
   - *Clip and divide multiple tributaries linking the tail and body of the pancreas with the splenic vessels until the distal pancreas is completely free*.
9. Divide the neck of the pancreas using a linear stapler appropriate for pancreatic transaction.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_111

10. Send off specimen for frozen sections of margins in case of malignant etiology. Mark resection bed with metallic clips as a guide to postoperative radiation therapy if needed.
11. Check hemostasis.
12. Close the abdomen and secure drains.

Note These Variations

- Choice of incision
- Laparoscopic approach (Chap. 112)
- Preservation of the spleen (may be done with full mobilization of the spleen or with spleen left in situ)

Complications

- Bleeding
- Pancreatitis
- Pancreatic leak/fistula
- Subphrenic abscess
- Diabetes
- Pancreatic insufficiency
- Recurrence of cancer
- Overwhelming postsplenectomy infection

Template for Operative Dictation

Preoperative Diagnosis *Tumor of/trauma to the body/tail* of the pancreas

Procedure Distal pancreatectomy with *splenectomy/splenic preservation*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had *tumor/trauma* isolated to *the body/tail* of the pancreas. Distal pancreatectomy with *splenectomy/splenic preservation* was elected.

Description of Procedure An epidural catheter was placed by anesthesia prior to the start of the operation. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. *A vertical midline incision was made from xiphoid to just above the umbilicus/left subcostal/chevron incision was made two finger breadths below the left costal margin*. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The fascia was identified and incised and the peritoneal cavity entered. The abdomen was explored and the pathology confirmed (*enumerate findings*, *specifically absence of metastatic disease for tumor*, *and extent of exploration for trauma*). *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. Mechanical retractors were placed. The colon was mobilized and the splenic flexure was reflected downward. The gastrocolic ligament was divided widely to open the lesser sac and expose the pancreas.

[Choose One:]
If splenectomy: *The spleen was mobilized by incising the splenocolic ligament. The splenic flexure was mobilized. Gentle traction on the spleen was applied medially to divide the lienorenal and splenocolic ligaments to free the left colon inferiorly. The short gastric arteries were ligated and the stomach was retracted superiorly and medially. The spleen and pancreas were mobilized from their retroperitoneal attachments, and the inferior mesenteric vein was divided and ligated. The spleen and pancreas were dissected free medially to identify origin of the splenic artery and vein at the superior mesenteric vein–splenic vein junction. The splenic artery and splenic vein were divided and ligated at the origin of the splenic artery. The pancreas was transected with a TA 55 stapler after placing stay sutures cranially and caudally on the pancreatic remnant to control bleeding*.

If splenic preservation: *The spleen was reflected anteromedially and the posterior surface* *of the spleen and pancreas were freed. A point of transection was chosen ___ cm distal to the superior mesenteric vein. The pancreas was gently elevated from the retroperitoneum. The pancreas was transected with a TA 55 stapler after placing stay sutures cranially and caudally on the pancreatic remnant to control bleeding. The end of the pancreatic duct was oversewn with figure-of-eight 3-0 silk sutures. The distal pancreas was elevated, and multiple small tributaries linking the splenic vessels and pancreas were clipped and divided until the pancreas was free*.

The specimen was removed and sent for frozen section to assess margin status. The field was checked for hemostasis. Closed suction drains were placed in the operative field. The colon and stomach were placed in the correct anatomic position. Drains were brought out on the left side of the abdomen and secured with 3-0 nylon suture.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ___ were placed*.) The fascia was closed with *a running suture of ___/a Smead-Jones closure of interrupted ___*. The skin was closed with *skin staples/subcuticular sutures of ___/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Prashant Khullar, M.D., in the previous edition.

Laparoscopic Distal Pancreatectomy

112

Philip M. Spanheimer

Indications

- Malignant tumor of the body or tail of the pancreas located left of the superior mesenteric vein deemed resectable by high-quality cross-sectional imaging
- Benign tumors of the body/tail of the pancreas
- Chronic pancreatitis localized to the body/tail of the pancreas refractory to endoscopic management
- Pseudocyst of the tail of the pancreas

Essential Steps

1. Supine position on a split-leg bed or in the lithotomy position to allow surgeon positioning between the legs of the patient.
2. Mark open and hand port incisions in the event these should be rapidly needed during the operation.
3. Enter the peritoneal cavity, establish pneumoperitoneum, and place an initial port at the umbilicus or superior/left of the umbilicus.
4. Introduce the laparoscope and perform a thorough exploration for distant disease including liver metastasis, peritoneal nodules, or enlarged lymph nodes outside of the planned resection. Send biopsies of suspicious lesions for frozen section.
5. Place additional ports: one subxiphoid port, two staggered ports in the low/mid left abdomen to prevent instrument interference. An additional port can be placed in the right upper quadrant for retraction if necessary.
6. Expose the body and tail of the pancreas by separating the colon from retroperitoneal and splenic attachments.
7. Incise the gastrocolic ligament to enter the lesser sac.
8. Retract the stomach superiorly using an instrument through the subxiphoid port.
9. Expose the inferior border of the pancreas by separating the transverse mesocolon from retroperitoneal attachments.
10. Mobilize inferior margin of the pancreas.
11. Identify the superior mesenteric vein, inferior mesenteric vein, splenic vein, splenic artery, and hepatic artery.
12. Bluntly mobilize behind the pancreas with a finger through a hand port or with a laparoscopic Kittner dissector.
13. Transect the pancreas with an Endo GIA™ stapler (4.8 mm).
14. The splenic vessels can be transected separately with a vascular load of the Endo GIA stapler.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_112

15. Dissect the pancreatic tail from the retroperitoneum in a medial-to-lateral direction.
16. *If splenectomy*:
    - *Gently apply traction on the spleen medially and divide the lienorenal ligament*.
    - *Divide the splenocolic ligament to free the left colon inferiorly*.
    - *Ligate the short gastric vessels*.
    - *Mobilize the spleen and pancreas from retroperitoneal attachments*.
    - *Ligate and divide the inferior mesenteric vein*.
17. Retrieve specimen.
18. *The pancreatic staple line can be oversewn or reinforced with fibrin glue as needed*.
19. *Place and secure a drain adjacent to the staple line*.

Note This Variation

- Port placement
- Preservation of the spleen
- Order of transection of the splenic artery, vein, and pancreatic parenchyma

Complications

- Bleeding
- Pancreatitis or pancreatic leak
- Subphrenic abscess

Template for Operative Dictation

Preoperative diagnosis *Tumor of the body/tail* of the pancreas

Procedure Laparoscopic distal pancreatectomy *with splenectomy*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had *tumor* isolated to *the body/tail* of the pancreas. Laparoscopic distal pancreatectomy with *splenectomy/splenic preservation* was elected.

Description of Procedure The patient was placed in the *supine split-leg/lithotomy position*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. A *12 mm Hasson port/Veress needle* was placed superior and to the left of the umbilicus, and carbon dioxide pneumoperitoneum was induced up to a pressure of 15 mmHg. The laparoscope was introduced and peritoneal exploration was done for distant disease and *none was noted*/(*describe distant disease location and biopsy if performed*, *procedure generally terminated at this point*). Three 5 mm ports were introduced under direct vision: one at the subxiphoid and two in the mid left abdomen. The left colon was dissected free from the splenic and retroperitoneal attachments. The lesser sac was entered by incising the gastrocolic ligament in an avascular plane near the transverse colon. The splenic flexure was mobilized and the greater omentum was divided along the greater curvature of the stomach. Stomach is retracted superomedially through the epigastric port. *Laparoscopic ultrasound was used to identify the tumor and the blood vessels to determine the line of transection and preservation of blood vessels*.

[Choose One:]
If splenectomy: *The spleen was mobilized by incising the splenocolic ligament. The splenic flexure was fully mobilized. Gentle traction on the spleen was applied medially to divide the lienorenal and splenocolic ligaments to free the left colon inferiorly. The short gastric vessels were ligated. The spleen and pancreas were mobilized from their retroperitoneal attachments*, *and the inferior mesenteric vein was divided and ligated. The spleen and pancreas were dissected free medially to the junction of the splenic vein and the SMV. The splenic artery and splenic vein were transected with vascular Endo GIA staplers at the level of the pancreatic transection. The pancreas was transected with an Endo GIA stapler* (*4.8 mm*).

If splenic preservation: *The inferior margin of the pancreas was mobilized by developing a plane between the root of the transverse colon and the anterior fascia of the pancreas. Splenic vessels were identified and isolated*, *and a plane is created between the pancreas and the splenic vessels. The Endo GIA stapler* (*4.8 mm*) *was used to transect the pancreas. The electrocautery/energy device was used to divide the vasculature between the pancreas and the splenic vessels. The distal pancreas specimen was dissected from the retroperitoneum in a medial-to-lateral direction until it was completely freed*.

The specimen was retrieved in an Endo Catch bag. *The pancreatic staple line was reinforced with fibrin glue. A Blake drain was secured and port sites were closed in a standard fashion*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and was taken to the postanesthesia care unit in stable condition. The patient tolerated the procedure well and no complications were noted.

Acknowledgment This chapter was contributed by Prashant Khullar, MD, in the previous edition.

113 Partial Pancreaticoduodenectomy (Whipple Procedure)

Philip M. Spanheimer

Indications

- Malignancy of the head of the pancreas, proximal duodenum, or distal bile duct.
- Chronic pancreatitis with failed nonoperative management.
- Cystadenoma of the head of the pancreas.
- Whipple procedure for trauma is rarely, if ever, indicated.

Essential Steps

1. Upper midline/chevron incision.
2. *Explore for distant disease* (*liver metastasis*, *peritoneal or omental nodules*, *aortocaval lymph nodes*). *Send frozen section as needed*.
3. Place mechanical retraction device.
4. Open the lesser sac, and identify the inferior border of the pancreas and the superior mesenteric vein. Pass a blunt instrument over the superior mesenteric vein behind the neck of the pancreas onto the portal vein. Encircle the neck of the pancreas with a *Penrose drain/umbilical tape/vessel loop*.
5. Extensive Kocher maneuver.
6. Mobilize gallbladder from the gallbladder fossa and divide the cystic artery. Mobilize the cystic duct to its junction with the common bile duct.
7. Palpate for enlarged portal and celiac lymph nodes, and perform selective lymphaden ectomy.
8. Palpate for a pulse lateral to the bile duct to assess for a replaced/accessory right or common hepatic artery.
9. Evaluate all frozen sections and vascular involvement, and decide to proceed with resection.
10. Divide the common hepatic duct close to the level of the cystic duct entry site, and retract it caudally to identify the portal vein. Send the distal bile duct margin for frozen section.
11. Identify, dissect, and clamp the gastroduodenal artery. Assess pulse in the right and left hepatic artery prior to ligating.
12. Divide the stomach to include the entire antrum or the duodenum 3 cm distal to the pylorus (if pylorus preserving).
13. Divide the neck of the pancreas. Send the distal pancreatic duct margin for frozen section.
14. Divide the proximal jejunum about 10 cm distal to the ligament of Treitz. Divide the mesentery of the jejunum and lyse the ligament of Treitz until the transected jejunum can be passed through the transverse mesocolon.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_113

15. Separate the uncinate process from the portal vein (PV), superior mesenteric vein (SMV), and superior mesenteric artery (SMA) gently by serially clamping, dividing, and ligating the vascular branches off the SMV, SMA, and PV.
16. Remove and send marked specimen to pathology for analysis of the common hepatic duct, pancreatic duct, and uncinate process margins.
17. *Place pediatric feeding tube into the pancreatic duct as a stent*.
18. Create a window in the mesocolon to the right of the middle colic vessels. Pass the distal end of jejunum through the mesocolon to facilitate reconstruction.
19. Create a pancreaticojejunostomy with either a duct-to-mucosal anastomosis or with an invagination technique, 4-0/5-0 PDS full-thickness sutures between the pancreatic duct and the jejunum, and an outer layer between the pancreatic capsule and seromuscular jejunum to cover exposed pancreatic parenchyma.
20. End-to-side bile duct to jejunum anastomosis 7–10 cm distal to the pancreaticojejunostomy in a single layer using interrupted/continuous 4-0 or 5-0 PDS.
21. Antecolic gastro or duodenojejunostomy 10–15 cm distal to the biliary-enteric anastomosis.
22. Check hemostasis.
23. Place omentum and closed suction drains in proximity to anastomoses, and secure drains to the skin
24. Close the abdomen.

Note These Variations

- Hepatic artery arising from the superior mesenteric artery may be encountered and should be preserved.
- Classical pancreatoduodenectomy versus pylorus preserving.
- Anastomotic technique, use of stents.

Complications

- Pancreatic leak
- Bile leak
- Inadvertent ligation of an anomalous hepatic artery
- Injury to the portal vein and superior mesenteric vein
- Delayed gastric emptying
- Leak from gastrojejunostomy
- Intra-abdominal abscess

Template for Operative Dictation

Preoperative Diagnosis *Carcinoma of head of the pancreas/distal bile duct/duodenum/others*

Procedure Partial pancreaticoduodenectomy (Whipple procedure)

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed *progressive jaundice/weight loss/diabetes/abdominal pain* and was found to have a ___. Evaluation with *computed tomography scan/ERCP/endoscopic ultrasound* demonstrated no obvious metastatic disease, involvement of the portal vein, superior mesenteric vein, superior mesenteric artery, or hepatic artery. Exploration for partial pancreaticoduodenectomy is indicated.

Description of the Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Subcutaneous heparin was administered for venous thromboembolism prophylaxis. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed.

The abdomen was prepped and draped in the usual sterile fashion. *A limited vertical midline incision was made in the epigastrium/diagnostic laparoscopy was performed*. This was deepened through the subcutaneous tissues with electrocautery until the fascia was encountered. The fascia was entered in the midline. The peritoneum was elevated and incised to enter the peritoneal cavity. A finger was inserted, attachments to the anterior abdominal wall were swept aside, and the remainder of the incision was opened with electrocautery. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. The falciform ligament was ligated with the *LigaSure/between clamps with 2-0 silk ties*. The liver was palpated and *no nodules were felt/suspicious nodules were biopsied with a #15 scalpel and sent for frozen section*. There was no evidence of peritoneal nodules or mesenteric implants. The transverse colon was elevated and the pancreatic head mass was palpated through the transverse mesocolon with no obvious vascular involvement. The incision was extended from just below the xiphoid to below the umbilicus, and a mechanical retractor was placed.

The transverse colon was elevated, and the gastrohepatic ligament was incised in an avascular plane near the colon to enter the lesser sac. The greater omentum was dissected free from the transverse mesocolon until the inferior border of the pancreas could be identified. The middle colic vein was followed to the confluence of the superior mesenteric vein. The right gastroepiploic vein was ligated and divided. A plane was bluntly developed between the pancreas and the anterior surface of the superior mesenteric vein and the portal vein. The plane was dissected between the head of the pancreas and the portal vein. The neck of the pancreas was encircled with *umbilical tape/Penrose drain/vessel loop*.

The peritoneum over the gallbladder was incised with electrocautery and the gallbladder was separated from the liver. The cystic artery was identified, ligated, and divided. The cystic duct was isolated and traced to the confluence with the common hepatic duct. An extensive Kocher maneuver was performed. The hepatic flexure was taken down with electrocautery. A generous Kocher maneuver was performed, freeing up the duodenum off the inferior vena cava. Next, the gastrohepatic ligament was incised in an avascular plane. This was continued laterally until the hepatoduodenal ligament was encountered. The stomach was retracted inferiorly and laterally and the hepatic artery was identified. *Enlarged celiac/hepatic lymph nodes were excised and sent for pathology*. The hepatic artery was dissected to the origin of the gastroduodenal artery (GDA). The GDA was isolated and encircled with a vessel loop. This was clamped and a *strong pulse was palpated in the common hepatic artery and the right and the left hepatic arteries/describe other findings*. The GDA was ligated on both sides with a 4-0 prolene stick tie and transected sharply. The common bile duct was then dissected circumferentially, developing a plane between the portal vein and the common bile duct. A bulldog clamp was placed on the common bile duct and it was transected proximally with a scalpel. The distal end of the bile duct was shaved with a #15 scalpel which was sent for frozen section of the bile duct margin.

[Choose One:]

If standard Whipple: *The right gastric artery was identified, ligated, and divided. A window was made in the gastrohepatic ligament at the third vein. The stomach was transected at the junction of the antrum and body using serial loads of a gastrointestinal stapler*.

If pylorus-preserving Whipple: *The first and second parts of the duodenum were circumferentially dissected and divided 3 cm distal to the pylorus using a linear stapling device*.

The neck of the pancreas was divided with electrocautery. *Stay sutures cranially and caudally on the pancreatic remnant to control bleeding*. The ligament of Treitz was taken down with electrocautery and LigaSure. Once the ligament of Treitz was completely freed, a window was made in the jejunal mesentery about 10 cm past the ligament of Treitz, and the jejunum was then transected with a 60 mm GIA blue load stapler. This was then passed through the root of the mesentery back to the lesser sac. The uncinate process was dissected free from the SMA, SMV, and PV by serially clamping, dividing, and ligating the vascular branches off these vessels. The specimen was removed, marked, and sent to pathology for analysis of the bile duct, pancreatic duct, and uncinate process retroperitoneal margins.

The distal end of the jejunum was passed into the supracolic compartment through an opening created in the transverse mesocolon. A duct-to-mucosa pancreaticojejunostomy was performed. A posterior layer of interrupted 3-0 silk sutures was placed between the pancreatic capsule and seromuscular layer of jejunum. The anastomosis was performed with interrupted sutures of 4-0 or 5-0 PDS between the pancreatic duct and full-thickness jejunum. An outer layer of 3-0 silk interrupted stitches incorporating the pancreatic capsule and the seromuscular layer of the jejunum were placed.

Next an end-to-side choledochojejunostomy anastomosis was performed 7–10 cm from the pancreaticojejunostomy. This was performed with *running/interrupted* 4-0 PDS between full-thickness bile duct and full-thickness jejunum in a single layer.

Choose One: *An antecolic duodenojejunostomy was performed 10–15 cm distal to the biliary-enteric anastomosis in a single interrupted/continuous layer with absorbable suture.*

Attention was turned toward the gastrojejunostomy. A loop of jejunum was brought up to the stomach in an antecolic fashion. The anastomosis was created in two layers. A posterior outer layer of running 3-0 PDS was placed. Next the caudal staple line was excised with cautery and a jejunostomy made. The inner layer of the anastomosis was performed with a running 3-0 PDS Connell stitch. Prior to completing the anterior layer, the nasogastric tube was advanced into the stomach and the position confirmed. The anterior outer layer was completed with an inverting running stitch of 3-0 PDS.

All anastomoses were checked and found to be patent and intact. Hemostasis was assured. The abdomen was copiously irrigated. Closed suction drains were placed in close proximity to the anastomoses and brought out (*detail locations*) and secured with 3-0 nylon sutures. The fascia was closed with a running suture of looped #1 PDS. The skin was re-approximated with staples and a sterile dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient, and the patient was taken to the PACU in satisfactory condition.

Acknowledgment This chapter was contributed by Prashant Khullar, MD, in the previous edition.

Total Pancreaticoduodenectomy 114

Carlos H.F. Chan

Indications

- Tumors involving the entire pancreas – e.g., diffuse intraductal papillary mucinous neoplasm (IPMN), multicentric neuroendocrine tumors, and rare giant tumors such as cystadenocarcinoma or sarcoma.
- Hereditary pancreatic cancer.
- Positive resection margin on frozen section during a pancreaticoduodenectomy or distal pancreatectomy when negative margin cannot be obtained otherwise.
- Pancreatic anastomosis after pancreaticoduodenectomy is not possible.
- Intractable pain associated with chronic pancreatitis that fails all other medical or surgical therapies

Essential Steps

1. *Diagnostic laparoscopy may be indicated to assess for occult metastatic disease*.
2. *Upper midline/right Chevron* incision/*a bilateral subcostal incision*.
3. Explore for disease outside resection field (liver metastasis, peritoneal nodules, ascites, or lymph nodes).
4. Place appropriate mechanical retraction device, e.g., Bookwalter, Omni-Tract, Thompson, etc.
5. Mobilize the right colon and hepatic flexure to access the duodenum and the head of the pancreas.
6. Retract the colon medially and inferiorly to visualize the third and fourth portions of the duodenum.
7. Extensive Kocher maneuver to expose the superior mesenteric vessels. (Optional: In case of pancreatic head cancer, Gerota's fascia can be incised at the lateral border and mobilized medially to obtain an extra layer of tissue to improve posterior resection margin and to evaluate aortocaval nodal status prior to resection).
8. Palpate the head of the pancreas and superior mesenteric vessels to determine resectability.
9. Widely open the gastrocolic ligament to expose the body of the pancreas.
10. Detach the greater omentum from the left transverse colon.
11. Mobilize gall bladder from the gall bladder fossa, divide the cystic artery, and mobilize the cystic duct until the junction with the common bile duct.
12. Dissect the porta hepatis to assess for a replaced/accessory right or common hepatic artery.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_114

13. Evaluate celiac axis lymph node status.
14. Identify and test clamp gastroduodenal artery to ensure hepatic arterial blood flow from the celiac axis
15. Divide the proximal jejunum about 10 cm distal to the ligament of Treitz, and deliver it dorsal to the superior mesenteric vessels from left to right into the supracolic compartment.
16. Divide the common hepatic duct close to the level of the cystic duct entry site, and retract it caudally to identify the portal vein.
17. Identify, dissect, clamp, ligate, and divide the gastroduodenal artery to open the plane anterior to the portal vein behind the neck of the pancreas.
18. Identify, ligate, and divide the right gastric artery and the terminal branches of the left gastric artery at the junction of the antrum and the body of the stomach.
19. Transect the stomach at the junction of the antrum and the body of the stomach with a linear stapling device, and retract the stomach laterally.
20. Gently apply traction on the spleen medially and divide the lienorenal ligament.
21. Divide the splenocolic ligament to free the left colon inferiorly.
22. Ligate the short gastric arteries.
23. Retract the stomach superiorly and medially.
24. Mobilize the spleen and pancreas from retroperitoneal attachments.
25. Divide the inferior mesenteric vein.
26. Dissect the spleen and pancreas medially to identify origin of the splenic artery and vein at the superior mesenteric vein–splenic vein junction.
27. Ligate and divide the splenic artery and splenic vein.
28. Ligate veins from the duodenum and pancreas as they come into the portal vein and superior mesenteric vein.
29. Separate the uncinate process from the portal vein, superior mesenteric vein, and artery gently by serially clamping, dividing, and ligating the vascular branches off the SMV, SMA, and PV.
30. Remove the specimen.
31. Pass the distal end of the jejunum into the supracolic compartment through an opening created in the transverse mesocolon.
32. An end-to-side biliary-enteric anastomosis of the common bile duct to proximal ascending loop, in a single layer using interrupted/continuous absorbable sutures, e.g., 4-0 or 5-0 PDS, is created.
33. Create antecolic gastrojejunostomy 15–20 cm distal to the biliary-enteric anastomosis for classical pancreatoduodenectomy.
34. Place nasogastric tube in efferent limb of gastrojejunostomy (*18 French gastrostomy drainage tube brought out the abdomen is an alternative*).
35. Check hemostasis.
36. Replace omentum and closed suction drains in proximity to anastomoses.
37. Secure drains with 3-0 nylon suture.
38. (*Optional*) *place feeding jejunostomy*.
39. Close the abdomen.

Note These Variations

- Anomalous replaced/accessory/common hepatic artery arising from the superior mesenteric artery may be encountered and should be preserved.
- Exact order of dissection varies.
- Pylorus preserving versus classical pancreatoduodenectomy may be done. A duodenojejunostomy is done instead of a gastrojejunostomy 15–20 cm distal to the biliary-enteric anastomosis in a single interrupted/continuous layer with absorbable suture.
- *Gastrostomy* and *feeding jejunostomy optional*.

Complications

- Brittle diabetes
- Pancreatic insufficiency
- Bleeding
- Anastomotic leak
- Bile leak

- Recurrence of cancer
- Intra-abdominal abscess
- Overwhelming postsplenectomy infection

Template for Operative Dictation

Preoperative Diagnosis *Carcinoma/cystadenoma/others of pancreas*

Procedure Total pancreaticoduodenectomy with splenectomy

Postoperative Diagnosis Same

Indications This___-year-old *male/female* developed progressive *jaundice/weight loss/diabetes/abdominal pain* and was found to have a ___. Evaluation with *computed tomography scan/ERCP/endoscopic ultrasound* demonstrated no obvious metastatic disease and a high probability of resectability with total pancreatectomy. Exploration for total pancreaticoduodenectomy was indicated.

Description of the Procedure An epidural catheter was placed by anesthesia prior to the start of the operation. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. *A vertical midline incision was made from xiphoid to just above the umbilicus/right Chevron incision/a bilateral subcostal incision was made two finger breadths below the costal margin*. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. Fascial layers were divided with electrocautery and the peritoneal cavity entered. The abdomen was explored. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. There was no evidence of spread outside the planned resection field, specifically, no liver or peritoneal nodules, ascites, obvious local extension, or lymphadenopathy. Mechanical retractors were placed.

The right colon and hepatic flexure were mobilized and retracted medially and inferiorly. The gastrocolic ligament was widely divided to expose the pancreas. An extensive Kocher maneuver was performed. The head of the pancreas and superior mesenteric vessels were palpated to assure resectability. The mass appeared to be localized to the pancreas and did not appear to involve the mesenteric vessels.

The gastrohepatic ligament was dissected and the common bile duct was freed circumferentially. The gall bladder was separated from the underlying gall bladder fossa, and the cystic artery was identified, ligated, and divided. Absence/presence of a replaced/accessory right or common hepatic artery was confirmed. At the superior border of the pancreas, the trifurcation of the celiac axis was identified. No suspicious lymph node was identified. The gastroduodenal artery was identified and clamped. The pulsation of the common hepatic artery remained present. The middle colic vein was identified in the transverse mesocolon and traced toward the inferior border of the pancreas where the superior mesenteric vein was identified. Using a blunt right-angled instrument, a tunnel was gently created between the portal vein/superior mesenteric vein. A Penrose drain was inserted.

The proximal jejunum was divided about 10 cm distal to the ligament of Trietz using a linear stapler. Using *LigaSure device/serial clamping*, *division*, *and suture ligations*, the jejunum was separated from its mesentery at the bowel edge. The proximal jejunal loop was delivered to the supracolic compartment through the mesenteric defect at the level of ligament of Treitz.

The common hepatic duct was divided close to the level of the cystic duct entry site and retracted caudally to identify the portal vein. The portal vein and hepatic artery were carefully preserved. The gastroduodenal artery was identified, dissected, clamped, divided, and ligated.

[Choose One:]

If standard pancreaticoduodenectomy**:** *The right gastric artery and the terminal branches of the left gastric artery at the junction of the antrum and the body of the stomach were identified, ligated, and divided. The antrum of the stomach was stapled and transected just below the visible branches of the vagus nerve. The antrum was reflected superiorly and to the right laterally.*

If pylorus-preserving pancreaticoduodenectomy**:** *The first and second parts of the duodenum were circumferentially dissected and divided 3 cm distal to the pylorus using a linear stapling device.*

The splenic flexure was mobilized. Gentle traction on the spleen was applied medially to divide the lienorenal and splenocolic ligaments to free the left colon inferiorly. The short gastric arteries were ligated, and the stomach was retracted superiorly and medially. The spleen and pancreas were mobilized from their retroperitoneal attachments, and the inferior mesenteric vein was divided and ligated.

The spleen and pancreas were dissected free medially to identify origin of the splenic artery and vein at the superior mesenteric vein–splenic vein junction. The splenic artery and splenic vein were divided and ligated at the origin of the splenic artery. The veins from the duodenum and pancreas as they entered into the portal vein and superior mesenteric vein were identified, ligated, and divided. The uncinate process was separated from the portal vein, superior mesenteric vein, and artery gently by serially clamping, dividing, and ligating the vascular branches off the SMV, SMA, and PV. The specimen was sent off to pathology for histopathological assessment.

The distal end of the jejunum was passed into the supracolic compartment through an opening created in the transverse mesocolon. End-to-side biliary-enteric anastomosis of the common bile duct to proximal ascending loop was performed in a single layer using interrupted/continuous 4-0 or 5-0 PDS sutures.

[Choose One:]

If pylorus-preserving pancreaticoduodenectomy**:** *An antecolic duodenojejunostomy was done 15–20 cm distal to the biliary-enteric anastomosis in a single interrupted/continuous layer with absorbable suture.*

If standard pancreaticoduodenectomy**:** *A gastrojejunostomy was performed as a two-layered sutured anastomosis between the gastric remnant and the jejunum about 15–20 cm distal to the hepatojejunal anastomosis. This was constructed with an inner running layer of 3-0 PDS and an outer layer of interrupted 3-0 silk Lembert sutures. A three-corner stitch was placed at the angle of sorrow.*

All anastomoses were checked and found to be patent and intact. *The nasogastric tube was positioned in the desired location/a Stamm gastrostomy was created in the usual fashion and the nasogastric tube removed.*

(*Optional*: *A Witzel feeding/needle catheter jejunostomy was then constructed in the usual fashion.*) Hemostasis was checked. Mesenteric defects were closed. Closed suction drains were placed in close proximity to the anastomoses and brought out (*detail locations*). All tubes, stents, and drains were brought out through the anterior abdominal wall and secured to the skin with 3-0 nylon sutures.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ___ were placed.*) The fascia was closed with *a running suture of ___/a Smead-Jones closure of interrupted ___*. The skin was closed with *skin staples/subcuticular suture of ___/other*. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in a stable condition.

Acknowledgment This chapter was contributed by Prashant Khullar, M.D., in the previous edition.

115 Pancreatic Cystogastrostomy

Carlos H.F. Chan

Indications

- Pancreatic pseudocyst
  - Persistent clinical symptoms, for example, abdominal pain, nausea, vomiting, and biliary or bowel obstruction
  - Failure or contraindication of interventional/endoscopic drainage
  - Cyst enlargement on serial imaging or size more than 6 cm
  - Cyst with necrotic debris or infection

Essential Steps

1. *Upper midline/left subcostal/chevron incision* over the palpable mass.
2. Place mechanical retractors, e.g., Bookwalter, Omni-Tract, Thompson, etc.
3. Palpate and confirm the presence of an isolated pseudocyst adherent to the back wall of the stomach.
4. *Roux-en-Y jejunal loop is an option if these conditions are not met*.
5. Place 2-0 silk stay sutures in the anterior wall of the stomach, distant from the pylorus.
6. Longitudinal/transverse gastrotomy, approximately 5–8 cm.
7. Place retractors to expose the back wall of the stomach.
8. Palpate the pseudocyst and aspirate through the back wall of the stomach (to confirm location and absence of blood and send for culture if turbid. Fluid is also sent for biochemistry and tumor markers).
9. Place stay sutures in the posterior gastric wall.
10. Enter the cyst with electrocautery or sharp hemostat.
11. Decompress with suction.
12. Enlarge hole in the posterior gastric wall to approximately 3 cm.
13. Send wedge of the cyst wall to frozen section pathology to exclude cystic neoplasm.
14. Debride the necrotic material and address any underlying ductal abnormalities.
15. Palpate retroperitoneum to assure no other masses.
16. Assure hemostasis at edges.
17. Place running lockstitch of 2-0 PDS around cystogastrostomy in such a fashion as to incorporate full thickness of the gastric and cyst wall.
18. Position nasogastric tube in the stomach.
19. Close the anterior gastrotomy *two-layer sutured/stapled*.
20. Place omentum over the gastrotomy.
21. *Address any biliary abnormalities. A Roux-en-Y hepaticojejunostomy or a choledochoduodenostomy may be required to relieve biliary obstruction*.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_115

22. Recheck hemostasis.
23. Close the abdomen without drainage.

Note These Variations

- Stapled vs. sutured closure of anterior gastrotomy.
- Cystojejunostomy (with Roux-en-Y limb) if not adherent to the stomach.
- Biliary abnormalities (gallstones, stricture of distal common duct from chronic pancreatitis) may need to be addressed as described above.

Complications

- Recurrence
- Suture line (upper gastrointestinal) bleeding
- Gastric leak

Template for Operative Dictation

Preoperative Diagnosis Pancreatic pseudocyst

Procedure Cystogastrostomy

Postoperative Diagnosis Same

Indications This___-year-old *male/female* developed chronic pseudocyst___weeks after acute pancreatitis. The cyst *failed to resolve/was enlarging/was associated with abdominal pain*, and cystogastrostomy was elected.

Description of Procedure An epidural catheter was placed by anesthesia prior to the start of the operation. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position, and general endotracheal anesthesia was induced. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion. *A vertical midline incision was made from xiphoid to just below the umbilicus/a left subcostal/a chevron incision two finger breadths below the costal margin was made*. This was deepened through the subcutaneous tissues, and hemostasis was achieved with electrocautery. The fascia was incised and the peritoneal cavity entered. The abdomen was explored. Mechanical retractors were placed. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. The retrogastric pseudocyst, adherent to the back wall of the stomach, was noted. *No other abnormalities were noted/* (*detail abnormalities*). The decision was made to proceed with cystogastrostomy.

The stomach was visualized and two interrupted 2-0 silk stay sutures were placed in the anterior wall, away from the pylorus. Electrocautery was then used to incise the gastric wall and the stomach was entered. Retractors were placed to expose the back wall of the stomach overlying the pseudocyst. An *18-gauge* needle was then passed through the posterior gastric wall into the pseudocyst. Fluid was aspirated and found to be non-bloody. A fluid sample was sent to microbiology for stat gram stain, culture, biochemistry, and tumor markers.

Two interrupted 2-0 silk stay sutures were then placed in the posterior gastric wall. The pseudocyst was entered with *electrocautery/a sharp hemostat*. The cyst was decompressed using suction. The incision was extended to approximately 3–5 cm and a section of the edge submitted for frozen section pathology. The cyst was debrided of all necrotic tissue. Hemostasis was assured at the edges. The cystogastrostomy anastomosis was then oversewn with a running lock-stitch of 2-0 PDS placed through the full thickness of the posterior gastric wall and the pseudocyst.

The retroperitoneum was palpated and no other masses were identified. Hemostasis was again assured and a nasogastric tube was passed into the stomach. The anterior wall gastrostomy was then closed.

[Choose One:]

If sutured: *The inner layer was sutured with a running 3-0 PDS Connell suture and the outer layer with interrupted 3-0 silk Lembert sutures*.

If stapled: *The gastrotomy was closed with the linear stapler*. Omentum was then placed over the gastric closure.

(*Optional*: *Closed suction drain was placed in close proximity to the gastrotomy and cystogastrostomy sites and brought out* (*detail locations*).)

The patient had *no underlying/the following underlying* biliary abnormalities requiring further intervention (*detail cholecystectomy*, *ductal drainage procedures*, *or any other biliary procedures done*).

(*Optional*: *Multiple interrupted through-and-through retention sutures of ___ were placed*.) The fascia was closed with *a running suture of ___/a Smead-Jones closure of interrupted ___*. The skin was closed with *skin staples/subcuticular sutures of ___/other*. A debriefing checklist was completed to share information critical to the postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by and Prashant Khullar, M.D., in the previous edition.

116 Longitudinal Pancreaticojejunostomy (Puestow Procedure)

James P. De Andrade and James R. Howe

Indications

- Symptomatic chronic pancreatitis with pancreatic ductal obstruction and/or dilated pancreatic duct

Essential Steps

1. Make an *upper midline/left subcostal incision*.
2. Widely open the gastrocolic omentum to expose the pancreas.
3. Separate peritoneal attachments between the posterior wall of the stomach and the pancreas.
4. Identify the pancreatic duct (*with intraoperative ultrasound and/or aspiration with 22-gauge needle*).
5. Open the pancreatic duct from just lateral to the gastroduodenal artery to the tail.
6. Transect jejunum 20–30 cm distal to the ligament of Treitz.
7. Pass the stapled distal limb up through a defect in the transverse mesocolon.
8. Approximate the antimesenteric border of the jejunum to the inferior and anterior surface of the pancreas in a longitudinal fashion with stapled end toward the tail. Make a longitudinal jejunal enterotomy.
9. Suture the pancreatic duct to the jejunum with posterior and anterior 3-0 PDS sutures.
10. Place another reinforcing suture line across the superior pancreas to the serosa of the jejunal limb.
11. Close the mesocolon defect with continuous running Vicryl suture.
12. Construct an end-to-side jejunojejunostomy 50–60 cm distal to the pancreaticojejunostomy.
13. Place one closed suction drain in close proximity to the pancreaticojejunostomy.
14. Check hemostasis.
15. Place omentum into the operative site if available.
16. Close the abdomen.

Note These Variations

May be combined with distal pancreatectomy with or without splenectomy

Complications

- Pancreatic fistula
- Leak from jejunojejunostomy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_116

- Abdominal abscess
- Refractory pain/pancreatitis

Template Operative Dictation

Preoperative Diagnosis Symptomatic chronic pancreatitis

Procedure Longitudinal pancreaticojejunostomy

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with symptomatic chronic pancreatitis. Workup with *endoscopic retrograde cholangiopancreatography/computed tomography/magnetic resonance imaging* demonstrated a *pancreatic duct obstruction and/or a dilated pancreatic duct*. Longitudinal pancreaticojejunostomy was indicated.

Description of Procedure The risks, benefits, and alternatives to surgery were discussed with the patient, and written informed consent was obtained. *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position, and general endotracheal anesthesia was induced.

Preoperative antibiotics were given. A Foley catheter and an *orogastric/nasogastric* tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from xiphoid to just below the umbilicus/left subcostal incision was made two fingerbreadths below the left costal margin. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The peritoneum was identified and incised, and the peritoneal cavity entered. The abdomen was explored (*detail findings including presence or absence of pseudocysts*, *biliary tract disease*, etc.).

The gastrocolic omentum was opened widely in a plane just off the colon, thus exposing the lesser sac from the left of the hepatic flexure to the splenic flexure. The pancreas was fully exposed, and adhesions to the posterior wall of the stomach were lysed. The pancreas was palpated and found to be consistent with chronic pancreatitis. The dilated pancreatic duct *was/was not* palpable in the body of the pancreas. The pancreatic duct was located *with ultrasound and confirmed by aspiration with a 22-gauge needle*. The pancreatic tissue was opened with electrocautery until the duct was encountered. The duct was then incised and opened over a clamp proximally from 1 cm lateral to the gastroduodenal artery to the tail of the gland distally.

Attention was turned toward the jejunum. The ligament of Treitz was identified, and a loop of intestine was pulled up approximately 20–30 cm distal to the ligament of Treitz. The bowel was divided with a linear cutting stapler. A window was then created in an avascular portion of the transverse mesocolon near the ligament of Treitz. The distal limb of jejunum was oversewn with 3-0 silk Lembert sutures, then passed through this window, and brought adjacent to the pancreas. The limb was arranged so that the oversewn end was aligned with the tail and that the mesenteric side of the loop lay along the inferior border of the pancreas.

An outer layer of 3-0 PDS running horizontal mattress sutures was placed through the bowel wall and pancreatic parenchyma approximately 1 cm away from the duct, traveling from the tail toward the head. The jejunum was then opened, and full-thickness bites with 3-0 PDS were taken through bowel and pancreas to create a running duct-to-mucosa anastomosis. The inferior layer was created first, then a separate suture used for the superior layer, carefully invaginating the bowel to approximate the duct to the mucosa. Next an outer layer of 3-0 PDS running horizontal mattress sutures was placed to further reinforce the superior suture line. A 10-Fr Jackson-Pratt drain was placed below the anastomosis.

A point 50–60 cm distal to the anastomosis was chosen and the jejunojejunostomy created.

[Choose One:]

If stapled: *The two limbs of jejunum were approximated with 3-0 silk sutures. Enterotomies were then made and a GIA-55 blue load stapler was introduced and fired. The enterotomies were then closed with a TA 60 stapler. The staple line was checked for hemostasis*, *and the anastomosis was noted to be patent*.

If sutured: *A hand-sewn two-layer anastomosis was then made between the end of the proximal limb of jejunum and the side of the distal jejunum using running 3-0 PDS and interrupted 3-0 silk*.

[*If gallbladder present*, *a cholecystectomy was performed*.]

The closed suction drain was brought through a separate stab wound. The drain was sutured to the skin with a nylon suture. Hemostasis was checked, and the abdomen was irrigated. *The omentum was placed in the vicinity of the anastomosis*.

The fascia was closed with a running #*1/0* PDS. The skin was closed with skin staples. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to postanesthesia care unit in stable condition. There were no immediate complications noted.

Acknowledgment This chapter was contributed by Kevin Bridge, M.D., in the previous edition.

Part IX

General Surgery: Spleen

117 Open Splenectomy for Disease

Angela Stork and Luis Garcia

Indications

- Idiopathic thrombocytopenic purpura
- Hereditary spherocytosis
- Thalassemia, sickle cell anemia, and hemolytic anemias complicated by symptomatic splenomegaly, hypersplenism, and frequent transfusions
- Symptomatic splenomegaly, hypersplenism in malignancy (lymphomas, hairy cell leukemia, chronic lymphocytic leukemia, chronic myelogenous leukemia)
- Wandering spleen
- Splenic cysts, abscess
- Conversion from laparoscopic splenectomy

Essential Steps

1. Left subcostal incision.
2. Obtain adequate left upper quadrant exposure.
3. Incise the gastrocolic ligament to open the lesser sac.
4. Clamp, divide, and ligate the gastrosplenic (short gastrics) and splenocolic ligaments.
5. Mobilize the spleen medially.
6. Incise the splenorenal and splenophrenic ligaments.
7. Ligate and divide the splenic artery and vein.
8. Remove the spleen.
9. Obtain hemostasis.
10. Search for and resect any accessory spleens.
11. Close the abdomen.

Note These Variations

- Upper midline incision may be used.
- Optional preliminary ligation of the splenic artery in the lesser sac.
- Vessel ligation can be achieved with vascular load GIA stapler.
- Drain placement if concern for pancreatic tail injury.

Complications

- Portal vein thrombosis, other thrombotic events
- Bleeding
- Overwhelming postsplenectomy sepsis
- Subphrenic abscess
- Splenosis
- Pancreatic, gastric, or colon injury
- Missed accessory spleen with recurrence of hematologic disorder

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_117

Template Operative Dictation

Preoperative Diagnosis *See "Indications" listed above*.

Procedure Open splenectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was found to have *idiopathic thrombocytopenic purpura/hereditary spherocytosis/autoimmune hemolytic anemia/other refractory to medical management*. Splenectomy was indicated for the management of *thrombocytopenia/anemia/neutropenia/pancytopenia/others*.

Description of Procedure Patient was taken to the operating room and placed on the table in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Anesthesia was initiated and patient intubated. [*Lines/tubes*, etc. (i.e., *Foley catheter*, *OG/NG*, *SCDs*, *arterial line*, etc.)] were placed, and all pressure points appropriately padded. Patient was then prepped and draped in a sterile fashion.

A left subcostal incision was made two fingerbreadths below the costal margin, extending from midline to the anterior axillary line. This was deepened through the subcutaneous, fascial, and muscular layers with electrocautery, and the peritoneal cavity was entered.

Inspection of the abdomen showed *a normal-appearing/enlarged spleen* (*list other abnormal findings*). [*Adhesions were lysed sharply under direct vision with Metzenbaum scissors*]. A(n) *Omni/Bookwalter* retractor was placed and the colon packed inferiorly for exposure. The gastrocolic ligament was incised in an avascular plane to access the lesser sac. The splenic artery was palpated, carefully exposed, and ligated close to the spleen. The gastrosplenic and splenocolic ligaments were then serially clamped, divided, and ligated with 2-0 silk. The spleen was carefully mobilized medially to expose the retroperitoneal attachments. The splenorenal and splenophrenic ligaments were incised and the spleen elevated to the midline, taking care not to injure the hilar vessels or pancreas. The splenic artery and vein were then identified, *separately clamped*, *and divided near the hilum. The spleen was passed off the field*, *and vessel suture ligated with 2-0 silk/ligated and divided with vascular load GIA stapler*.

The left upper quadrant was carefully examined and hemostasis achieved. *No injuries to the pancreatic tail were noted/due to concern for possible pancreatic tail injury*, *a closed-suction drain was placed*, *externalized through a separate stab incision*, *and secured to the skin with 3-0 nylon*.

Systematic exploration for accessory spleen was then performed, and *none were identified/an accessory spleen was identified in the ___. It was dissected free of surrounding tissues*, *the hilum was ligated with 2-0 silk*, *and the accessory spleen was removed intact*. The incision was closed in layers with *running/interrupted* ___. Skin edges were reapproximated with *staples/running subcuticular _____/other and Dermabond/Steri-Strips/sterile dressing applied*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated in the OR, and transferred to PACU in stable condition.

Acknowledgment This chapter was contributed by Charles H. Mosher, M.D., in the previous edition.

Splenectomy for Trauma

118

Angela Stork and Luis Garcia

Indications

- Splenic trauma is associated with the following:
  - High-grade injury involving the hilum
  - Hemodynamic instability
  - CT with contrast blush, when angiographic embolization is unavailable
  - Moderate to severe brain injury, due to risks of further hypotension
  - Failure of splenic salvage/nonoperative management:
    - Transfusion threshold exceeded
    - Failure of angiographic embolization

Essential Steps

1. Midline incision.
2. Pack the left upper quadrant for temporary hemostasis.
3. Evacuate blood and clots.
4. Thorough exploration for other injuries.
5. Pack/retract the colon downward.
6. Gently rotate the spleen medially, maintaining downward pressure, to expose the lateral attachments.
7. Sharply divide the lateral attachments (phrenicosplenic and splenocolic ligaments).
8. Sweep the hand behind the spleen to bluntly release posterior attachments to the kidney (splenorenal ligament).
9. Freely mobilize the spleen medially out of the retroperitoneum, taking care not to injure the pancreas.
10. Pack the left upper quadrant.
11. Clamp, divide, and ligate the gastrosplenic ligament/short gastrics.
12. *Individually* ligate and divide the splenic artery and vein and their branches.
13. Remove the spleen.
14. Obtain hemostasis.
15. *Place closed-suction drain*.
16. Close the abdomen.

Note These Variations

- Level of exploration for other injuries can be individualized based on mechanism of injury, imaging findings, and clinical suspicion.
- Vessel ligation can be achieved with vascular load GIA stapler.
- Drain placement is optional, but indicated if concern for pancreatic tail injury.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_118

- Partial splenectomy and splenorrhaphy are options to consider in those with Grades I–III injury who are hemodynamically stable and without coagulopathy, serious head injury, or other potentially life-threatening injuries.

Complications

- Bleeding
- Overwhelming postsplenectomy sepsis
- Subphrenic abscess
- Splenosis
- Pancreatic, gastric, or colon injury
- Missed injuries
- Portal vein thrombosis, other thrombotic events

Template Operative Dictation

Preoperative Diagnosis *Abdominal trauma/splenic injury with hemodynamic instability/failure of nonoperative management/other*.

Procedure Splenectomy (*list any additional procedures*).

Postoperative Diagnosis Splenic injury *not amenable to/with failed* splenic preservation due to *severity of injury/hemodynamic instability/other injuries* (*list any additional intra-abdominal injuries*).

Indications This ___-year-old *male/female* was found to have *blunt trauma to the abdomen*, *positive computed tomography scan/FAST* (*focused abdominal sonography for trauma*), *and hemodynamic instability/stab wound/gunshot wound to the abdomen/failure of nonoperative management/other*, and therefore, *exploration/splenectomy* was indicated.

Description of Procedure The patient was taken to the operating room and placed on the table in supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Anesthesia was initiated and the patient intubated. *Lines/tubes*, etc (e.g. *Foley catheter*, *OG/NG*, *SCDs*, *arterial line*) were placed and all pressure points appropriately padded. *Blood products/auto-transfuser was available in the room*. The patient was then prepped and draped in a sterile fashion.

A vertical midline incision was made and deepened through the subcutaneous and fascial layers with electrocautery. The peritoneal cavity was entered and *gross blood/clots/succus/other/no gross abnormalities were* immediately noted. [*Describe initial steps based on the plan for full exploratory laparotomy or focused splenectomy and findings on entry*, *i.e.*, *all quadrants were packed and the abdomen was systematically explored*; *the left upper quadrant was packed and the abdomen systematically explored/spleen examined*.] [*Remainder of this dictation will relate to isolated splenic trauma*.]

Blood and clot was rapidly evacuated and spleen examined, showing *rupture/active bleeding/other*. A(n) *Omni/Bookwalter* retractor was placed and the colon packed inferiorly for exposure. The spleen was then gently grasped and rotated medially to expose and sharply divide the lateral attachments. A hand was then swept between the spleen and kidney to bluntly release the posterior attachments. The spleen was then freely mobilized to the midline and the left upper quadrant packed. The short gastrics were serially clamped, divided, and ligated with 2-0 silk. The splenic artery and vein were then individually ligated with 2-0 silk and divided close to the hilum, and the spleen was removed. The left upper quadrant was carefully examined and hemostasis achieved. *No injuries to the pancreatic tail were noted/due to concern for possible pancreatic tail injury*, *a closed-suction drain was placed*, *externalized through a separate stab incision*, *and secured to the skin with 3-0 Nylon*. Incision was closed in layers with *running/interrupted* ___. Skin edges were re-approximated with *staples/running subcuticular*

_____/*other and Dermabond/Steri-Strips/sterile dressing applied*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated in the OR, and transferred to PACU in stable condition/*remained intubated and was transferred to SICU/other*.

Acknowledgment This chapter was contributed by Charles H. Mosher, M.D., in the previous edition.

Laparoscopic Splenectomy

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Angela Stork and Luis Garcia

Indications

- Idiopathic thrombocytopenic purpura
- Hereditary spherocytosis
- Thalassemia, sickle cell anemia, and hemolytic anemias complicated by symptomatic splenomegaly, hypersplenism, and frequent transfusions
- Symptomatic splenomegaly and hypersplenism in malignancy (lymphomas, hairy cell leukemia, chronic lymphocytic leukemia, chronic myeloid leukemia)
- Splenic cysts
- Splenic abscess

Essential Steps

1. Position patient in right lateral decubitus (left side up).
2. Induce pneumoperitoneum and place first port in midclavicular line below left costal margin.
3. Insert laparoscope and inspect the abdomen for injury and pathology.
4. Place additional ports.
5. Systematic exploration for accessory spleen and immediate resection. Possible locations of accessory spleen are as follows: the gastrosplenic ligament, splenocolic ligament, greater omentum, phrenosplenic ligament, small and large bowel mesenteries, pelvis, adnexal structures, and pancreatic tail.
6. Divide the splenocolic ligament to mobilize the splenic flexure and release the lower pole of the spleen.
7. Divide the lateral peritoneal attachments.
8. Enter the lesser sac, divide the short gastric vessels, and divide the remaining gastrosplenic ligament.
9. Identify and divide the splenic artery and vein. Protect the pancreas.
10. Divide any remaining posterior attachments.
11. Place the spleen in a bag, and remove in piecemeal fashion without spillage.
12. Assess for hemostasis.
13. Remove ports and deflate the abdomen.
14. Close port sites.

Note These Variations

- Supine position may be used.
- Initial access via Hasson vs Veress needle technique.
- Number, sizes, and positions of ports may be altered.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_119

- In addition to the LigaSure, various laparoscopic vessel-sealing devices are currently available for dissection.
- Splenic vessels may be suture ligated or divided with Endo GIA stapler (vascular load).

Complications

- Bleeding
- Missed accessory spleens
- Splenosis
- Overwhelming postsplenectomy sepsis
- Subphrenic abscess
- Portal vein thrombosis
- Pancreatic, gastric, or colon injury
- Need for conversion to open splenectomy (note: this is not a complication but rather a sign of sound judgment when conditions are not favorable)

Template Operative Dictation

Preoperative Diagnosis *See* section "Indications" *listed above*, *other*.

Procedure Laparoscopic splenectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was found to have *idiopathic thrombocytopenic purpura/hereditary spherocytosis/autoimmune hemolytic anemia/other refractory to medical management*. Splenectomy was indicated for the management of *thrombocytopenia/anemia/neutropenia/pancytopenia/other*, and the laparoscopic approach was elected.

Description of Procedure Patient was taken to the operating room and placed on the table in supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Anesthesia was initiated and patient intubated. *Lines*, *tubes*, etc. (i.e., *Foley catheter*, *OG/NG*, *SCDs*, *arterial line*, etc.) were placed and all pressure points appropriately padded. Patient was then prepped and draped in a sterile fashion. A *12-mm* incision was made at the midclavicular line of the left costal margin.

[Choose One:]
If Veress needle: *The fascia was elevated and the Veress needle inserted. Proper position was confirmed by aspiration and saline meniscus test.*

If Hassan cannula: *The fascia was elevated and incised, followed by the peritoneum. Atraumatic entry into the peritoneum was confirmed visually. Two anchoring sutures were placed through the fascia. The Hassan cannula was inserted under direct vision and secured with the stay sutures.*

The abdomen was insufflated with carbon dioxide to a pressure of 12–15 mmHg. The patient tolerated insufflation well. *A 12-mm port was then inserted*. The laparoscope was inserted and the abdomen inspected to ensure no injuries occurred with initial port placement. Additional ports were then placed *along the left costal margin*. Systematic exploration of all usual accessory spleen locations was performed and *none were identified/an accessory spleen was identified in the* ___. *It was dissected free of surrounding tissues*, *the hilum was ligated*, *and the accessory spleen was removed intact*. Next, the splenocolic ligament was divided with LigaSure to mobilize the splenic flexure of the colon and the lower pole of the spleen. The lateral peritoneal attachments were divided in a similar manner. The lesser sac was then entered and the short gastric vessels and remaining gastrosplenic ligament divided with LigaSure. The splenic hilum was visualized and carefully dissected *to allow passage of the Endo GIA stapler* (*vascular load*) *for ligation and division of the splenic vessels*. The tail of the pancreas was identified and protected. Remaining posterior attachments were then divided and the spleen placed in an endoscopic retrieval bag. The open end of the bag was externalized through a port site and the spleen removed in piecemeal. Care was taken to prevent spillage of contents. Camera was then reinserted and surgical field inspected for hemostasis. *A GraNee/Carter-Thomason needle was used to close the fascia of the 12-mm port site*. Ports were removed under direct vision with *no bleeding noted/trocar site bleeding controlled by electrocautery*, and abdomen deflated. The skin of all incisions was re-approximated with *subcuticular 4-0 Monocryl and Dermabond/Steri-Strips applied*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated in the OR and transferred to PACU in stable condition.

Acknowledgment This chapter was contributed to by Carol E. H. Scott-Conner, M.D., in prior editions.

120 Partial Splenectomy

Jaswin Sawhney

Indications

- Splenic cysts.
- Injury to the upper or lower pole of the spleen (iatrogenic or traumatic). The decision to perform partial splenectomy versus splenectomy should be based on the patient's physiology, age, extent of the injury to the spleen, and overall trauma burden.

Essential Steps

1. Upper midline for trauma or iatrogenic. Laparoscopic or left subcostal incision for cysts.
2. Explore the abdomen. Pack all four quadrants for trauma.
3. For trauma or iatrogenic injuries: mobilize the lateral attachments of the spleen (splenophrenic and splenocolic ligaments).
4. Mobilize the spleen and tail of the pancreas medially into the wound, keeping the left kidney in the retroperitoneum. May need to incise the splenocolic ligament. For splenic cysts or if lateral approach fails, you can approach the splenic artery medially through the lesser sac or at the hilum.
5. If necessary, place Bulldog clamp on the splenic artery.
6. Identify the area involved. When considering partial splenectomy for injury, the spleen has often already been divided by the injury.
7. Take the short gastric vessels and incise the gastrosplenic ligament to improve mobility and access to the segmental vasculature.
8. Identify major vessels to the upper or lower pole at the hilum.
9. Ligate blood supply to the area of planned resection (*if upper pole, also ligate short gastrics*).
10. Remove Bulldog clamp.
11. Observe for line of demarcation.
12. Remove the demarcated area with cautery or stapling device.
13. The raw surface can often be treated with topical agents, argon beam coagulator, running monofilament suture over pledgets, or Vicryl mesh wrapping
14. Check hemostasis and close without drains.

Note These Variations

- Closure of the splenic remnant
- Upper or lower pole resected

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_120

Complications

- Infarction of the remnant
- Bleeding
- Injury to the stomach, colon, or tail of the pancreas
- Subphrenic abscess

Template Operative Dictation

Preoperative Diagnosis *Traumatic rupture of the spleen/splenic cyst/iatrogenic injury* limited to the *upper/lower* pole of the spleen

Procedure Partial splenectomy with preservation of the *lower/upper* pole with intact blood supply

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was found to have *traumatic rupture of the spleen/iatrogenic injury/splenic cyst*.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed in the supine position and general endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from the left side of xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissue and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered/a left subcostal incision was made from the midline to the anterior axillary line, approximately two finger breadths below and parallel to the costal margin. Anterior rectus sheath was divided, the rectus muscle was carefully divided with cautery, and the posterior sheath was opened to enter the peritoneal cavity.

The abdomen was packed in all four quadrants and explored. The spleen was found to be *normal in size/enlarged.* (*List any other abnormalities found.*) *The spleen and tail of the pancreas were mobilized medially. Injury/pathology* was found to be limited to the *upper/lower* pole and therefore amenable to partial splenectomy. Care was taken to avoid injury to the pancreas or splenic hilum. Packs were placed behind the spleen. The lesser sac was entered or the splenic hilum exposed to clamp the splenic artery (as needed).

The vessels supplying the *area/pole* were ligated. A line of demarcation was observed to form and the spleen was divided along this line with *electrocautery/a TA or linear stapling device with wide staple load. The cut edge of the splenic remnant was treated with 2-0 running/interrupted monofilament suture with pledgets of __ Teflon or omental buttress*. The remnant was inspected and found to be viable, with an intact blood supply from the splenic artery. Hemostasis was achieved. The splenic remnant was replaced in the left upper quadrant.

The fascia was closed with *a running suture of ____/interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ___/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition. All counts were correct.

Acknowledgment This chapter was contributed by Charles H. Mosher, M.D., in the previous edition.

121 Splenorrhaphy

Jaswin Sawhney

Indication

- Splenic injury (traumatic or iatrogenic) with desire for splenic preservation.
- The decision to perform partial splenectomy versus splenectomy should be based on the patient's physiology, age, extent of the injury to the spleen, and overall trauma burden.

Essential Steps

1. Upper midline incision.
2. Pack all four quadrants and explore the abdomen.
3. Mobilize the lateral attachments of the spleen (splenophrenic and splenocolic ligaments) with blunt or sharp dissection.
4. Mobilize the spleen and tail of the pancreas medially into the wound keeping the left kidney in the retroperitoneum. May need to incise the splenocolic ligament.
5. If lateral approach fails, you can approach the splenic artery medially through the lesser sac or at the hilum.
6. Divide the short gastric vessels as needed.
7. Identify the injured area.
8. *Apply hemostatic agents/argon beam/omental fixation/placement of absorbable mesh wrap/suture placement with pledgets*.
9. Observe for hemostasis.
10. If hemostasis is inadequate or the patient becomes unstable, proceed to splenectomy (see Chaps. 117 and 118).

Note These Variations

- Hemostatic agent (type and result).
- Suture (type).
- Pledgets (use and type).
- Mesh (use and type).
- Failure requires partial or complete splenectomy (see Chaps. 117, 118, and 120).

Complications

- Bleeding
- Infarction of the partial or entire spleen
- Injury to the stomach, colon, or pancreas
- Subphrenic abscess

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_121

Template Operative Dictation

Preoperative Diagnosis *Traumatic rupture/laceration of the spleen/iatrogenic injury*

Procedure Splenorrhaphy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was found to have *traumatic rupture/laceration of the spleen/iatrogenic injury and a desire for splenic preservation*.

Description of Procedure *An epidural catheter was placed by anesthesia prior to the start of the operation*. The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. A Foley catheter and a nasogastric tube were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertical midline incision was made from xiphoid to just below the umbilicus. This was deepened through the subcutaneous tissues and hemostasis was achieved with electrocautery. The linea alba was identified and incised and the peritoneal cavity entered. The abdomen was packed in all four quadrants and then explored. *No other injuries/the following additional injuries* (*list*) were found. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*.

Attention was directed to the left upper quadrant. *The spleen and tail of the pancreas were mobilized medially*. The short gastric vessels were clamped, divided, and ligated with 2-0 silk ties. Packs were placed behind the spleen and the spleen was inspected. Injury was found to consist of *avulsion of ____ pole/stellate laceration with intact hilar vessels/complex laceration/simple laceration*. The patient was hemodynamically stable and the decision was made to proceed with splenorrhaphy. *Hemostatic agents* (*detail type*) *were applied with direct pressure to stop bleeding*, *a capsular tear was repaired with a running 4-0 Chromic suture*, *the fracture was repaired with horizontal mattresses and pledgets using 2-0 Chromic*, *a portion of the omentum was placed in the splenic fracture and fixed with horizontal mattresses*, *absorbable mesh was placed over the spleen*, and *argon beam coagulator was used for hemostasis*.

The spleen was inspected for hemostasis and then placed into the left upper quadrant. The remainder of the abdomen was again checked for other injuries. Hemostasis in the left upper quadrant was again inspected and found to be adequate.

(*Optional*: *Multiple interrupted through-and-through retention sutures of ____ were placed.*) The fascia was closed with *a running suture of ____/interrupted ____*. The skin was closed with *skin staples/subcuticular sutures of ___/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition. All counts were correct.

Acknowledgment This chapter was contributed by Charles H. Mosher, M.D., in the previous edition.

Part X

General Surgery: Hernia Repairs

Bassini Repair of Inguinal Hernia

122

Melissa Garrett

Indication

- Inguinal hernia (direct, indirect)

Essential Steps

1. Verify and mark side of surgery.
2. Groin incision (approximately two finger-breadths above and parallel the groin crease).
3. Expose the external oblique aponeurosis and external ring.
4. Incise the external oblique aponeurosis in the direction of fibers.
5. Identify and protect the ilioinguinal nerve.
6. Mobilize flaps of the external oblique.
7. Gently encircle the spermatic cord (*or round ligament*, *if female*) at the external ring with a Penrose drain.
8. Identify the indirect hernia sac on the antero-medial surface of the cord *or round ligament*.
9. Dissect indirect sac free of surrounding structures and open.
10. Reduce contents.
11. *Suture ligate and reduce the sac/suture ligate and divide the round ligament with the sac in female*.
12. Assess the floor of the canal.
13. Identify the conjoint tendon and assess mobility to the shelving edge of the inguinal ligament.
14. *Relaxing incision of the internal oblique fascia/anterior rectus sheath if any tension*.
15. Suture the conjoint tendon to the shelving edge of the inguinal ligament with interrupted nonabsorbable sutures.
16. *In male*: *Leave enough room to pass Kelly clamp through the internal ring next to the cord*.
17. *In female*: *Completely close the internal ring*.
18. *A single stitch lateral to the internal ring is sometimes needed in males*.
19. Check hemostasis.
20. Close aponeurosis of the external oblique.
21. Close Scarpa's fascia (optional).
22. Close the skin.
23. After applying dressing, pull the testis down into normal position in the scrotum.

Note These Variations

- Type of suture material.
- Completely close the canal in females.
- In males, a dilated internal ring may require an additional stitch lateral to the cord.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_122

- Relaxing incision.
- Type of anesthesia, including local anesthesia and ilioinguinal nerve block.
- If done for incarceration, note findings, including viability of the bowel.
- Cord lipoma may be present and excised.

Complications

- Hematoma, including scrotal hematoma
- Recurrence
- Neuropraxia
- Femoral vessels injury
- Bowel injury

Template Operative Dictation

Preoperative Diagnosis *Left/right* indirect inguinal hernia

Procedure Bassini repair of *left/right* inguinal hernia *with local anesthesia by the surgeon*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed a symptomatic *left/right reducible/incarcerated* inguinal hernia *with/without* symptoms of obstruction. Repair was indicated, and because of the *patient's age/sex/nature of the hernia*, a Bassini repair was elected.

Description of Procedure The patient was taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

[Choose One:]
***If not local anesthesia*: *General/epidural/spinal anesthesia was induced*.** The *left/right* groin was prepped and draped in the usual sterile fashion. An incision was marked in a natural skin crease parallel to the inguinal ligament, two fingerbreadths above the groin crease, and planned to end near the pubic tubercle.

If local anesthesia: *A field block was produced by raising skin wheals along the proposed skin incision, along a vertical line lateral to it, and along a horizontal line superior to it. A skin wheal was raised 1 cm lateral and superior to the anterior superior iliac spine, and a fascial injection of __% lidocaine was made to block the ilioinguinal nerve. Additional local anesthesia was injected during the procedure under the external oblique aponeurosis, at the internal ring, and as needed. A total of ___ mL of 0.5/1 % lidocaine was used.*

[*Note*]: *The ilioinguinal nerve block could be performed either at the beginning or at the end of the procedure.*

The skin crease incision was made with a knife and deepened through Camper's and Scarpa's fascia with electrocautery until the aponeurosis of the external oblique was encountered. This was cleaned and the external ring was exposed. Hemostasis was achieved in the wound. An incision was made in the midportion of the external oblique aponeurosis in the direction of its fibers. The ilioinguinal nerve was identified and protected throughout the dissection.

If neurectomy performed: *Specify if neurectomy is routine* versus *selective* and *main* versus *peripheral branches*. After additional infiltration of the nerve origin with anesthetic solution, the __ *nerve* was circumferentially dissected and sharply divided proximally under gentle traction, allowing the stump to retract back into the internal oblique muscle. Distally, the nerve was divided at the level of the pubic tubercle (*ilioinguinal nerve*) or rectus sheath (*iliohypogastric nerve*).

Peripheral (or connecting) branch was sharply divided as needed for further dissection preserving the main trunk of the nerve.

Flaps of external oblique were developed cephalad and inferiorly. The cord was identified. It was gently dissected free at the pubic tubercle and encircled with a Penrose drain. Attention was directed to the anteromedial aspect of the cord, where an indirect hernia sac was identified.

If male: *The sac was carefully dissected free of the cord down to the level of the internal ring. The vas deferens and testicular vessels were identified and protected from harm*.

If female: *The round ligament was doubly ligated and divided at a convenient point near the sac*.

The sac was opened and its contents were inspected for viability and then reduced. The floor of the inguinal canal assessed and found to be *strong/weak*. The femoral canal was palpated and *a hernia identified/no hernia identified*.

If male: *The sac was twisted and suture ligated with __ suture.*

If female: *The round ligament and sac were twisted and suture ligated*.

Redundant sac was excised. The stump of the sac was checked for hemostasis and allowed to retract into the abdomen.

Attention was then turned to the floor of the canal, which appeared to be *intact with the exception of dilated internal ring/weak*. The conjoint tendon was identified and grasped with Allis clamps. It *reached/did not reach* easily to the shelving edge of the ligament *with/without* tension.

If tension: *Decision was made to do a relaxing incision. The internal oblique fascia/ anterior rectus sheath was incised with electrocautery medial and well superior to the conjoint tendon. Hemostasis was checked. The conjoint tendon could then easily reach the inguinal ligament without tension*.

The conjoint tendon was then sutured to the shelving edge of the inguinal ligament with multiple simple sutures of ___. This suture line began at the pubic tubercle and commenced laterally to the internal ring. Care was taken not to take severely deep bites that might inadvertently injure the femoral vessels.

If male: *At the conclusion of this*, *the internal inguinal ring accommodated the tip of a Kelly hemostat*. (*Optional*: *A single suture was placed lateral to the cord to additionally tighten it*.)

If female: *The internal ring was completely obliterated at the conclusion of this procedure*.

Hemostasis was again checked. The Penrose drain was removed. The external oblique aponeurosis was closed with a running suture of 3-0 Vicryl, taking care not to catch the ilioinguinal nerve in the suture line (if neurectomy was not performed). The Scarpa's fascia was closed with interrupted 3-0 Vicryl. The skin was closed with a subcuticular *stitch of ___/skin clips/other*. A sterile dressing was applied.

If male: *The testis was gently pulled down into its anatomic position in the scrotum*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Jessemae Welsh, M.D., in the previous edition.

Shouldice Repair of Inguinal Hernia

123

Evgeny V. Arshava

Indications

- Indirect inguinal hernia in adults
- Direct inguinal hernia
- Coexisting inguinal and femoral hernias (complete Shouldice groin repair)

Essential Steps

1. Verify side of surgery.
2. *Local anesthesia*.
3. Groin incision.
4. Expose the external oblique aponeurosis and external ring.
5. *Define the inguinal ligament and incise thigh fascia* (*if suspicious of femoral hernia*). The incision of the thigh fascia starts just below the level of the inguinal ligament and extends from the level of the femoral vein to the pectineus muscle.
6. Incise the external oblique aponeurosis in the direction of fibers.
7. Identify and protect the ilioinguinal and iliohypogastric nerves. *Perform ilioinguinal/iliohypogastric neurectomy* (*main or peripheral branches*).
8. Mobilize flaps of the external oblique.
9. Incise and divide cremaster muscle to expose the spermatic cord (*or round ligament*, *if female*).
10. Search for an indirect hernia sac or any peritoneal protrusion on the anteromedial surface of the cord *or round ligament* and dissect it free off surrounding structure.
11. Reduce indirect sac or peritoneal protrusion into preperitoneal space. *Suture ligate sac if neck is narrow*.
12. Assess inguinal floor for the presence of direct hernia.
13. Incise the transversalis fascia *and trim excess if needed*.
14. Assess for femoral hernia. *Reduce if present and perform complete groin repair*.
15. Identify the transversus aponeurotic arch and lateral border of rectus abdominis muscle.
16. Perform inguinal repair with four continuous lines. *Tie free sutures to close femoral canal if complete groin repair was performed*.
17. Check for hemostasis.
18. Close the external oblique aponeurosis.
19. Close Scarpa's fascia and skin.
20. After applying dressing, pull the testis down into normal position in the scrotum.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_123

Note These Variations

- Type of anesthesia, including local anesthesia, varies.
- Complete groin repair required if femoral hernia present.

Complications

- Recurrence
- Infection
- Post herniorrhaphy groin pain syndromes
- Retroperitoneal hematoma due to unrecognized injury to the epigastric vessels and scrotal hematoma
- Ischemic orchitis and testicular atrophy

Template Operative Dictation

Preoperative Diagnosis *Left/right* inguinal hernia

Procedure Shouldice repair (*or complete groin repair*) of *left/right* inguinal hernia

Postoperative Diagnosis *According to intraoperative findings*

Indications Patient is a ___-year-old *male/female* with symptomatic *left/right* inguinal hernia for which repair is indicated.

Description of Procedure The patient was taken to the operating room prepped and draped in usual sterile fashion. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

If local anesthesia: *A skin wheal was raised 2 cm medial and superior to the anterior superior iliac spine, and sequential subcutaneous injections of local anesthetic were performed to block the distribution of ilioinguinal and iliohypogastric nerves. Additional local anesthesia was administered during the procedure under the external oblique aponeurosis*, *cremaster muscle*, *transversalis fascia*, *and at the internal ring. A total of ___ mL of anesthetic solution* (*specify*) *were used*.

If not local anesthesia: Under *general/regional anesthesia*, the *left/right* groin was prepped and draped in the usual sterile fashion.

Patient was placed in slight Trendelenburg position to facilitate operation.

An incision was made two fingerbreadths above and parallel to inguinal crease/*1 cm above and parallel to inguinal ligament*, starting midway between anterior superior iliac spine and internal inguinal ring and extending medial to the pubic tubercle.

The incision was deepened through subcutaneous adipose layer (Camper's) and superficial (Scarpa's) fascia until the aponeurosis of the external oblique was encountered. This was cleaned and the external ring was exposed. Hemostasis was achieved in the wound. An incision was made in the midportion of the external oblique aponeurosis in the direction of its fibers.

The ilioinguinal and iliohypogastric nerves were identified and protected throughout the dissection.

If neurectomy performed: *Specify if neurectomy is routine* versus *selective* and *main* versus *peripheral branches*. After additional infiltration of the nerve origin with anesthetic solution, the nerve was circumferentially dissected and sharply divided proximally under gentle traction, allowing the stump to retract back into the internal oblique muscle. Distally, the nerve was divided at the level of the pubic tubercle (*ilioinguinal nerve*) or rectus sheath (*iliohypogastric nerve*).

Peripheral (*or connecting*) *branch was sharply divided as needed for further dissection preserving the main trunk of the nerve*.

Flaps of external oblique were developed cephalad and inferiorly.

The lower edge of inguinal ligament was defined. Thigh fascia medial to the femoral vein was identified and incised to rule out presence of femoral hernia and to relax inguinal ligament for subsequent repair. Femoral hernia was found/not found.

If male: The cord was identified. *It was circumferentially dissected and encircled with Penrose drain*. The cremasteric muscle was split longitudinally and divided in two portions. The medial portion was excised and its stumps ligated. The lateral portion, containing cremasteric vessels and genital branch of genitofemoral nerve, was ligated with 2-0 absorbable suture and divided. Testicular vessels and vas were identified, encircled with Penrose drain, and protected throughout the operation.

Attention was directed to the anteromedial aspect of the cord, where a *small/medium/large indirect hernia sac/peritoneal protrusion* was identified. The indirect sac *or peritoneal protrusion* was carefully dissected free of the cord behind the level of the internal ring.

[Choose One:]

If sac is empty: *The sac was reduced into preperitoneal space*.

If sac is long and narrow or not empty: *The sac was opened and contents were reduced. The neck of the sac was twisted and suture ligated with 2-0 suture. The stump of the sac was checked for hemostasis and allowed to retract into the abdomen*.

If sac is densely adherent to the cord structures: *After division of the sac and ligation of the neck, the distal part of the sac was left attached to cord structures*.

If there was a presence of cord lipoma**:** *A cord lipoma was identified. It was left in place/freed from the spermatic cord and excised and the stump ligated*.

In females: The cremasteric muscle was divided. The indirect sac/peritoneal protrusion was dissected free and reduced into preperitoneal space. *The sac was ligated and divided and the stump was allowed to retract into the abdomen*. The round ligament was ligated at the level of internal ring and pubic tubercle and excised.

Attention then turned to the floor of the canal, which appeared to be weakened without a well-defined direct hernia. *Small/medium/large direct hernia was identified*.

An incision of the transversalis fascia was made beginning at the internal inguinal ring and extending medially to the pubic tubercle along the border of inguinal arch. Inferior-lateral flap of transversalis fascia was developed *and any excess was trimmed*. The inferior epigastric vessels were identified and protected. Femoral space was examined and found to contain no hernia.

Small/medium/large femoral hernia was found and reduced. Complete hernia repair was performed. 0 Prolene suture was passed initially through the femoral defect from below the inguinal ligament. The bites were taken in the following fashion: *the first bite incorporated the Cooper's ligament*, *followed by the transversalis fascia and then the inguinal ligament*, *in a wide loop. Three sutures were then placed in the following fashion*: *from the pubic tubercle to the femoral sheath* (*adjacent to the femoral vein*) *to completely close the femoral canal. This was left untied extending inferiorly toward the thigh*, *but clamped with hemostats. The sutures were subsequently incorporated in the second*, *third*, *and fourth lines of inguinal repair and tied*.

The inguinal floor was reconstructed with four continuous lines of 32 or 34 gauge stainless steel *or 0 Prolene stitch*. The first line was started at the pubic tubercle and brought the inferior-lateral flap of the transversalis fascia beneath the lateral border of the rectus abdominal muscle medially and beneath the transversus aponeurotic arch laterally. The proximal stump of cremasteric was incorporated into the end of first line during formation of the new internal ring. The suture was reversed just medial to the cord structures, and the second line brings the full-thickness layer of internal oblique, transversus abdominis muscles, and transversalis fascia to the shelving edge of the inguinal ligament. *Lateral to pubic tubercle and medial to location of the femoral vein one or two bites were taken deeper*, *tacking this full-thickness layer to Cooper's ligament* (not part of the classic repair). The tails of the first and second lines were tied at the pubic tubercle. The third line was started at the internal inguinal ring and incorporates the layer of internal oblique muscle and inferior-lateral flap of the external oblique aponeurosis. The suture was reversed at the pubic tubercle, and the fourth line imbricates the same structures over the third line.

Interrupted 0-Prolene sutures on the femoral defect were incorporated in the second, third, and fourth lines of inguinal repair and were tied to complete the groin repair.

No venous congestion was appreciated in the cord after completion of the repair. The tip of a forceps was inserted through the internal ring to confirm adequate laxity and rule out preperitoneal bleeding.

The spermatic cord was repositioned in the normal anatomic position under the external oblique aponeurosis. The wound was irrigated and hemostasis ensured. The external oblique aponeurosis was then closed with a running suture, taking care not to catch nerves in the suture line. The distal stump of the cremaster muscles was included in the reconstruction of the external ring. The superficial (Scarpa's) fascia was closed with running/*interrupted* 3-0 suture. The skin was closed with running 4-0 absorbable suture. Dressing was applied.

If male: *The testicle was gently pulled down into the scrotum to assure its appropriate position.*

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the recovery area in stable condition.

Note: **Definitions of hernia sizes that may be used for dictations**:

Direct and femoral hernias
- Small <2 cm
- Medium 2–5 cm
- Large >5 cm

Indirect hernias
- Small <5 cm
- Medium 5–15 cm
- Large >15 cm
- Giant hernia – extends below the midpoint of inner thigh in standing position
- Peritoneal protrusion – an empty small gossamer thin sac (that may appear obliterated)

It is rare in males not to find a peritoneal protrusion on the anteromedial aspect of the cord. It must be identified, dissected, and reduced behind the level of the internal ring to avoid indirect recurrence.

Acknowledgment I would like to acknowledge Michael A. J. Alexander, M.B., B.S., Surgeon-in-Chief, and his colleagues for their hospitality at the Shouldice Hospital.

124 McVay Repair of Inguinal Hernia

Melissa Garrett

Indications

- Inguinal hernia
- Femoral hernia

Essential Steps

1. Verify and mark side of surgery.
2. *Local anesthesia and ilioinguinal nerve block.*
3. Groin incision.
4. Expose the external oblique aponeurosis and external ring.
5. Incise the external oblique aponeurosis in the direction of the fibers.
6. Identify and protect the ilioinguinal nerve.
7. Mobilize flaps of the external oblique.
8. Gently encircle the spermatic cord (*or round ligament*, *if female*) at the external ring with Penrose drain.
9. Seek the indirect hernia sac on the anteromedial surface of the cord *or round ligament*.
10. Dissect free the surrounding structures and open.
11. Reduce contents.
12. Suture ligate and reduce the sac. Suture ligate and divide the round ligament with the sac in female.
13. Assess the floor of the canal.
14. Identify the conjoint tendon and assess quality and mobility to Cooper's ligament.
15. Make relaxing incision in the anterior rectus sheath.
16. Suture the conjoint tendon to Cooper's ligament with interrupted sutures; begin at the pubic tubercle and progress laterally.
17. At the femoral canal, place transition stitch that incorporates the following structures: conjoint tendon, Cooper's ligament, femoral sheath, and shelving edge of the inguinal ligament.
18. Remaining sutures are placed from the conjoint tendon to the inguinal ligament.
19. *In male*: *Leave enough room to pass Kelly clamp through the internal ring next to the cord.*
20. *In female*: *Completely close the internal ring*.
21. *A single stitch lateral to the internal ring is sometimes needed in males*.
22. Check hemostasis.
23. Close the aponeurosis of external oblique with running 3-0 Vicryl.
24. Close Scarpa's fascia with interrupted 3-0 Vicryl.
25. Close the skin.
26. After applying dressing, pull the testis down into normal position in the scrotum.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_124

Note These Variations

- Type of suture material varies.
- Completely close the inguinal canal in females.
- In males, a dilated internal ring may require an additional stitch lateral to the cord.
- Type of anesthesia, including local anesthesia, varies.
- If done for acute incarceration, note findings, including viability of the bowel.

Complications

- Hematoma, including scrotal hematoma
- Femoral vein injury
- Recurrence
- Neuropraxia
- Hydrocele
- Obstruction of the vas deferens
- Testicular artery injury, testicular atrophy

Template Operative Dictation

Preoperative Diagnosis *Left/right indirect/direct inguinal/femoral* hernia

Procedure McVay repair of *left/right inguinal/femoral* hernia

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed a symptomatic *left/right reducible/incarcerated* inguinal hernia *with/without* symptoms of obstruction. Repair was indicated.

Description of Procedure The patient was taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

[Choose One:]
If not local anesthesia: *General/epidural/spinal anesthesia was induced*. The *left/right* groin was prepped and draped in the usual sterile fashion. An incision was marked in a natural skin crease parallel to the inguinal ligament and planned to end near the pubic tubercle.

If local anesthesia: *A field block was produced by raising skin wheals along the proposed skin incision, along a vertical line lateral to it, and along a horizontal line superior to it. A skin wheal was raised 1 cm lateral and superior to the anterior superior iliac spine, and a fascial injection of lidocaine was made to block the ilioinguinal nerve. Additional local anesthesia was injected during the procedure under the external oblique aponeurosis, at the internal ring, and as needed. A total of ___mL of 0.5/1 % lidocaine was used.*

The skin crease incision was made with a knife and deepened through Camper's and Scarpa's fascia with electrocautery until the aponeurosis of the external oblique was encountered. The external ring was exposed. An incision was made in the midportion of the external oblique aponeurosis in the direction of its fibers. The ilioinguinal nerve was identified and protected throughout the dissection. Flaps of external oblique were developed cephalad and inferiorly.

The cord was identified. It was gently dissected free at the pubic tubercle and encircled with a Penrose drain. Attention was directed to the anteromedial aspect of the cord, where an indirect hernia sac was identified.

If male: *The sac was carefully dissected free of the cord down to the level of the internal ring. The vas deferens and testicular vessels were identified and protected from harm.*

If female: *The round ligament was doubly ligated and divided at a convenient point near the sac.*

The sac was opened and contents were inspected for viability and then reduced. A finger was passed into the peritoneal cavity, and the floor of the inguinal canal assessed and found to be *strong/weak*. The femoral canal was palpated *and a hernia identified/no hernia identified*.

If male: *The sac was twisted and suture ligated with 2-0 silk*.

If female: *The round ligament and sac were twisted and suture ligated with 2-0 silk*.

Redundant sac was excised and submitted to pathology. The stump of the sac was checked for hemostasis and allowed to retract into the abdomen.

Attention was then turned to the floor of the canal, which appeared to be *intact with the exception of dilated internal ring/weak*. The conjoint tendon was identified and grasped with Allis clamps. A relaxing incision was then made along the cephalad aspect of the anterior rectus sheath. The conjoint tendon then reached easily to the shelving edge of the ligament *with/without* tension.

The conjoint tendon was then sutured to Cooper's ligament with multiple simple sutures of ___. A transition stitch was placed incorporating the conjoint tendon to Cooper's ligament, the medial portion of femoral sheath, and the shelving edge of the inguinal ligament. Remaining repair then consisted of sutures placed between the conjoint tendon and the shelving edge of the inguinal ligament.

If male: *At the conclusion of this*, *the internal inguinal ring accommodated the tip of a Kelly hemostat*. (*Optional*: *A single suture was placed lateral to the cord to additionally tighten it*).

If female: *The internal ring was completely obliterated at the conclusion of this procedure*.

Hemostasis was again checked. The Penrose drain was removed. The external oblique aponeurosis was closed with a running suture of 3-0 Vicryl, taking care not to catch the ilioinguinal nerve in the suture line. Scarpa's fascia was closed with interrupted 3-0 Vicryl. The skin was closed with a *subcuticular stitch of ___/skin clips/other*. A dressing was applied.

If male: *The testis was gently pulled down into its anatomic position in the scrotum*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Peter C. Fretz, M.D., in the previous edition.

125 Mesh Repair of Inguinal Hernia/ Lichtenstein Hernioplasty

Carol E.H. Scott-Conner

Indication

- Inguinal hernia not amenable to autologous tissue repair (poor quality fascia, excessive tension, recurrent hernia)
- Recurrent inguinal hernia after laparoscopic inguinal hernia repair
- Patient or surgeon preference

Essential Steps

1. Verify side of surgery!
2. Prophylactic antibiotics.
3. *Local anesthesia*.
4. Groin incision.
5. Expose the external oblique aponeurosis and external ring.
6. Incise the external oblique aponeurosis in the direction of fibers.
7. Identify and protect the ilioinguinal nerve.
8. Mobilize flaps of the external oblique.
9. Gently encircle the spermatic cord (*or round ligament*, *if female*) at the external ring with Penrose drain.
10. Seek the indirect hernia sac on the anteromedial surface of the cord *or round ligament*.
11. *Dissect sac free of surrounding structures and open*.
12. *Reduce contents*.
13. *Suture ligate and reduce the sac*.
14. Assess the floor of the canal.
15. Place mesh and suture, beginning at the pubic tubercle.
16. Avoid narrowing the internal ring too much or catching nerves in repair.
17. Check hemostasis.
18. Close the external oblique aponeurosis.
19. Close Scarpa's fascia.
20. Close the skin.
21. After applying dressing, pull the testis down into normal position in the scrotum.

Note These Variations

- Type of suture material and mesh varies.
- Type of anesthesia, including local anesthesia, varies.

Complications

- Hematoma, including scrotal hematoma
- Recurrence
- Neuropraxia
- Injury to the cord structures
- Mesh migration
- Mesh infection

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_125

Template Operative Dictation

Preoperative Diagnosis *Left/right* inguinal hernia (*specify if recurrent*)

Procedure Mesh repair of *left/right* inguinal hernia *with local anesthesia by the surgeon*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed a symptomatic *left/right* inguinal hernia. Repair was indicated, and because of the *patient's age/nature of the hernia/preference*, a prosthetic mesh repair was elected.

Description of Procedure The patient was taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

[Choose One:]

If not local anesthesia: *General/epidural/spinal anesthesia was induced*. The *left/right* groin was prepped and draped in the usual sterile fashion. An incision was marked in a natural skin crease and planned to end near the pubic tubercle.

If local anesthesia: *A field block was produced by raising skin wheals along the proposed skin incision, along a vertical line lateral to it, and along a horizontal line superior to it. A skin wheal was raised 1 cm lateral and superior to the anterior superior iliac spine, and a fascial injection of lidocaine was made to block the ilioinguinal nerve. Additional local anesthesia was injected during the procedure under the external oblique aponeurosis, at the internal ring, and as needed. A total of ___ mL of 0.5/1 % lidocaine was used.*

The skin crease incision was made with a knife and deepened through Scarpa's and Camper's fascia with electrocautery until the aponeurosis of the external oblique was encountered. This was cleaned and the external ring was exposed. Hemostasis was achieved in the wound. An incision was made in the midportion of the external oblique aponeurosis in the direction of its fibers. The ilioinguinal nerve was identified and protected throughout the dissection. Flaps of the external oblique were developed cephalad and inferiorly.

The cord was identified. It was gently dissected free at the pubic tubercle and encircled with a Penrose drain. Attention was directed to the anteromedial aspect of the cord, where an indirect hernia sac was identified. The sac was carefully dissected free of the cord down to the level of the internal ring. The vas and testicular vessels were identified and protected from harm. The sac was opened and contents were reduced. A finger was passed into the peritoneal cavity and the floor of the inguinal canal assessed and found to be strong. The femoral canal was palpated and no hernia identified. The sac was twisted and suture ligated with 2-0 silk. Redundant sac was excised and submitted to pathology. The stump of the sac was checked for hemostasis and allowed to retract into the abdomen.

Attention was then turned to the floor of the canal, which appeared to be grossly weakened without a well-defined defect or sac. The *polypropylene/other mesh was cut to the appropriate size with an oval medial portion, and a longitudinal lateral opening/precut mesh prosthesis was checked for fit and trimmed as needed*. Beginning at the pubic tubercle, the mesh was sutured to the inguinal ligament inferiorly and the conjoint tendon superiorly using two continuous running 2-0 nonabsorbable sutures. Care was taken to assure that the mesh was placed in a relaxed fashion to avoid excessive tension and that no neurovascular structures were caught in the repair. Laterally, the tails of the mesh were crossed and the internal ring recreated, allowing for passage of the surgeon's fifth fingertip.

Hemostasis was again checked. The Penrose drain was removed. The external oblique aponeurosis was closed with a running suture of 3-0 Vicryl, taking care not to catch the ilioinguinal nerve in the suture line. Scarpa's fascia was closed with interrupted 3-0 Vicryl. The skin was closed with a subcuticular *stitch of ___/skin clips/other*. A dressing was applied.

If male: The testis was gently pulled down into its anatomic position in the scrotum.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

126 Laparoscopic Totally Extraperitoneal (TEP) Inguinal Hernia Repair

Jessica K. Smith

Indications

- Recurrent hernia
- Bilateral hernias
- Surgeon or patient preference

Essential Steps

1. Verify side of surgery.
2. Supine position, general anesthesia, arms tucked, and Foley catheter if preferred.
3. Trendelenburg position.
4. Make skin incision for the first trocar (10–12 mm) at the umbilicus. If the patient is tall, adjust the incision inferiorly so that you will clear the posterior sheath.
5. Open the anterior rectus sheath on the ipsilateral side and retract the muscle laterally to expose the posterior rectus sheath.
6. Insert finger over the posterior rectus sheath and develop space.
7. Insert a transparent balloon-tipped trocar or other device into this space directed toward the pubic symphysis.
8. Place laparoscope in the trocar and inflate the balloon under direct vision to create the extraperitoneal space. Deflate balloon and start CO_2 insufflation of the preperitoneal space. Alternatively, start CO_2 insufflation and create the space with the laparoscope itself using blunt dissection.
9. Place two additional trocars in the midline or bilateral lower quadrants under direct vision. For midline ports place:
   - The second (5 mm) just distal to the umbilical balloon trocar.
   - The third (5 mm) two fingerbreadths away from the second trocar. For lateral lower quadrant ports, place laterally and superiorly with respect to the bilateral anterior superior iliac spines (ASIS).
10. Use a 30 or 45° angled laparoscope for best visualization.
11. Identify the inferior epigastric vessels keeping them always anterior to the plane of dissection in their investing fat.
12. Beginning at the pubis dissect Cooper's ligament to its junction with the iliac vein.
13. Inspect the direct space medial to the inferior epigastric vessels and reduce any sac or preperitoneal fat with gentle traction.
14. *Direct hernias*: *Reduce the sac to the level of the iliopubic tract with gentle traction*.
15. Skeletonize the spermatic cord laterally to the inferior epigastric vessels to expose the iliopubic tract. Do not go lateral or posterior to this to avoid nerve or vascular injury.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_126

16. *Indirect hernias*: *If an indirect hernia sac is identified, mobilize the sac from the cord structures and reduce into the peritoneum. Reduce any lipomas of the spermatic cord. If the sac is exceptionally large and will not reduce with gentle traction it can be suture ligated*.
17. *Bilateral hernias*: *Repeat dissection on the contralateral side*.
18. Place mesh behind the spermatic cord structures (at least 10×12 cm) over the myopectineal orifice to completely cover the direct, indirect, and femoral spaces. A keyhole can be cut in the mesh, but there must be overlap of the mash encircling the cord.
19. *Bilateral hernias*: *Either two separate pieces or one large piece of mesh may be used*.
20. A minimum number of absorbable Vicryl or titanium tacks are used to secure the mesh. One tack is placed in the anterolateral abdominal fascia (above the anterior superior iliac spine) to secure the mesh as it is unfurled. If the mesh lies perfectly in position without tacks, it is not necessary to use them.
21. A second tack is placed to Cooper's ligament to secure the medial side of the mesh.
22. Additional tacks, if needed, can be placed in Coopers or the lateral anterior abdominal wall while palpating the end of the tacking device to avoid intraperitoneal injury.
23. Avoid placing staples directly into the pubic tubercle.
24. Ensure hemostasis.
25. Deflate preperitoneal space while gently holding mesh in position.
26. Withdraw trocars.
27. Close anterior sheath and skin incisions.

Note These Variations

- Type of mesh, balloon dissector, tracking device, and number of tacks used varies.
- Midline or lateral operating port placement.
- Bilateral hernias can be repaired with the use of either a single large prosthesis or two separate pieces.
- A keyhole can be precut in the mesh to accommodate the cord structures or the mesh can be left whole.

Complications

- Bladder injury
- Vascular injuries, especially the inferior epigastric artery or spermatic vessels
- Nerve injury, especially the branches of the genitofemoral nerve, lateral femoral cutaneous nerve, and femoral nerve
- Vas deferens and testicular complications
- Recurrence of hernia
- Osteitis pubis

Template Operative Dictation

Preoperative Diagnosis *Left/right/bilateral* inguinal hernia

Procedure Totally extraperitoneal laparoscopic (TEP) repair of *left/right/bilateral* inguinal hernia

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed a *symptomatic/recurrent left/right/bilateral* inguinal hernia. Repair was indicated, and, because of the *patient's age/sex/nature of the hernia/patient preference*, laparoscopic repair was elected.

Description of Procedure The patient was taken to the operating room and the side of surgery was verified. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general anesthesia, the *arm opposite the hernia site/bilateral arms* were tucked. The patient's abdomen was prepped and draped in standard sterile fashion. The skin incision for the first trocar was made just below the umbilicus. The anterior rectus sheath on the ipsilateral side of the hernia was opened and the muscle retracted laterally to expose the posterior rectus sheath. This extraperitoneal space was gently developed with blunt dissection and a balloon-tipped 10-mm trocar placed into the space, directed toward the pubic symphysis. An angled laparoscope was placed into the trocar and the balloon inflated under direct vision to create the extraperitoneal space. A 5-mm trocar was placed just below the umbilical balloon trocar site, and a second 5-mm trocar placed two fingerbreadths away from the second trocar. *Alternatively*, *two additional 5-mm trocars were placed under direct visualization in the bilateral lower quadrants*. The patient was placed in the Trendelenburg position.

The preperitoneal space was further developed by exposing the inferior epigastric vessels and keeping them anterior to the dissection plane. Cooper's ligament was dissected laterally to its junction with the iliac vein. The dissection was continued inferiorly to the iliopubic tract, with care taken to avoid injury to the femoral branch of the genitofemoral nerve and the lateral femoral cutaneous nerve. The cord structures were dissected. The direct hernia sac was identified and reduced by gentle traction.

[Choose One:]

If indirect hernias: *The indirect hernia sac was noted to be small and was easily mobilized from the cord structures and reduced into the peritoneal cavity/the indirect hernia sac was noted to be large and was therefore suture ligated and divided just distal to the internal ring leaving the distal sac* in situ *while the proximal sac was dissected away from the cord structure*.

If bilateral hernias: *The procedure was repeated on the contralateral side*.

A 10 × 12 cm piece of mesh was marked for orientation and rolled longitudinally into a compact cylinder and passed through the camera trocar. The mesh was placed along the inferior aspect of the working space and unrolled into place to completely cover the direct, indirect, and femoral spaces. The mesh was tacked into place laterally and superiorly to the iliopubic tract and inferior and medially to Cooper's ligament. *Excess mesh was trimmed and removed*.

After ensuring adequate hemostasis using electrocautery, the preperitoneal space was deflated while the mesh was held in position. The trocars were removed and the balloon deflated. The anterior rectus sheath was closed using ____. The trocar incisions were closed using ___ and dry dressings/skin adhesive were applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Laparoscopic Inguinal Hernia Repair: Transabdominal Preperitoneal (TAPP)

127

Jessica K. Smith

Indications

- Recurrent hernia
- Bilateral hernias
- Patient preference for laparoscopic repair rather than open repair

Essential Steps

1. Verify side of surgery.
2. General anesthesia.
3. Patient supine with both arms tucked.
4. Trendelenburg position, surgeon on the opposite side of table from the hernia, single video monitor at the foot of the operating table.
5. First trocar (10–12 mm) placed at the umbilicus.
6. Two additional trocars (5 mm) lateral to the rectus sheath on either side just below the level of the umbilicus. Alternatively one or both of these may be placed in the midline.
7. Angled laparoscope (*30°/45°*) provides best visualization.
8. Inspect both inguinal regions; identify:
    - The median umbilical ligament (remnant of urachus)
    - The medial umbilical ligament (obliterated umbilical artery)
    - The lateral umbilical fold (inferior epigastric artery)
9. *Divide the median umbilical ligament if necessary to improve exposure.*
10. Incise the peritoneum along a line superior to the hernia defect, extending from the anterior superior iliac spine to the median umbilical ligament.
11. Mobilize the peritoneal flap superiorly for several centimeters along the umbilical ligament.
12. Create the preperitoneal space with scissors and/or electrocautery beginning laterally and extending medially to the inferior epigastric vessels.
13. Cooper's ligament is identified and exposed medially to its junction with the femoral vein.
14. Identify the iliopubic tract.
15. Identify the cord structures and reduce any indirect or direct hernia contents.
16. *Direct hernia*: *Reduce the sac and preperitoneal fat from the hernia orifice*.
17. *Indirect hernia*: *Reduce with gentle traction. For a large sac*: *Divide the sac distal to the internal ring*, *leaving the distal sac* in situ *and dissect the proximal sac away from the cord structures*.
18. Ensure hemostasis.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_127

19. Place the mesh (at least 11×6 cm) over the myopectineal orifice and spermatic cord to completely cover the direct, indirect, and femoral spaces. The mesh may also be placed under the cord structures.
20. Fix the mesh superiorly to the abdominal wall inferiorly to the Cooper's ligament and medially to the pectineal ligament, avoiding the inferolateral edges to stay away from the triangle of pain (nerves) and the triangle of doom (vessels).
21. Excise redundant mesh.
22. Close the peritoneal flap over the mesh securing with tacks in similar positions of safety. Alternatively, endoscopic hernia clips can be used, or the peritoneal flap sutured back into position.
23. *Bilateral hernias can be repaired using one long transverse peritoneal incision extending from one anterior superior iliac spine to the other or*, *alternatively*, *with two separate peritoneal incisions preserving the peritoneum between the medial umbilical ligaments*.

Note These Variations

- Direct vs. indirect hernia.
- Sac of indirect hernia reduced or divided and left in situ.
- Bilateral hernia; can be repaired with a single large sheet of mesh or through two peritoneal incisions.
- In women, the round ligament is usually divided to complete the peritoneal flap.

Complications

- Vascular injuries, especially the inferior epigastric artery or spermatic vessels
- Nerve injury, especially the branches of the genitofemoral nerve, lateral femoral cutaneous nerve, and femoral nerve
- Vas deferens and testicular complications
- Recurrence of hernia
- Bowel injury or obstruction
- Osteitis pubis

Template Operative Dictation

Preoperative Diagnosis *Left*/*right*/*bilateral* inguinal hernia

Procedure Transabdominal preperitoneal laparoscopic (TAPP) repair of *left*/*right*/*bilateral* inguinal hernia

Postoperative Diagnosis Same

Indications This ___-year-old *male*/*female* developed a *symptomatic*/*recurrent left*/*right*/*bilateral* inguinal hernia. Repair was indicated, and because of the *patient's age*/*sex*/*nature of the hernia*/*patient preference*, laparoscopic repair was elected.

Description of Procedure The patient was taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was placed supine with arms tucked at the sides. After obtaining adequate anesthesia, the patient's abdomen was prepped and draped in standard sterile fashion. The patient was placed in the Trendelenburg position.

A Veress needle was placed at the *umbilicus*/*Palmers point* and pneumoperitoneum created with insufflation of carbon dioxide to 15 mmHg. After the Veress needle was removed, a 10-mm trocar was placed via an infraumbilical incision and the *30°*/*45°* angled laparoscope inserted. Two 5-mm trocars were then placed lateral to the rectus sheath under direct visualization. Both inguinal regions were inspected and the median umbilical ligament, medial umbilical ligament, and lateral umbilical fold were identified. The median umbilical ligament was divided sharply with electrocautery to achieve optimal exposure. The peritoneum was incised with endoscopic scissors along a line 2 cm above the superior edge of the hernia defect, extending from the median umbilical ligament to the anterior superior iliac spine. The peritoneal flap was mobilized inferiorly using blunt and sharp dissection. The inferior epigastric vessels were exposed and the pubic symphysis was identified.

Direct hernia: *The direct hernia sac was identified and reduced by gentle traction*.

Cooper's ligament was dissected to its junction with the iliac vein. The dissection was continued inferiorly to the iliopubic tract, with care taken to avoid injury to the femoral branch of the genitofemoral nerve and the lateral femoral cutaneous nerve. The cord structures were identified.

Indirect hernia: *The indirect hernia sac was noted to be small and was easily mobilized from the cord structures and reduced into the peritoneal cavity/the indirect hernia sac was noted to be large and was therefore divided just distal to the internal ring*, *leaving the distal sac* in situ, *while the proximal sac was dissected away from the cord structures*.

A large piece of mesh (*measurement*) was rolled longitudinally and passed through a trocar. It was unrolled into place to completely cover the direct, indirect, and femoral spaces. *The mesh was secured into place superiorly to the anterior abdominal wall and inferiorly and medially to Cooper*'*s/pectineal ligaments with absorbable/titanium tacks*. Care was taken to avoid the inferolateral triangles containing the iliac vessels and genital nerves. The peritoneal flap was closed over the mesh and secured with tacks in similar positions of safety. After ensuring adequate hemostasis, the trocars were removed and the pneumoperitoneum allowed deflate. The trocar incisions were closed using ___ and dry dressing/skin adhesive dressings applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Open Repair of Femoral Hernia

128

Jessemae L. Welsh

Indication

- Femoral hernia

Essential Steps

1. Verify and mark side of surgery.
2. Skin line incision *above the inguinal ligament/directly over the hernia*.
3. Develop flaps to expose the sac.
4. Reduce the hernia and open the sac if possible.
5. If not reducible:
   - *Divide the inguinal ligament cephalad to the sac, protecting the underlying cord structures.*
   - *Enlarge the femoral orifice.*
   - *Open the sac and inspect contents.*
   - *If viable, replace contents in the abdomen.*
   - *If nonviable, perform segmental bowel resection.*
6. Close the sac with suture ligature.
7. Excise the redundant sac and allow it to retract into the abdomen.
8. Close the femoral canal with mesh plug.
9. *Close defect in the inguinal ligament.*
10. Attain hemostasis.
11. Close the wound.

Note These Variations

- Femoral hernia may also be repaired through the inguinal canal (see McVay repair, Chap. 124) or via a laparoscopic totally extraperitoneal approach (Chap. 126) or laparoscopic transabdominal preperitoneal approach (Chap. 127).
- Incision directly over the hernia for small, easily reduced herniae.
- Incision over the inguinal canal allows better access and exposure.
- Type of mesh, suture, and local anesthesia used.
- Repair with autologous tissue rather than mesh is possible.
- Local anesthesia or regional block instead of general anesthesia for patients with medical comorbidities.
- Aberrant obturator artery may be encountered deep to the inguinal ligament.

Complications

- Superficial wound infection
- Hematoma
- Urinary retention

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_128

- Injury to the bowel
- Reduction of compromised/strangulated bowel into the abdomen
- Injury to the femoral vessels
- If the inguinal ligament divided: injury to the cord structures or ilioinguinal nerve or bleeding from an aberrant obturator artery
- Postoperative neuralgia/persistent groin pain
- Mesh migration or erosion
- Mesh infection
- Recurrence

Template Operative Dictation

Preoperative Diagnosis *Left/right incarcerated* femoral hernia

Procedure Repair of *left/right* femoral hernia

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* presented with *symptomatic/incarcerated left/right* femoral hernia *with/without* symptoms of obstruction. Repair is indicated.

Description of Procedure The patient was taken to the operating room and positioned supine on the operating table. All pressure points were properly padded. Preoperative antibiotic was administered.

[Choose One:]
If not local anesthesia: *General anesthesia was induced. Epidural/spinal anesthesia was administered. IV sedation with monitored anesthesia care was initiated.*

If local anesthesia: *The area of the planned surgery was infiltrated with lidocaine/bupivacaine. A total of ___ mL of 0.5%/1% lidocaine/0.25%/0.5% bupivacaine was used.*

Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The *left/right* groin was prepped and draped in the usual sterile fashion. An incision was made *over the hernia bulge/over the inguinal ligament*.

The incision was deepened through the subcutaneous tissues. Hemostasis was maintained throughout the procedure with electrocautery. *A flap was developed inferiorly to expose the hernia sac/the hernia sac was exposed*. The sac was gently dissected free of surrounding tissues. It was found to be *reducible/irreducible*.

If hernia reducible: *The sac was opened, and the hernia contents were inspected and reduced as no compromised bowel was noted. The hernia sac was suture ligated with ___. Redundant sac was excised and the sac allowed to retract into the peritoneal cavity*.

If hernia not reducible: *The inguinal ligament was divided cephalad to the femoral canal taking care to avoid injury to the underlying cord structures and ilioinguinal nerve. The hernia sac was opened and the contents inspected and found to be viable/nonviable (if nonviable, include details of segmental bowel resection). The hernia contents were reduced and the redundant sac amputated and ligated with ___.*

Note: If nonviable bowel was noted and resected, permanent mesh in the groin should be avoided, and a primary tissue/McVay repair is performed (Chap. 124).

Note: If no compromised bowel was noted, mesh may be used for a tension-free repair.

A plug of ___ mesh was fashioned in such a way as to completely fill the defect without encroaching upon the femoral vein. It was placed in the femoral canal and sutured in place with multiple interrupted sutures of ___. Care was taken to protect the femoral vessels from harm. *The inguinal ligament was then reconstructed with multiple interrupted sutures of ___, with care taken to protect the underlying cord structures and ilioinguinal nerve*.

The wound was irrigated and closed in layers with *interrupted/running* 3-0 Vicryl for Scarpa's fascia and *skin staples/running subcuticular of 4-0 Monocryl*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Open Umbilical Hernia

129

Melissa Garrett

Indications

- Umbilical hernia

Essential Steps

1. Identify defect.
2. *Local anesthesia*.
3. Semicircular *infra-*/*supra*-umbilical incision.
4. Mobilize flaps at fascial level.
5. Define and dissect the hernia sac.
6. Evaluation of sac contents for viability. In cases where there is small bowel incarceration, small bowel resection may be necessary.
7. Reduce contents.
8. Amputation of sac.
9. *Tailor mesh* (*if defect is larger than 2–3 cm and no compromised bowel noted within the sac*).
10. Check hemostasis.
11. Primary closure of fascial edges/suture mesh to fascial edges.
12. Close the subcutaneous tissue.
13. Close the skin.

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Note These Variations

- Type of suture material varies.
- Type of mesh and method of fixation.
- Type of anesthesia, including local anesthesia, varies.
- If done for acute incarceration, note findings, including viability of the bowel.

Complications

- Hematoma
- Infection
- Recurrence

Template Operative Dictation

Preoperative Diagnosis Umbilical hernia

Procedure Open umbilical hernia *with*/*without mesh*, *with local anesthesia by surgeon*

Postoperative Diagnosis Same

Indications This is a ___-year-old *male*/ *female* that developed a symptomatic umbilical hernia. Repair was indicated.

Description of Procedure The patient was taken to the operating room. Time-outs were per-

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_129

formed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

[Choose One:]

If not local anesthesia: *General/epidural/spinal anesthesia was induced.*

If local anesthesia: *A field block was produced by raising skin wheals along the proposed skin incision and deep tissues. Additional local anesthesia was injected during the procedure*, *and as needed. A total of ___mL of 0.5/1 % lidocaine was used.*

The abdomen was prepped and draped in the usual sterile fashion. A 3 cm curvilinear *supra-/infra*-umbilical incision was made and carried down through the skin and subcutaneous tissue. Bleeding points were controlled with electrocautery device. Dissection of the subcutaneous tissue revealed the *small-/moderate-/large*-sized hernia sac, which was adherent to the lower portion of the umbilicus. This was circumferentially dissected away from the fascia. The sac was opened in order to evaluate the contents. This was noted to contain *pre-peritoneal fat/small bowel* which was *viable/not viable*.

If viable: Contents were totally reduced back into the defect.

If small bowel not viable: *The section of bowel that was found not to be viable was resected with end-to-end stapled/sutured anastomosis*.

The sac was then amputated from the base of the umbilicus. Blunt finger dissection was used to clear off the under surface of the fascia.

If using mesh (***permanent mesh not advised in the setting of compromised or necrotic bowel***):

Next, a mesh (*describe size and type*) was opened *and prepared/soaked in antibiotic solution*. The mesh was then sutured to the fascial edges in an *underlay/overlay/other fashion* with __ sutures in an *interrupted/running* fashion.

If primary repair:

The fascia edges of the defect are brought together with multiple interrupted sutures of _____.

The wound was irrigated with copious amount of *saline/antibiotic solution* and then evacuated. Hemostasis was achieved. Deep subcutaneous tissue was approximated using 3-0 Vicryl in an interrupted fashion. The skin was closed using 4-0 Vicryl continuous subcuticular fashion. Steri-Strips were applied on the wound. Sterile dressings were then applied. All the instruments, sponge, and needle counts were correct.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the post-anesthesia care unit in satisfactory condition.

Ventral Hernia Repair

130

Carol E.H. Scott-Conner

Indication

- Ventral (incisional) hernia

Essential Steps

1. *Excise the old scar if necessary*.
2. Mobilize flaps at the fascial level.
3. Define and dissect the hernia sacs.
4. *Enter the peritoneal cavity and lyse adhesions/mobilize the small bowel if necessary*.
5. Identify all defects and convert into single defect.
6. Tailor mesh.
7. Suture mesh in place.
8. Fascial closure
9. *Place closed-suction drains*.
10. Check hemostasis.
11. Close the subcutaneous tissues and skin.

Note These Variations

- Excision of scar.
- Location and number of defects.
- Type of mesh and method of fixation.
- Mesh position: underlay, sublay, or overlay.
- Drain placement is optional.
- Incarcerated hernias require individualized management.

Complications

- Infection
- Recurrence
- Enterocutaneous fistula

Template Operative Dictation

Preoperative Diagnosis Ventral (incisional) hernia

Procedure Mesh repair of ventral hernia

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed a ventral hernia in the site of a previous ___ incision. This was *symptomatic/incarcerated* and repair was indicated.

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_130

prior to beginning the procedure. General anesthesia was induced. Antibiotics were administered prior to making the incision. The anterior abdominal wall was prepped and draped in the standard sterile fashion. A *vertical midline incision/other* incorporating the old incision was made. *The old scar was completely excised*. The incision was deepened to the fascia. The hernia sac was then identified and dissected free. The peritoneum of the sac was entered and the contents were reduced (*detail findings if incarcerated*). The fascia was carefully palpated and *no additional defects/additional defects* (*detail location*) were identified. *Intervening fascial bridges were cut to create a single defect* (*if multiple*).

Adhesions to the underside of the abdominal wall were lysed and the fascia was assessed. The fascial defect measured __ cm (length) x __ cm (width). A piece of ___ mesh was cut to the size of __cm (length) x __ cm (width). *The mesh was placed in an underlay/sublay/overlay/other fashion*. The fascia was closed with *running/interrupted* sutures of ___. Complete/partial fascial closure was achieved. Hemostasis was checked. *Closed suction drains were placed*. Subcutaneous tissues were closed with 3-0 Vicryl and the skin was closed with *skin staples/subcuticular sutures of ___/other*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was brought to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Peter C. Fretz, M.D., in the previous edition.

Laparoscopic Ventral Hernia Repair

131

Carol E.H. Scott-Conner

Indication

- Ventral hernia

Essential Steps

1. General anesthesia.
2. Insufflate abdomen either using Veress needle, Hasson cannula, or Optiview trocar.
3. Place initial trocar.
4. Insert laparoscope and inspect the abdomen.
5. Place additional trocars.
6. Lyse adhesions as needed.
7. Mark boundaries of the hernia defect.
8. *Perform primary fascial closure*.
9. Cut mesh to size.
10. Orient mesh with Ethibond suture outside the abdomen and then insert via a 12-mm trocar.
11. Nonadherent side of mesh toward the bowel.
12. Collapse the abdomen to pressure of 8–10 mmHg.
13. Place transfascial sutures to anchor mesh with 3–5-cm overlap on all sides of the hernia.
14. Tack mesh to abdominal wall at key points (e.g., corners).
15. Place additional transfascial sutures.
16. Tie sutures.
17. Check hemostasis.
18. Close.

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Note These Variations

- Orogastric tube
- Abdominal access: Veress needle, Hasson cannula, or Optiview trocar
- Cutting or muscle-splitting trocars
- Fascial closure followed by underlay of mesh
- Closing of trocar sites
- Type of mesh

Complications

- Injury to the bowel, bladder, or inferior epigastric vessels from trocar placement
- Mesh migration
- Mesh infection
- Hernia recurrence
- Chronic abdominal pain

Template Operative Dictation

Preoperative Diagnosis *Initial/recurrent* ventral hernia

Procedure Laparoscopic ventral hernia repair

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_131

Postoperative Diagnosis Same

Indications Patient is a ___-year-old *man/woman* who was evaluated for *an initial/recurrent* ventral hernia. *He/she* complains of (*describe symptoms*). Laparoscopic approach was chosen.

Description of Procedure The patient was brought into the operating room and placed on the table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was administered. All bony prominences were padded. Both arms were tucked. *A Foley was placed. An orogastric tube was placed*. The abdomen was prepped from the xiphoid to pubis and table to table with *chlorhexidine/Betadine/other*. The patient was draped in the usual sterile fashion. *Ioban was used*.

[Choose One:]
If Veress needle: *The fascia was elevated and the Veress needle inserted at the* (*describe location*). *Proper position was confirmed by aspiration and saline meniscus test*.

If Hasson cannula: *An incision was made at the* (*describe location*). *Dissection was carried down until the level of the fascia. The fascia was elevated and incised. Entry into the peritoneum was confirmed visually. Two figure-of-eight sutures of 2-0 Vicryl were placed and the Hasson cannula inserted under direct vision. The sutures were anchored around the cannula*.

If Optiview trocar: *An incision was made at the* (*describe location*). *The Optiview trocar was inserted into the abdominal cavity under direct visualization*.

The abdomen was insufflated with carbon dioxide to a pressure of 15 mmHg. The patient tolerated insufflation well. A ___-mm trocar was inserted. The laparoscope was inserted and the abdomen inspected. (Describe normal and abnormal findings.) Under direct visualization, additional trocars were placed in the following location: *describe locations*. There was *minimal/moderate/significant* amount of *omental/bowel adhesion* to the hernia defect. Lysis of adhesion was performed using *laparoscopic shears/other devices*. ___ *min/h* was spent performing adhesiolysis. *No serosal tear or enterotomy/describe others* was noted after adhesiolysis was completed. Examination of the abdominal wall revealed the hernia to be _____ (describe size and findings such as multiple defects).

If primary repair: *Using a GraNee needle/other*, *the hernia defect was closed with interrupted 0 Ethibond/other sutures*. ___*number of sutures were placed approximately 1 cm apart*.

Mesh repair was then performed. A Proceed/Parietex Composix mesh/other which measured ___ × ___ cm was used for repair of this ventral hernia, with a ___-cm circumferential overlap of mesh under the hernia defect. Extracorporeally, the mesh was oriented. __ 0 Ethibond sutures were placed at the four quadrants of the mesh to serve transfascial anchoring sutures. The mesh was rolled into a tight cigar-like configuration and was introduced through the right upper quadrant 12-mm port.

The mesh was unraveled and proper orientation of the mesh was maintained throughout the entire procedure, with the nonadherent hydrocellulose-coated side of the mesh facing the bowel. *The abdominal insufflation pressure was decreased to 8–10 mmHg*. After proper positioning of the mesh, a *GraNee needle/other device* was used to pull the transfascial sutures out at corresponding stab incisions.

After the transfascial sutures were tied down, the mesh was tacked using a *Tacker/AbsorbaTack/other device. Crowning was done with a second row of tacks circumferentially*. After the mesh was tacked in its entirety, ___ additional transfascial sutures were placed along the edge of the mesh in a circumferential fashion.

The abdominal cavity was inspected and the hernia repair appeared satisfactory. The trocars were removed under direct vision and the abdomen deflated. *All trocar sites greater than 5 mm were closed with* _____.

The skin was closed with 4-0 *Monocryl/Vicryl/other. Benzoin/Steri-Strips/Glue* was applied. *The port sites and transfascial suture sites were infiltrated with ___ cc of 1% lidocaine/2% lidocaine/0.25% Marcaine/other. An abdominal binder was then placed*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was brought to the PACU in stable condition.

Acknowledgment This chapter was contributed by Susan Skaff Hagen, M.D., M.S.P.H. in the previous edition.

Open Component Separation

132

John T. Heineman and W. Thomas Lawrence

Indications

- Large or complex abdominal wall defects up to 20 cm at the level of the umbilicus.
- Etiology most commonly secondary to incisional hernia, surgical open abdomen, or necrotizing abdominal wall infection.
- Associated symptoms may include abdominal pain, back strain, and lack of abdominal strength creating limitations in lifting or sitting up.
- Key indications include prevention of bowel incarceration/strangulation, inability to work, and decreased quality of life.

Essential Steps

1. Foley catheter +/− *orogastric tube* placement.
2. Create midline incision if the patient is slender and tissues are relatively normal, or excise previous midline abdominal scars if tissues are compromised or redundant.
3. Expose and enter hernia sac.
4. Lysis of adhesions to hernia sac, hernia margin, and anterior abdominal wall.
5. Excise hernia sac.
6. Explore the abdomen and measure the fascial defect.
7. Expose the external oblique fascia just lateral to the rectus sheath from the inguinal area to the costal margin. *It is best to not simply undermine the skin and subcutaneous tissues from the midline to the lateral abdominal tissues. Particularly in more obese patients, such extensive undermining is likely to create vascular compromise and tissue necrosis. One way of doing this is to create tunnels from the midline with preservation of perforators from the rectus sheath, which are more prevalent in the periumbilical area. Alternatively, the external oblique fascia may be exposed through transverse incisions in the lower abdomen or by excising the tissue from the lower abdomen if there is significant excess. Subcutaneous tunnels may then be created over the fascia at the appropriate level extending up to the costal margin.*
8. Incise the external oblique fascia just lateral to the rectus sheath from the inguinal area to the costal margin while leaving the inguinal ligament intact.
9. Bluntly dissect laterally in the plane underneath the external oblique fascia to the region of the anterior axillary line for additional advancement.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_132

10. Obtain hemostasis and close the abdominal fascia in the midline.
11. Assess peak airway +/− *bladder pressures* to evaluate for abdominal compartment syndrome.
12. Bulb suction drain placement.
13. Closure of the Scarpa's fascia, with fixation of Scarpa's fascia to the abdominal wall to limit fluid collection, and subcutaneous layers.
14. Cutaneous closure +/− *abdominal binder placement*.

Note These Variations

- Combination with excision of excess skin, scar, and subcutaneous tissue both transversely in the lower abdomen and in a vertical elliptical manner centrally in patients with significant abdominal redundancy. *Such excision of excess tissue improves exposure of the fascial defect centrally and the external oblique fascia laterally. It also often provides aesthetic and functional benefits*.
- Incision and mobilization of the posterior sheath if further advancement is required.
- Placement of the mesh intra-abdominally, within the rectus sheath, or, least desirably, above the fascia to provide additional strength to the repair.
- Placement of the mesh in the defects created laterally by the incisions in the external oblique fascia.

Complications

- Abdominal compartment syndrome
- Respiratory compromise
- Seroma/hematoma formation
- Necrosis of skin edges +/− surgical site infection
- Hernia recurrence
- Hernia at the site of lateral fascial release

Template Operative Dictation

Preoperative Diagnosis Large symptomatic ventral hernia

Procedure Open component separation

Postoperative Diagnosis Same

Indications This __-year-old *male/female* presented with a large, midline abdominal wall incisional hernia status post ___ (*surgery*) *for* ___ (*indication*). CT abdomen showed a hernia defect __ cm by __ cm that most likely cannot be closed by simple fascial approximation in the midline. The patient notes an inability to work and decreased quality of life secondary to the hernia. Component separation was recommended to restore functional and structural integrity of the abdominal wall. Written consent was obtained after a thorough discussion of the risks and indications of the procedure.

Description of Procedure The patient was placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, positioning, *implant/special equipment*, and additional critical information prior to beginning the procedure. General anesthesia was induced. A Foley catheter *and orogastric tube* were placed. The abdomen was prepped and draped in the usual sterile fashion.

A vertically oriented incision was made sharply at the midline and carried down to the underlying fascia with electrocautery. The hernia sac was identified and dissection was carried out to expose the anterior surface of the sac in its entirety. The sac was entered in a location where it was determined that the sac was free of enteric adhesions. Adhesions to the hernia sac, hernia margin, and anterior abdominal wall were lysed, and the hernia sac was resected. It was evident *he/she* had a fascial defect __ cm in length by __ cm in width that would require advancement and separation of component parts to achieve abdominal closure.

We then exposed the external oblique fascia just lateral to the rectus sheath from the inguinal area to the costal margin by creating subcutaneous tunnels from the midline in a suprafascial plane. Care was taken to limit the size of the tunnels in order to preserve blood supply to the lateral abdominal tissues. Local anesthesia was injected underneath the external oblique fascia. We then incised the fascia just lateral to the rectus sheath, which was identified by pinching the abdominal wall after it was mobilized. Fat was visualized to be protruding from the nick in the fascia. The incision was extended from the inguinal area to the costal margin. Care was taken to keep the plane of dissection above any underlying muscle that was identified. The inguinal ligament was left intact. After incising the fascia, dissection was then carried out laterally in the plane underneath the external oblique fascia to the region of the anterior axillary line to create additional advancement of the midline abdominal fascia.

We then achieved hemostasis with electrocautery. The abdominal fascia was approximated with interrupted figure-of-eight 0 __ (*nonabsorbable*) sutures. The peak airway pressures were __ prior to fascial closure and increased to __ afterwards. The patient had no issues with ventilation according to anesthesia. Closed bulb suction drains were then placed over the fascia in the midline and bilaterally in the created tunnels.

The subcutaneous tissues were approximated with interrupted 0 __ (*nonabsorbable*) sutures with fixation of the Scarpa's fascia to the abdominal wall. Interrupted 3-0 __ (*absorbable*) sutures were placed to approximate the deep dermal layers. The closure was completed with running 4-0 __ (*absorbable*) subcuticular sutures and __ (*skin adhesive*). All sponge and instrument counts were correct. Sterile dressings *and an abdominal binder* were applied.

The patient was awakened from anesthesia. A debriefing checklist was completed to share information critical to postoperative care of the patient. *He/she* tolerated the procedure well and was taken to the postanesthesia care unit in satisfactory condition.

133 Laparoscopic Component Separation

Julie L. Holihan and Mike K. Liang

Indications

- Ventral hernia too large to achieve primary fascial closure under physiologic tension without additional release
- Loss of abdominal wall domain

Essential Steps

1. Incise the skin at the upper quadrant, lateral to the semilunar line.
2. Dissect the subcutaneous tissue down to the external oblique aponeurosis.
3. Incise the external oblique aponeurosis and muscle.
4. Separate internal and external oblique muscles using a balloon dissector.
5. Exchange the dissector for a balloon trocar.
6. Incise the external oblique and Scarpa's fascia starting from 5 cm above the costal margin to the conjoint tendon using an energy device-free lateral avascular adhesions between the internal and external oblique.
7. Advance the rectus fascia medially to check if able to re-approximate the midline under physiologic tension.
8. Proceed with planned ventral hernia repair.

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Note These Variations

- If unable to re-approximate fascia even after bilateral endoscopic component separation, you may perform a bridged repair or bridge the gap with an inlay mesh.
- Mesh versus no mesh.
- Unilateral versus bilateral.
- Drain versus no drain.

Complications

- Bleeding
- Violation/injury of the internal oblique with injury to perforating nerves
- Surgical site infection
- Seroma
- Hernia recurrence
- Abdominal compartment syndrome

Template Operative Dictation

Preoperative Diagnosis Large ventral hernia/loss of domain

Procedure Laparoscopic/open ventral hernia repair with laparoscopic component separation

Postoperative Diagnosis Large ventral hernia/loss of domain

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_133

Indications This __-year-old *male/female* presented with a *primary/incisional* ventral hernia that was *__x__cm* on *CT/exam*. Ventral hernia repair with laparoscopic component separation was planned.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure. After satisfactory general anesthesia, the abdomen was prepped and draped in the usual sterile fashion. Preoperative antibiotics were given.

[Choose One:]

Laparoscopic approach: The abdomen was entered for a laparoscopic ventral hernia repair (*describe usual technique – Veress*, *optical port*, *or Hasson at Palmer's point*). Additional 5-mm ports were placed under direct visualization along the left lateral abdomen.

Open approach: *A midline incision was performed. Lysis of adhesions was performed.*

The midline defect measured __×__cm. The right and left rectus complexes could not reach the midline without undue tension. A decision was made to perform laparoscopic component separation. An incision was made in the *right/left/both* upper quadrant(s), approximately 1.5 cm below the costal margin at the anterior axillary line. The subcutaneous tissue was bluntly dissected, and the external oblique aponeurosis was incised. A balloon dissector was used to separate the internal and external oblique muscles. The balloon dissector was exchanged for a balloon trocar and the space insufflated with CO2 to a pressure of 12–15 mmHg.

Two operating trocars were inserted. A 5-mm port was inserted just superior to the inguinal ligament. Another 5-mm port was placed at the middle/posterior axillary line along the level of the umbilicus.

Under direct visualization, the space between the internal and external oblique muscles was further developed with blunt dissection.

Approximately *1–2 cm* lateral to the linea semilunaris, the external oblique aponeurosis was incised starting from __ *cm* above the costal margin to the inguinal ligament using an energy device. This allowed *the rectus complex to reach the midline* without undue tension.

[Choose One for Repair of the Midline Hernia Defect:]

If laparoscopic underlay of mesh: *A __x__ cm mesh with four 0-PDS sutures placed in the corners was inserted. The fascial defect was closed with interrupted __ sutures every 1 cm using the GraNee® Needle/Carter-Thomason® Suture Passer. A double crown of titanium/absorbable tacks was placed to further fixate the mesh.*

If open underlay of mesh: A __ (size) mesh was brought into the field and placed in the intraperitoneal position. It was secured in place with multiple __ transfascial sutures. The fascial defect was then closed over the mesh with a __ suture.

If open sublay mesh: The retro-rectus space was entered. The posterior rectus sheath was closed using running suture. A __ (size and type) mesh was placed in the retro-rectus position. The mesh was secured with transfascial sutures. The anterior rectus sheath was closed using running suture.

If open onlay mesh: The skin and subcutaneous tissue were dissected off of the anterior rectus fascia. The fascial defect was closed using running suture. A __ (size and type) mesh was placed over the anterior rectus sheath in an onlay position. The mesh was secured to the fascia with running interrupted sutures.

If bridged repair: The rectus complex was still unable to reach the midline after laparoscopic component separation, so a bridged repair was performed. A __ (size and type) mesh was secured to the either side of the defect using transfascial sutures.

If drain: Drain was placed in the ___ space.

The excess skin and subcutaneous tissue were excised. The skin and soft tissue were closed in layers (*describe*). Sterile dressing was applied to the closed skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated, and was transferred to the postanesthesia care unit in stable condition.

134 Transversus Abdominis Release

Julie L. Holihan and Mike K. Liang

Indications

- Ventral hernia too large to achieve primary fascial closure without additional release
- Loss of abdominal wall domain
- Off-midline defects
- Need for greater mesh overlap in the retro-rectus space

Essential Steps

1. Midline incision.
2. *Lysis of adhesions*.
3. Excise hernia sac.
4. Enter the retro-rectus space to expose the transversus abdominis muscle near the linea semilunaris.
5. Divide the transverse abdominis medial to perforating nerves and blood supply to the rectus.
6. Advance posterior rectus sheath medially.
7. Close posterior rectus sheath.
8. *Place mesh in a sublay (retro-rectus) position*.
9. *Secure mesh with transfascial sutures*.
10. Close anterior rectus sheath with running suture.
11. Close the skin in the usual fashion.

Note These Variations

- If unable to reapproximate fascia even after transversus abdominis release, bridge the gap with a small inlay of biologic or absorbable mesh.
- Unilateral versus bilateral.
- Drain versus no drain.

Complications

- Bleeding
- Violation of the transversalis fascia and peritoneum
- Violation/injury of the internal oblique
- Injury to perforating nerves and blood supply
- Surgical site infection
- Seroma
- Hernia recurrence
- Abdominal compartment syndrome

Template Operative Dictation

Preoperative Diagnosis Large ventral hernia/loss of domain

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_134

Procedure Open ventral hernia repair with posterior component separation/transversus abdominis release

Postoperative Diagnosis Large ventral hernia/loss of domain

Indications This __-year-old *male/female* presented with a *primary/incisional* ventral hernia that was *__x__cm* on *CT/exam*. Open ventral hernia repair was planned.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure. After satisfactory general anesthesia, pressure points were padded and a Foley catheter placed. The abdomen was prepped and draped in the usual sterile fashion. Preoperative antibiotics were given.

A vertical midline incision was made. Lysis of adhesions was performed. The hernia sac was excised to expose fascial edges. The right and left rectus complexes could not be approximated in the midline without excessive tension. The retro-rectus space was entered to expose the transversus abdominis muscle near the linea semilunaris on the *right/left/both sides*. The transversus abdominis was divided to create lateral myofascial flaps on the *right/left/both sides*. The posterior rectus fascia was medialized, and the fascia was reapproximated under physiologic tension.

If mesh: The posterior rectus sheath was closed with running suture (*describe type*). A __x__ cm mesh (*describe type*) was placed in the retro-rectus position. The mesh was secured with transfascial sutures (*describe number and type*).

If bridged repair: The rectus complex was still unable to reach the midline after bilateral transverse abdominis release, so an inlay of absorbable mesh (*describe type*) was placed. The mesh was secured to the either side of the defect using with a running suture (*describe type*).

If drain: A __ Fr __drain was placed on the *right/left/both sides in* the ___ *space*.

The excess skin and subcutaneous tissue were excised to prevent wound complication. The anterior rectus sheath was closed with a running __ suture. The wound was copiously irrigated. The skin was closed with *staples/others*. Sterile dressing was applied to wound.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated, and was transferred to the postanesthesia care unit in stable condition.

Open Retro-rectus Repair of Hernia

135

Amir M. Alhajjat and Luis Garcia

Indications

- Primary or recurrent ventral hernia

Essential Steps

1. Consider mechanical and antibiotic bowel prep. If the patient with history of MRSA, they should get vancomycin preoperatively.
2. All patients should get universal MRSA decontamination with mupirocin nasal ointment and chlorhexidine showers for 5 days prior to surgery.
3. Safe entry into the abdomen.
4. Lysis of adhesions to free the anterior abdominal wall. Perform complete adhesiolysis if the patient has obstructive symptoms.
5. Develop minimal subcutaneous flaps, no more than 1–2 cm.
6. Define and excise hernia sac.
7. Open rectus fascia and define plane between rectus muscle and posterior rectus sheath. Avoid blunt dissection, and dissection with cautery is ideal to avoid bleeding. Carry retro-rectus dissection to the linea semilunaris.
8. Close posterior rectus sheath. If below the arcuate line, then you will be closing only the peritoneum and transversalis fascia.
9. Fashion mesh and lay onto posterior rectus sheath.
10. Fix mesh to rectus sheath using transfascial sutures.
11. Place drains.

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Variations

- Type and size of mesh, permanent mesh versus biologic mesh
- Different fixation methods and suture material
- Component separation
- Drain placement
- May consider keeping patient on antibiotic while drains in place

Complications

- Wound infection
- Mesh infection
- Seroma/hematoma formation
- Hernia recurrence

Template Operative Dictation

Preoperative Diagnosis Recurrent ventral hernia

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_135

Procedure Retro-rectus ventral hernia repair with mesh

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *male/female* presented to our care with a primary/recurrent *symptomatic/incarcerated* ventral hernia. This was thus indicated for repair.

Description of Procedure The patient was brought to the operating room and laid supine on the operating table. Time-outs were performed using both preinduction and pre-incision safety checklist to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure. Appropriate cardiopulmonary monitors were placed after which general endotracheal anesthesia was induced without difficulty. An OG and Foley catheter were placed. The abdomen was then prepped and draped in standard sterile fashion.

A midline incision was made. The incision was carried down the subcutaneous tissue and fascia with electrocautery. The peritoneum was then grasped and opened sharply.

Upon entering the peritoneal cavity, we encountered *mild/moderate/extensive* amount of omental and small bowel adhesions to the anterior abdominal wall. These were meticulously taken down with Metzenbaum scissors and electrocautery. *If serosal tear or enterotomies occurred, describe how they were repaired*. The hernia sac was then excised and the midline fascia exposed.

Two to three centimeter of subcutaneous flaps was raised circumferentially. Perforators were *spared/tied in between silk sutures*. We then proceeded with identifying and isolating the posterior rectus sheath. The rectus fascia was opened and a fascial plane developed between the rectus muscle and the posterior rectus sheath to the level of the linea semilunaris. Six to eight interrupted trans-fixating U-stitches were then placed in the posterior rectus sheath circumferentially for fixation of mesh. The posterior fascia was closed with a continuous *0/1 absorbable* suture. (Alternatively, closure with multiple figure of eight *0/1 absorbable* stitches can also be done.)

A (*mention the size and type of mesh*) was brought into the field and laid flat in the retro-rectus plane. The mesh covered the defect and overlapped 4–5 cm in excess of the defect. The mesh was then fixed with the circumferential trans-fixating suture that was previously placed in the posterior rectus sheath. A 10 Fr round Blake drain was then laid anterior to the mesh and bought out the skin through a separate stab incision. The anterior rectus sheath was then closed with *0/1 nonabsorbable/absorbable* suture in figure-of-eight fashion. Two 19 Fr Blake drains were also placed underneath the subcutaneous flaps and brought out through separate stab incisions. All drains were stitched in place. Scarpa fascia was closed with 3-0 Vicryl and the skin was closed with 4-0 monocryl.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated in the OR and transferred to the postanesthesia care unit in good condition.

Part XI

General Surgery: Breast

Excision of Ducts

136

Brittany E. Splittgerber and Ingrid Lizarraga

Indications

- Nipple discharge, suspicion of intraductal papilloma
- Mammary fistula

Essential Steps

1. Confirm side of surgery!
2. Cannulate the draining duct with a *lacrimal duct probe/0 Prolene*.
3. Identify the quadrant to which the probe passes.
4. *Circumareolar incision over that quadrant/radially oriented incision including the fistula site*.
5. Elevate flaps.
6. Excise the duct distally to termination on the nipple, proximally as far as possible.
7. Orient the specimen.
8. Achieve hemostasis in the cavity.
9. Close the subcutaneous tissue with interrupted 3-0 Vicryl.
10. Close the skin with subcuticular sutures.

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Note These Variations

- Total ductal excision is sometimes needed.
- When performed for subareolar abscess, use radial incision (including the skin over the fistula site). Leave the tract open if purulence is encountered.
- If the drainage is scant or difficult to elicit in the clinic, have the patient apply skin glue to the nipple 5 days prior to surgery. This can help to dilate the duct and make it easier to identify intraoperatively. The glue can be carefully peeled off in the operating room.

Complications

- Hematoma
- Infection
- Missed lesion
- Recurrence

Template Operative Dictation

Preoperative Diagnosis *Right/left* nipple discharge

Procedure *Right/left* ductal excision

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_136

Indications This ___-year-old *female/male* with *persistent nipple discharge/mammary fistula* underwent workup with *ultrasound/mammogram/cytology*. These showed ___ and ductal excision was recommended for *management/diagnosis*.

Description of Procedure The patient was taken to the operating room and placed supine on the operating table and *general anesthesia was induced/sedation was given*. A time-out was completed verifying correct patient, procedure, site, positioning, and implant(s) and/or special equipment prior to beginning this procedure. The *right/left* chest and axilla were prepped and draped in the usual sterile fashion. A lacrimal duct probe was used to cannulate the draining duct at the __ o'clock location on the nipple. The relevant quadrant was identified *and 1% lidocaine without epinephrine was used to infiltrate the region*. A *circumareolar/radially oriented* incision was made and flaps were elevated. Using the lacrimal duct probe as a guide, the involved duct was excised sharply from its termination on the nipple with a wedge-shaped portion of the proximal breast tissue. The specimen was oriented and sent to pathology. *Additional local anesthesia was infiltrated as needed throughout the case and a total of___ mL of 1% lidocaine was used.*

The wound was irrigated and hemostasis was achieved with electrocautery and suture ligatures of 3-0 Vicryl. The subcutaneous tissue immediately under the skin was approximated with interrupted 3-0 Vicryl sutures. *No attempt was made to close the dead space. The breast tissue was approximated with 3-0 Vicryl. The skin was closed with a subcuticular suture of running ___/packed open with* ____. A dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Carol E.H. Scott-Conner, M.D., in the previous edition.

Breast Biopsy

137

Jessemae L. Welsh and Lillian M. Erdahl

Indication

- Palpable breast mass with the need for removal/definitive diagnosis

Essential Steps

1. Confirm if mass is palpable and mark preoperatively.
2. Confirm side of surgery.
3. Local anesthesia.
4. Incision.
5. Mobilize flaps.
6. Confirm palpable mass.
7. If incisional biopsy:
    - *Remove a generous wedge of tissue using scalpel*.

    If excisional biopsy:
    - *Remove the palpable mass with narrow rim of surrounding normal breast tissue*.
    - *Palpate the cavity for remaining/additional abnormalities*; *send additional tissue if necessary*.
8. Achieve hemostasis in the cavity.
9. Close subcutaneous tissue.
10. Close the skin.

Note These Variations

- Site of incision: *circumareolar/skin crease/radial*
- Incisional vs. excisional biopsy
- Frozen section
- Additional tissue submitted

Complications

- Hematoma
- Infection
- Missed lesion
- Need for reoperation to achieve satisfactory margins if malignant
- Nipple necrosis
- Breast lymphedema

Template Operative Dictation

Preoperative Diagnosis *Right/left* breast mass

Procedure *Right/left incisional/excisional* biopsy

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_137

Indications This ___-year-old *female/male* with a palpable *right/left* breast mass underwent workup with *ultrasound/mammogram/MRI/percutaneous biopsy*. This showed___ and *excisional/incisional biopsy was recommended for definitive diagnosis/treatment*.

Description of Procedure The patient was taken to the operating room, properly identified, and placed supine on the operating table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure.

After adequate sedation, the *right/left* chest and axilla were prepped and draped in the usual sterile fashion. *Preoperative antibiotics were administered*.

A *circumareolar skin incision/skin crease incision/radial incision* was planned adjacent to the palpable mass. Local anesthesia was infiltrated, and a skin incision was made. Additional local anesthesia was infiltrated as needed throughout the case and a total of ___ mL of *1% lidocaine/0.25% bupivacaine* was used. *An ellipse of the skin was excised overlying the mass*. Flaps were raised, and the location of the mass was confirmed by palpation. *A 2-0 silk figure-of-eight stay suture was placed in the mass and used to retract/an Allis clamp was gently placed on the mass and used to retract/gentle traction was achieved by placing a sponge over the mass*.

[Choose One:]

If incisional biopsy (**rarely indicated**): *A generous wedge was cut from the mass using sharp dissection and submitted for pathologic examination*.

If excisional biopsy: *The mass was dissected from surrounding tissues using scalpel/electrocautery. The use of electrocautery was avoided on the specimen. The mass was oriented with sutures/markers/ink and submitted to pathology. After removing the mass, the cavity was palpated and no additional abnormalities/an additional firm area was palpated. This additional area was similarly excised and submitted separately with orientation. Clips were/were not placed to mark the biopsy cavity*.

Hemostasis was achieved with electrocautery and suture ligatures of 3-0 Vicryl. *The deep breast tissue was reapproximated with figure-of-eight 2-0 Vicryl sutures*. The subcutaneous tissue immediately under the skin was approximated with interrupted 3-0 Vicryl sutures. *No attempt was made to close the dead space*. The skin was closed with 3-0 Vicryl deep dermal sutures and a subcuticular suture of running ___. A dressing was applied, and surgical bra was placed.

All sponge, needle, and instrument counts were reported to be correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Carol E. H. Scott-Conner, M.D., Ph.D., in the second edition.

138 Breast Ultrasound-Guided Core Biopsy or Cyst Aspiration

Anjali R. Thawani

Indications

- Abnormal ultrasound with the need for biopsy or aspiration
- Palpable mass with the need for biopsy or aspiration
  - Ultrasound used to increase precision

Essential Steps

1. Preoperative time-out and confirmation of surgical site.
2. Prep and drape patient and ultrasound probe.
3. Local anesthesia.
4. Localize mass with ultrasound probe.
5. Advance needle into mass/cyst.
6. Biopsy/aspirate mass.
7. *If biopsy*: *Place clip*.
8. Hold pressure over biopsy site.
9. *If biopsy*: *Close skin entry site with Steri-Strips/single interrupted suture*.

Note These Variations

- Core needle biopsy vs. cyst aspiration
- Type of biopsy device used
- Type of clip placed
- Method of skin closure if biopsy performed

Complications

- Bleeding
- Hematoma
- Infection
- Missed lesion
- Pneumothorax (rare)

Template Operative Dictation

Preoperative Diagnosis *Right/left* breast mass/cyst

Procedure *Right/left* breast ultrasound-guided *core needle biopsy/cyst aspiration. Placement of clip*

Postoperative Diagnosis Same

Indications This is a ____-year-old *female/male* with a suspicious breast mass identified by *ultrasound/palpation. Biopsy/aspiration* of mass was indicated for diagnosis of mass. *If palpable mass*: *Ultrasound was used to increase accuracy. Clip was placed to mark the location of the mass*.

Description of Procedure The patient was placed supine on the exam room table with the arm raised

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_138

above the head. Time-outs were performed using both preinduction and pre-incision safety checklist to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient and ultrasound probe were then prepped and draped in the usual sterile fashion. Local anesthesia (____ ml of *1% lidocaine with epinephrine/other*) was infiltrated into the overlying skin and region around the mass. The mass was identified on ultrasound. It was located in the *right/left* breast at ____ o'clock _____ cm from the *nipple/areolar border*. It was *isoechoic/hypoechoic/anechoic/other*, had *smooth/microlobulated/irregular* margins, and measured ____ cm by _____ cm by _____ cm. *It corresponded to the palpable abnormality/the previously noted imaging abnormality*. It exhibited *posterior enhancement/posterior shadowing/other*.

[Choose One:]

If core needle biopsy**:** *A lateral-to-medial/other approach was chosen. A skin entry site was identified and a nick made in the skin with a #11 blade scalpel. The ____ automated biopsy needle was advanced to the edge of the mass under ultrasound guidance*, *and the automated core biopsy needle was fired. Multiple samples were taken and submitted for pathology in formalin. A ____ clip was then advanced into the mass and deployed in the center of the mass under ultrasound guidance*.

If cyst aspiration: *Using a 22 gauge needle the needle was advanced into the cyst. The contents of the cyst were aspirated*. There was return *of ____cc's of bloody/straw colored/purulent/other fluid*. This fluid *was/was not* sent for cytology.

The needle was withdrawn. Pressure was held over the biopsy site and hemostasis was ensured. *If biopsy*: *The skin incision was closed with Steri-Strips/with a single interrupted suture of* _____.

A sterile dressing was applied over the wound. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well.

Acknowledgment This chapter was contributed by Kevin A. Bridge, M.D., MSPH, in the previous edition.

Needle-Localized Breast Biopsy

139

Megan G. Groff and Sonia Sugg

Indications

- Abnormal mammogram (nonpalpable lesion) not amenable to image-directed core biopsy
- Also used (as a lumpectomy) for excision of core biopsy-proven malignant and lesions of uncertain malignant potential
  - Invasive breast cancer or ductal carcinoma in situ
  - Lesions that have a significant risk of upgrading to a malignant diagnosis such as ADH (atypical ductal hyperplasia)
  - Possible discordant core biopsy

Essential Steps

1. Confirm side of surgery.
2. Preoperative localizing wire placed under mammographic or ultrasound guidance.
3. Check localizing studies and estimate trajectory of wire and location of mass.
4. *Local/general* anesthesia.
5. *Circumareolar incision/incision over mass/incision midway between mass and needle entry site into the skin.*
6. Develop flaps.
7. Deliver wire into the operative field.
8. Place traction stitch.
9. Carefully remove the mass of the tissue around the wire and the tip of the wire.
10. *If methylene blue was injected by mammography, keep the dissection plane away from blue-stained tissues.*
11. Orient the specimen.
12. Send to radiology for confirmation.
13. Attain hemostasis.
14. After receiving confirmation, close the wound.

Note These Variations

- Location of incision, type of wire
- Use of methylene blue

Complications

- Missed lesion
- Incomplete excision
- Wire broken/transected during dissection, unable to retrieve
- Hematoma

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_139

Template Operative Dictation

Preoperative Diagnosis *Right/left* breast mammographic abnormality

Procedure *Right/left* needle-localized breast biopsy

Postoperative Diagnosis Same

Indications This ___-year-old *female/male* with *a nonpalpable right/left breast mass noted on mammography requires needle-localized biopsy for evaluation and treatment/core biopsy demonstrating ____, therefore is undergoing needle-localized lumpectomy for treatment*.

Description of Procedure Preoperative needle localization was performed by radiology. Localization studies were reviewed. The patient was taken to the operating room and placed supine on the operating table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After adequate sedation, the *right/left* chest and axilla were prepped and draped in the usual sterile fashion.

By comparing the localization studies with the direction and skin entry site of the needle, the probable trajectory and location of the mass was visualized. A *circumareolar skin incision/skin crease incision/transverse incision* was planned in such a way as to minimize the amount of dissection to reach the mass.

Local anesthesia was infiltrated and the skin incision was made. *Additional local anesthesia was infiltrated as needed throughout the case, and a total of ___ mL of 1% lidocaine/1:1 mixture of 0.5% Marcaine and 1% lidocaine was used*. Flaps were raised and the location of the wire confirmed. The wire was delivered into the wound. *A 2-0 silk figure-of-eight stay suture was placed around the wire and used for retraction*. Dissection was then taken down circumferentially, taking care to include the entire localizing needle and a wide margin of the grossly normal tissue. *No methylene blue was encountered*.

The specimen and entire localizing wire were removed. The specimen was oriented and sent to radiology with the localization studies. *Confirmation was received that the entire target lesion had been resected/radiograph revealed close margins*.

[If additional margins were taken]: *Additional margins were/were not taken. ___ additional margins were taken superiorly/inferiorly/medially/laterally/superficially and deep to the lumpectomy cavity and oriented appropriately*. Hemostasis was achieved. The wound was irrigated. Medium clips *were/were not* placed to mark the cavity. *The cavity was not closed/closed in a complex, layered fashion to maintain the contour of the breast*. The skin was closed with interrupted deep dermal sutures of 3-0 *Vicryl/Polysorb* and a subcuticular suture of 4-0 *Monocryl/Biosyn*. A dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in a stable condition.

Acknowledgment This chapter was contributed by Abdi Ahari, M.D., in the previous edition.

Lumpectomy (Partial Mastectomy) 140

Anna Beck and Ingrid Lizarraga

Indications

- Invasive breast cancer with tumor small enough relative to the breast to allow resection with negative margins and acceptable cosmesis
- Localized ductal carcinoma in situ and pleomorphic lobular carcinoma in situ (similar relative size considerations apply)
- No contraindications to postoperative radiation therapy (if indicated as part of the planned treatment of the cancer or in situ lesion)

Essential Steps

1. Mark palpable lesion preoperatively. Ultrasound can be used as an adjunct to improve precision of marking. If not palpable, localize with preoperative stereotactic or ultrasound-guided wire placement.
2. General anesthesia.
3. Prep and drape the involved breast.
4. *If palpable mass*:
   - (a) Circumlinear/radial incision over mass with local anesthetic prior to incision.
   - (b) Develop flaps. Flap thickness should depend on the depth of the lesion.
   - (c) Resect palpable mass with margins intact. Extend resection to include the pectoralis fascia if appropriate.
   - (d) Orient the specimen.
   - (e) Send for pathology.
   - (f) Identify that no additional masses are palpable.
   - (g) Consider taking additional margins if close on palpation on original specimen.
5. *If needle-localized lumpectomy*:
   - (a) Review localizing radiography and estimate trajectory of the wire, location of wire tip, and mass.
   - (b) Circumlinear/radial incision over the estimated location of the target lesion with local anesthetic prior to incision.
   - (c) Develop flaps.
   - (d) Deliver wire into operative field.
   - (e) Resect tissue around wire, including mass and appropriate margins.
   - (f) Orient the specimen.
   - (g) Send to radiology for confirmation of complete lesion resection and removal of the localizing clip, if one is present.
   - (h) Re-excision of margins if margins are close on radiology.
   - (i) Send for pathology.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_140

6. Obtain hemostasis using pressure and electrocautery.
7. Place clips within the lumpectomy cavity as markers for radiation planning.
8. Close the surgical defect in cosmetic fashion.

Note These Variations

- Localization may also be performed utilizing radioactive seed (or other small signal emitting marker placed within the lesion) preoperatively.
- Ultrasound-guided lumpectomy is discussed in Chap. 141.
- Consideration can be given to routine excision of additional margins during lumpectomy instead of selective margins based on specimen imaging or palpation.
- Ultrasound can be used intraoperatively to guide the extent of resection.
- If the lesion is very superficial/involves the skin, it may be necessary to excise an ellipse of the skin with the specimen.
- With re-excision in the setting of re-excision of biopsy or positive lumpectomy margins, open prior incision (may excise old scar), enter the lumpectomy cavity, and resect the margins of concern around biopsy cavity based on the pathology report of the original lumpectomy.
- Lumpectomy may be followed by sentinel lymph node biopsy/axillary dissection.
- Multiple lumpectomies can be performed on the same breast if tumor locations and tumor/breast size are favorable. Oncoplastic closure of a single large lumpectomy can be performed as well, usually with contralateral reduction for symmetry.

Complications

- Failure to resect entire lesion on lumpectomy (positive margins)
- Poor cosmetic outcome
- Hematoma
- Seroma
- Infection
- Nerve injury

Template Operative Dictation

Preoperative Diagnosis Invasive carcinoma of *right/left* breast/ductal carcinoma in situ/pleomorphic lobular carcinoma in situ of the *right/left* breast

Procedure *Right/left lumpectomy/partial mastectomy*, *palpation/needle localized*

Postoperative Diagnosis Carcinoma of the *right/left* breast (as above)

Indications The patient is a ___ -year-old *female/male* recently diagnosed with *invasive ductal carcinoma/invasive lobular carcinoma/other* of the *right/left* breast after *abnormal mammogram/identifying breast lump*. Diagnosis was confirmed with *fine needle aspiration/core needle biopsy*. The diagnosis and treatment options, risks, and benefits were discussed with the patient. *She/he* elected to proceed with breast-conserving therapy followed by radiation therapy.

Description of the Procedure The patient was brought back to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure. After general anesthesia was induced, the patient's *right/left* breast was prepped and draped in usual sterile fashion.

[Choose One:]

- ***If palpable mass***: A *curvilinear/radial* incision was marked overlying the palpable mass, ___ cc of local *anesthetic* was administered, and an incision was made. Skin flaps were raised. The palpable mass was identified and resected with appropriate margins using electrocautery. The mass was oriented and sent for pathology. No additional masses were palpated.
- ***If needle-localized lumpectomy***: After reviewing the localizing radiography and estimating the trajectory of the wire, a *curvilinear/radial* incision was marked over the estimated location of the lesion.___ cc of

local *anesthetic* was administered and an incision was made. Flaps were developed using electrocautery and the wire was delivered into the wound. Dissection was then taken down circumferentially, maintaining a gross 1 cm margin of normal breast tissue to include the entire localizing needle. The specimen and localizing needle were removed, oriented, and sent to radiology. Confirmation of resection of entire mass was obtained.

The resection *was/was not* taken down to the pectoralis fascia. The wound was irrigated. Meticulous hemostasis was obtained using pressure and electrocautery. Medium clips were placed in the lumpectomy cavity. The wound was closed in cosmetic fashion with single interrupted ____ sutures, and the skin was approximated with a subcuticular ____ stitch. A temporary dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was then extubated and taken to the postanesthesia care unit in stable condition. *She/he* tolerated the procedure well without complication.

Ultrasound-Guided Lumpectomy 141

Megan G. Groff and Sonia Sugg

Indications

Excision of core biopsy-proven malignant and lesions of uncertain malignant potential that are visible on surgeon performed ultrasound.

- Invasive breast cancer or ductal carcinoma in situ.
- Lesions that have a significant risk of upgrading to a malignant diagnosis such as ADH (atypical ductal hyperplasia).
- Possible discordant core biopsy.

Essential Steps

1. Confirm side of surgery.
2. *Local/general* anesthesia.
3. Position patient, localize lesion under ultrasound guidance and mark location (on skin, or with wire or needle).
4. *Circumareolar incision/incision over mass*
5. Develop flaps.
6. Carefully remove the mass of tissue around the imaged lesion.
7. Orient the specimen.
8. Send to radiology and/or ultrasound the specimen for confirmation.
9. Attain hemostasis.
10. After receiving confirmation, close the wound.

Note These Variations

- Location of incision
- Ultrasound of visible mass or visible clip
- Use of wire or needle to localize

Complications

- Missed lesion.
- Incomplete excision.
- Hematoma.

Template Operative Dictation

Preoperative Diagnosis *Right/left* breast *ultrasonic* abnormality.

Procedure *Right/left* ultrasound-guided lumpectomy.

Postoperative Diagnosis Same.

Indications This ___-year-old *female/male* with a non-palpable *right/left* breast mass noted on

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_141

mammography and ultrasound with a core biopsy demonstrating ____ requires ultrasound-guided lumpectomy for treatment.

Description of Procedure Preoperative ultrasound localization was performed by this surgeon prior to the procedure. The patient was taken to the operating room and placed supine on the operating table. Timeouts were performed using both pre-induction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After *adequate sedation/general anesthesia*, the *right/left* chest and axilla were prepped and draped in the usual sterile fashion.

The mass was localized at the ___ o'clock position, ___ cm from the nipple using ultrasound. A *circumareolar skin incision/skin crease incision/transverse incision* was planned in such a way as to minimize the amount of dissection to reach the mass.

Local anesthesia was infiltrated and the skin incision was made. *Additional local anesthesia was infiltrated as needed throughout the case and a total of ___ mL of 1% lidocaine/1:1 mixture of 0.5% Marcaine and 1% Lidocaine was used*. Flaps were raised and the location of mass was once again confirmed by ultrasound. The mass was delivered into the wound. Dissection was then taken down circumferentially, taking care to include a margin of grossly normal tissue.

The specimen was removed and confirmed with ultrasound. The specimen was oriented and sent to radiology. *Confirmation was received that the entire target lesion had been resected/radiograph revealed close margins. Additional margins were/were not taken*. [***If additional margins were taken***]: ___ *additional margins were taken superiorly/inferiorly/medially/laterally/superficially and deep to the lumpectomy cavity and oriented appropriately*. Hemostasis was achieved. The wound was irrigated. Medium clips *were/were not* placed to mark the cavity. *The cavity was not closed/closed in a complex, layered fashion to maintain the contour of the breast*. The skin was closed with interrupted deep dermal sutures of 3-0 *Vicryl/Polysorb* and a subcuticular suture of 4-0 *Monocryl/Biosyn*. A dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the post anesthesia care unit in a stable condition.

Acknowledgment This chapter was contributed by Abdi Ahari, M.D. in the previous edition.

Total Simple Mastectomy

142

Brittany E. Splittgerber and Ingrid Lizarraga

Indications

- Ductal carcinoma in situ (DCIS) or invasive breast cancer *not amenable to breast conservation/patient elects mastectomy*.
- Prophylaxis of carcinoma in selected high-risk women.

Essential Steps

1. Confirm side of surgery!
2. *Elliptical incision encompassing nipple–areola complex and biopsy scar/skin over the tumor*. Raise flaps in avascular plane between subcutaneous tissue and breast tissue:
   - Superiorly to the clavicle
   - Medially to the sternum
   - Inferiorly to the anterior rectus sheath
   - Laterally just beyond the pectoralis major muscle
3. Remove breast tissue from cranial to caudal. The pectoralis fascia is removed with the specimen, except in prophylactic surgery when it can be preserved.
4. Attain hemostasis.
5. Place closed suction drain(s).
6. Close the wound.

Note These Variations

- Sentinel node biopsy is done with mastectomy for DCIS/invasive cancer and can be performed through the same incision.
- Alternate incision patterns can be used for tumors located remote from the nipple.
- Skin-sparing mastectomy (Chap. 143) uses small, specially tailored incisions.
- Immediate reconstruction with implants or autogenous tissue, usually done in conjunction with skin-/nipple-sparing mastectomy.
- Prophylactic mastectomy commonly a bilateral procedure.

Complications

- Recurrence
- Seroma
- Nerve injury
- Skin slough/full-thickness flap necrosis

Template Operative Dictation

Preoperative Diagnosis *Ductal carcinoma* in situ/*invasive cancer/carcinoma prophylaxis* of the *right/left breast*

Procedure *Right/left* simple mastectomy

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_142

Indications *This ___-year-old female/male developed a breast lump/had an abnormal mammogram that on biopsy was found to be breast cancer*. **If prophylactic mastectomy**: *This ___-year-old female was known to be at significantly increased risk of breast cancer due to BRCA1/2 mutation/other*. After discussion of alternatives, the patient elected simple mastectomy *with immediate reconstruction*.

Description of Procedure The patient was brought to the operating room and general anesthesia was induced. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The breast, chest wall, axilla, and upper arm and neck were prepped and draped in the usual sterile fashion.

A transverse elliptical skin incision was made that encompassed the nipple–areola complex and the previous biopsy scar/skin over the tumor. Flaps were raised in the avascular plane between subcutaneous tissue and breast tissue from the clavicle superiorly, the sternum medially, the anterior rectus sheath inferiorly, and the anterior border of the latissimus dorsi muscle laterally. Hemostasis was achieved in the flaps. Next, the breast tissue was excised from the pectoralis major muscle, *preserving/not preserving* the pectoralis fascia. At the lateral border of the pectoralis major muscle, the breast tissue was swung laterally and a lateral pedicle identified where breast tissue gave way to fat of the axilla. The lateral pedicle was incised and the specimen removed and oriented.

Add dictation for sentinel node biopsy, *if performed* (Chap. 146).

The wound was irrigated and hemostasis was achieved.

[Choose One:]

If immediate reconstruction: *At this point the plastic surgical team took over to perform the reconstruction. A separate operative note will be dictated for that portion of the surgery*.

If no immediate reconstruction**:** *A closed suction drain was/closed suction drains were brought into the operative field through a separate stab incision and sutured to the skin with a 3-0 nylon suture. The wound was closed with interrupted 3-0 Vicryl to the subcutaneous layer*, *followed by a subcuticular layer of ___. The wound was dressed*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Michael C. Fraterelli, M.D., in the previous edition.

143 Skin-Sparing Total Mastectomy

Megan G. Groff and Sonia Sugg

Indications

- Ductal carcinoma in situ (DCIS) not amenable to breast conservation or patient requesting mastectomy, to be followed with reconstruction
- Breast cancer treatment in selected patients, to be followed with reconstruction
- Prophylaxis of carcinoma in select high-risk patients, to be followed with reconstruction

Essential Steps

1. Confirm side of surgery.
2. *Sentinel lymph node* (*SLN*) *biopsy if indicated for staging of the axilla*.
3. *Circumareolar skin incision or incision tailored to geometry of tumor*.
4. Develop skin flaps.
5. Dissect breast from chest wall.
6. Hemostasis.
7. Orient specimen for pathology.
8. Irrigate and pack wounds for hemostasis prior to reconstruction.

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Note These Variations

- SLN biopsy if patient has invasive or noninvasive carcinoma.
- Incision is tailored to allow maximum skin salvage but to excise scar from previous biopsy (if needed).
- Prophylactic mastectomy is commonly bilateral.
- Nipple-sparing mastectomy being offered in some centers.

Complications

- Skin necrosis
- Wound infection
- Seroma

Template Operative Dictation

Preoperative Diagnosis *Invasive carcinoma/dcis/prophylaxis* of the *left/right/bilateral* breast(s)

Procedure *Left/right/bilateral* skin-sparing mastectomy

Postoperative Diagnosis Same

Indications **If DCIS/invasive carcinoma**: This ___-year-old *female* with a *left/right breast*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_143

mass/abnormality on mammogram that on workup with fine-needle aspiration/biopsy was found to be ductal carcinoma in situ/*invasive carcinoma*. **If prophylactic**: This ___-year-old *female was known to be at significantly high risk of breast cancer due to BRCA1/BRCA2 mutation/other*. After discussion of options, the patient requested simple mastectomy with immediate reconstruction.

Description of the Procedure After identifying the patient and verifying the operative site, the patient was brought into the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. All pressure points were appropriately padded. The *left/right/bilateral* breast(s) and axilla *was/were* then prepped and draped in the usual sterile fashion.

If sentinel lymph node biopsy was performed, include details.

A *left/right circumareolar/____* skin incision was made. Skin flaps were developed in the avascular plane using blunt and sharp dissection with *scissors/electrocautery* superiorly to the clavicle, inferiorly to the inframammary skin fold, laterally to the latissimus dorsi, and medially to the sternal border. The breast was then removed from the chest wall using electrocautery, *leaving/not leaving* the pectoral fascia. Perforating branches of the internal mammary vessels *were/were not* spared. Hemostasis was obtained with electrocautery. The specimen was oriented and submitted whole to Pathology. The wound was irrigated with sterile saline and packed. *The identical procedure was performed on the right/left side*. The operation was then passed on to plastic surgery for immediate reconstruction.

Acknowledgment This chapter was contributed by Julie Guidroz, MD, in the previous edition.

144 Nipple-Sparing Total Mastectomy

Megan G. Groff and Sonia Sugg

Indications

- Desire for nipple preservation in a suitable candidate (sufficient distance from any pathology to the nipple must be attained), including:
  - DCIS not amenable to breast conservation or patient requesting mastectomy, in selected patients, to be followed with reconstruction
  - Breast cancer treatment in selected patients, to be followed with reconstruction
  - Prophylaxis of carcinoma in selected high-risk patients, to be followed with reconstruction

Essential Steps

1. Confirm side of surgery.
2. *Sentinel lymph node (SLN) biopsy if indicated for staging of the axilla.*
3. *Incision tailored to geometry of tumor/the breast – inframammary, lateral, and others.*
4. Develop skin flaps.
5. Dissect ducts from the nipple.
6. Biopsy terminal ducts of the nipple.
7. Dissect the breast from the chest wall.
8. Hemostasis under good visualization, lighted retractors are helpful.
9. Orient specimen for pathology.
10. Irrigate and pack wounds for hemostasis prior to reconstruction.

Note These Variations

- Sentinel lymph node biopsy if patient has in situ or invasive breast carcinoma.
- Prophylactic mastectomy is commonly bilateral.

Complications

- Skin necrosis
- Nipple necrosis
- Seroma
- Wound infection
- Positive margin on the skin or nipple

Template Operative Dictation

Preoperative Diagnosis *Invasive carcinoma/DCIS/carcinoma prophylaxis* of the *left/right/bilateral* breast(s).

Procedure *Left/right/bilateral* nipple-sparing mastectomy.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_144

Postoperative Diagnosis Same.

Indications **If DCIS/invasive carcinoma**: This ___-year-old *female/male* with a *left/right breast mass/abnormality on mammogram that on workup with fine needle aspiration/biopsy was found to be ductal carcinoma* in situ/*invasive carcinoma*.

If Prophylactic This ___-year-old *female/male was known to be at significantly high risk of breast cancer due to BRCA1/2 mutation/other*. After discussion of options, the patient requested nipple-sparing mastectomy with immediate reconstruction.

Description of the Procedure After identifying the patient and verifying the operative site, the patient was brought into the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify the correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. All pressure points were appropriately padded. The *left/right/bilateral* breast(s) and axilla *were* then prepped and draped in the usual sterile fashion.

If sentinel lymph node biopsy was performed, include details.

A *left/right inframammary/lateral/other* skin incision was made. Skin flaps were developed using *scissors/electrocautery* superiorly to the clavicle, inferiorly to the inframammary skin fold, laterally to the latissimus dorsi, and medially to the sternal border. The breast was then removed from the chest wall using electrocautery, *preserving/not preserving* the pectoralis fascia. Perforating branches of the internal mammary vessels *were/were not* spared. Hemostasis was obtained with electrocautery. The specimen was oriented and submitted whole to pathology. A separate nipple margin was excised (a core of the central nipple was removed with this) and oriented for pathology. The wound was irrigated with sterile saline and packed. *An identical procedure was performed on the right/left side*. The operation was then passed on to plastic surgery for immediate reconstruction.

Modified Radical Mastectomy

145

James P. De Andrade and Ronald J. Weigel

Indications

Invasive breast cancer with axillary lymph node metastasis

Essential Steps

1. Review patient information to ensure proper indications and laterality of operation.
2. Create an elliptical incision over the breast encompassing the nipple-areolar complex and biopsy scar.
3. Raise flaps in the avascular plane between the subcutaneous and breast tissues. Dissect:
   (a) Superiorly to the clavicle
   (b) Medially to the sternum
   (c) Inferiorly to the *superior aspect of the anterior rectus sheath/inframammary fold*
   (d) Laterally to the anterior border of the latissimus dorsi
4. Remove all the breast tissue, including the pectoralis fascial, from the chest wall. *If tumor extension is noted into the pectoralis muscle*, *remove the tumor en bloc with a surrounding disk of muscle*.
5. At the lateral border of the pectoralis major muscle, allow breast tissue to fall laterally. Incise the clavipectoral fascia.
6. Dissect between and under the pectoralis major and minor muscles, removing all fatty tissue but preserving the medial pectoral nerve.
7. Identify the axillary vein and clear it of fatty tissue.
8. *Ligate the first major branch of the axillary vein to the chest wall*.
9. Identify and preserve the thoracodorsal and long thoracic nerves.
10. Dissect and remove all the fatty contents of the axilla bounded by:
    (a) Axillary vein superiorly
    (b) Chest wall medially
    (c) Subscapularis muscle posteriorly
    (d) Latissimus dorsi laterally
11. Remove the specimen by dividing the lateral pedicle of subcutaneous fat.
12. Achieve hemostasis. Place closed suction drain(s). Close the wound.

Note These Variations

1. Skin-sparing mastectomy uses smaller, specially tailored incisions.
2. Sentinel node biopsy may be employed in patients with clinically negative nodes.
3. Immediate reconstruction with implants or autologous tissue.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_145

Complications

1. Recurrence
2. Seroma
3. Nerve injury
4. Skin slough
5. Lymphedema

Template Operative Dictation

Preoperative Diagnosis *Right/left* breast cancer

Procedure *Right/left* modified radical mastectomy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* found to have invasive *ductal/lobular/other* carcinoma of the breast with axillary nodal involvement. After discussing the risks, benefits, and alternatives to surgery, the patient elected to undergo modified radical mastectomy.

Description of Procedure The patient was brought to the operating room, and the site of surgery was confirmed. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. The breast, chest wall, neck, axilla, and upper arm were prepped and draped in the usual sterile fashion.

An oblique elliptical skin incision was made on the breast encompassing the nipple-areolar complex and the existing biopsy scar. Flaps were raised in the avascular plane between the subcutaneous tissue and breast tissue to the clavicle superiorly, sternum medially, inferiorly to the *superior aspect of the rectus sheath/inframammary fold*, and anterior aspect of the latissimus dorsi laterally. Hemostasis was achieved. Progressing from medial to lateral, the breast tissue with the underlying pectoralis fascia was dissected off the chest wall. *If indicated*: *The tumor was noted to extend directly into the pectoralis muscle*, *so this portion of the tumor and surrounding muscle was removed en bloc with the breast tissue*.

The clavipectoral fascia was incised, and the fatty tissue between and below the pectoralis major and minor muscles was excised. The pectoral muscles were retracted medially, and the medial pectoral neurovascular bundle was identified and preserved.

The axillary vein was then identified and cleared of overlying fatty tissue. *The first branch off the axillary vein was clamped*, *divided*, *and ligated with 2-0 silk ties*. The thoracodorsal nerve innervating the latissimus dorsi was identified and preserved. The long thoracic nerve was then identified along the edge of the chest wall and preserved. The remaining nodal tissue between these nerves was then carefully removed. The specimen, consisting of breast and attached nodal tissue, was excised by dividing the remaining lateral pedicle and sent to pathology. The wound was irrigated and hemostasis was achieved.

Choose One

If immediate reconstruction: *At this point*, *the plastic surgery team took over to perform the reconstruction. A separate operative note will be dictated for that portion of surgery*.

If no immediate reconstruction: *Closed suction drain*(*s*) *was/were brought into the operative field through separate stab incisions and sutured to the skin using 3-0 nylon suture. The subcutaneous tissue was closed using 3-0 Vicryl sutures followed by a running 4-0 Monocryl suture. The wound was dressed with Steri-Strips/Dermabond glue and bandages. At the end of the case*, *all needle and sponge counts were reported as correct*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. General anesthesia was reversed, and the patient was extubated. There were no immediate complications noted, and the patient was taken to the recovery unit in stable condition.

Acknowledgment This chapter was contributed by Michael C. Fraterelli, M.D., in the previous edition.

Axillary Sentinel Node Biopsy for Breast Cancer

146

Brittany E. Splittgerber and Ingrid Lizarraga

Indications

- Breast cancer with clinically negative nodes
- Desire to avoid lymphadenectomy

Essential Steps

1. Confirm side of surgery!
2. Inject radioisotope (Tc99 sulfur colloid) *in equal aliquots circumferentially /intradermally around lesion or site of excision/in subareolar region.*
3. *Obtain lymphoscintogram. (Optional)*
4. Within 1–24 h, take the patient to the operating room.
5. Inject 1–3 mL of isosulfan blue in the subareolar area and gently massage.
6. Use handheld gamma probe to identify the site of maximal activity and make incision over that spot along the border of the axillary hairline.
7. Orient incision so it can easily be incorporated into lymphadenectomy incision if necessary.
8. Open the axillary fascia to enter the axillary space.
9. Use the gamma probe/presence of blue lymphatics to direct the dissection and identify the first blue/radioactive lymph node.
10. Grasp the lymph node with an Allis clamp and dissect away the surrounding soft tissue. Control any blood vessels or lymphatics entering the node with clips/ligatures or electrocautery.
11. Record counts for 10 s over the excised node and then over the bed from which it was excised.
    - Seek additional nodes if counts on bed are greater than 10 % of ex vivo counts on excised node.
12. Identify blue lymphatic channels and follow to other nodes. Remove any blue stained lymph node even if not radioactive.
13. Palpate the axillary bed and remove any grossly abnormal nodes.
14. Close the incision.

Note These Variations

- Amount of isotope, use of methylene blue instead (must be diluted). Procedure may be done with blue dye or radioisotope alone.
- More than one node may be identified.
- Isotope may localize to internal mammary nodes as well as or instead of axilla – management then varies with protocol.
- May be combined with lumpectomy or mastectomy incision.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_146

- If indicated, an axillary node dissection can be done during the same operation by extending the existing incision.

Complications

- Failure to identify sentinel node
- Recurrence
- Lymphedema
- Hematoma/seroma/lymphocele
- Nerve injury

Template Operative Dictation

Preoperative Diagnosis Carcinoma of the breast, *right/left* side

Procedure Axillary sentinel node biopsy

Postoperative Diagnosis Same

Indications This ___-year-old *female/male* has invasive carcinoma of the *right/left* breast and desires to avoid lymphadenectomy. Lymph nodes are clinically negative and sentinel node biopsy was chosen for staging.

Description of Procedure In the nuclear medicine suite, *the skin surrounding the mass/the breast tissue around the mass/the subareolar region* was injected with Tc-99m sulfur colloid. *The* patient was taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced.

(Amount)____ cc's of *isosulfan blue/methylene blue dye diluted _:_* dye was injected into subareolar tissue. This was massaged gently for 5 min. The skin of the *right/left* breast and axilla/arm was prepped and draped in the usual sterile fashion.

A handheld gamma probe was used to identify the location of the area of maximal radioactivity in the axilla. An incision was made and the axillary fascia was divided. A *blue/not blue/hot/cold* node was identified. The node was excised in its entirety. Ex vivo, the node was measured for 10 s with the gamma probe. The count was ___. The wound bed was then examined for additional hot spots or blue lymphatics. *No additional/Additional* sentinel lymph node(s) was/were detected.

If additional lymph nodes removed: The additional lymph node(s) removed *was/were:* #1 *blue/not blue, ex vivo count:___#2 blue/not blue, ex vivo count___.etc.*

The background count after removal of all sentinel lymph nodes was ____. No clinically abnormal nodes were palpated. The wound was irrigated and hemostasis was achieved. The wound was closed in layers with deep interrupted 3-0 Vicryl and *interrupted deep dermal/subcuticular suture/other.* A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Micheal Bonebrake, M.D., in the previous edition.

Placement of Balloon Catheter for Brachytherapy

147

Anjali R. Thawani

Indication

- Radiation therapy for invasive breast cancer after lumpectomy

Essential Steps

1. Confirm side of surgery.
2. Familiarize yourself with the specific device to be used.
3. Localize previous biopsy site with ultrasound and measure cavity size.
4. Select appropriate-sized catheter. Test balloon.
5. *Open cavity through previous incision site/percutaneous entry of cavity with ultrasound guidance*.
6. *Excise wall of seroma cavity to create adequate size for balloon. Assure adequate skin margins*.
7. Irrigate wound and assure hemostasis.
8. If percutaneous entry, confirm with seroma fluid. Check for purulence.
9. Remove trocar. Do not allow cavity to completely collapse.
10. Close wound from medial and lateral corners leaving space for catheter.
11. Insert catheter. Inflate catheter with diluted water soluble contrast solution. Verify positioning.

Note This Variation

- Entry through old incision rather than percutaneous

Complications

- Recurrence
- Inadequate skin flap depth
- Balloon rupture
- Improper positioning

Template Operative Dictation

Preoperative Diagnosis Invasive carcinoma of the *left/right* breast

Procedure *Left/right* placement of balloon catheter for brachytherapy

Postoperative Diagnosis Same

Indications This ___-year-old *female/male* with invasive ___ carcinoma underwent lumpectomy with sentinel lymph node biopsy *and axillary*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_147

lymph node dissection on ____. After discussion of options, the patient elected to undergo brachytherapy for radiation therapy to reduce the risk of recurrence.

Description of the Procedure After identifying the patient and verifying the operative site, the patient was brought into the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. All pressure points were appropriately padded. The *left/right* breast was then prepped and draped in the usual sterile fashion.

Choose One

If open: *The previous lumpectomy scar was reopened with a scalpel. The incision was carried down to the opening of the seroma. The seroma fluid was inspected for signs of infection. Electrocautery was used for hemostasis. To allow room for the device, selected areas of the seroma scar were excised. Care was taken to leave sufficient anterior tissue to preserve an adequate skin bridge.*

If percutaneous: *The ultrasound probe was sterilely draped and used to identify the seroma cavity. An incision site was chosen superiorly/inferiorly/laterally/medially to the lumpectomy scar. The cavity measured ___.*

The appropriate-sized balloon catheter device was then chosen. The balloon was tested by inflation with sterile saline. It filled symmetrically and did not leak. It was deflated and set aside.

Choose One

If open: *The wound was irrigated with normal saline and hemostasis was obtained with electrocautery. The device was inserted through a separate, lateral stab wound/through the midportion of the incision. Inverted, interrupted simple sutures with 3-0 Vicryl were placed on both the lateral and medial portions of the incision. A running 4-0 Monocryl subcuticular stitch was advanced from each edge toward the middle of the incision. The balloon was inflated with the recommended mixture of dilute contrast and sterile saline. A total of ____ ml of dilute contrast was instilled.*

If percutaneous: *Under ultrasound guidance, the trocar was introduced into the seroma cavity. Seroma fluid was obtained, confirming satisfactory entry. The seroma fluid was inspected for signs of infection. The cavity was not allowed to fully collapse. The trocar was removed. The catheter was then inserted and inflated under ultrasound guidance using the recommended mixture of dilute contrast and sterile saline. A total of ___ ml of dilute contrast was instilled. The placement of the catheter was confirmed with ultrasound.*

The wound was then dressed with sterile dressings. All needle, sponge, and instrument counts were correct at the end of the case. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then extubated in the operating room and taken to recovery in stable condition.

Postoperative imaging was performed in radiation oncology to assure satisfactory conformance of device to surrounding tissue.

Acknowledgment This chapter was contributed by Julie Guidroz, M.D., in the previous edition.

148 Intraoperative Radiation Therapy (IORT)

Allison W. Lorenzen and Ingrid Lizarraga

Indications

- Invasive or in situ breast cancer amenable to breast conservation therapy that meets IORT eligibility criteria

Essential Steps

1. Perform lumpectomy to remove the tumor.
2. Measure size of lumpectomy cavity and select appropriate tumor bed applicator probe.
3. Place a purse-string suture circumferentially within the opening of lumpectomy cavity. Place tumor bed applicator in lumpectomy cavity and verify appropriate sizing.
4. Attach applicator to radiation machine and position over the patient.
5. Introduce tumor bed applicator into cavity and secure in place with purse string. Use ultrasound to confirm good tissue apposition and adequate distance from the skin. Record distance between the probe and skin in medial, lateral, inferior, and cephalad dimensions.
6. Place lead shields around the incision and initiate radiation therapy under the supervision of a radiation oncologist.
7. Remove the tumor bed applicator and close the incision.

Note These Variations

- The depth of the purse string can be varied depending on the depth of the tumor prior to excision to allow the best tissue apposition.
- Type of radiation machine and some details may vary.

Complications

- Wound infection
- Seroma formation
- Skin breakdown or poor wound healing
- Hematoma
- Radiation-related complications, e.g., dermatitis, fibrosis, telangiectasia, or pain in the radiated field

Template Operative Dictation

Preoperative Diagnosis Invasive/in situ carcinoma of the *right/left* breast

Procedure Intraoperative breast radiation

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_148

Postoperative Diagnosis Same

Indications This is a ___-year-old female with a history of *breast lump/abnormal finding on mammogram* that was found to have *invasive ductal carcinoma/DCIS* on further work-up. After discussion of the alternatives, the patient elected to receive breast conservation therapy. Due to the patient's age, receptor status, and relatively small tumor with appropriate distance from the skin, she was felt to be amenable to intraoperative radiation therapy (IORT).

Description of Procedure The patient was brought to the operating room and placed supine upon the operating table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. The *right/left* breast was prepped and draped in the usual sterile fashion.

Describe the Lumpectomy Procedure After the tumor was excised, the lumpectomy cavity was prepared for intraoperative radiation therapy. Good hemostasis was achieved with electrocautery to ensure a dry cavity. The lumpectomy cavity was estimated at ___cm using serial sizers and the appropriate tumor bed applicator (*specify size*) was selected. A #1 Prolene purse-string suture was placed circumferentially below the skin around the perimeter of the lumpectomy incision. The tumor bed applicator was placed within the cavity, and the suture was tightened around the applicator without tying a knot. The ultrasound machine was used to ensure there was good proximity of the applicator to the walls of the lumpectomy cavity. The applicator was then removed from the lumpectomy cavity and docked to the end of the radiation machine in a sterile fashion. The radiation machine with the attached applicator was then positioned next to the patient and the applicator was placed in the lumpectomy cavity. The purse string was tied down, and the ultrasound was used to confirm good tissue apposition and the probe was at least 1 cm from the skin in all directions. The distance to the skin was as follows: medial ____mm, lateral ____mm, inferior ____mm, and cephalad ___mm. A moistened 4×4 gauze was unfolded and placed between the skin at the incision and the tumor bed applicator to further elevate the skin away from the applicator. Lead shields were placed around the incisions. Intraoperative radiation therapy was then administered under the supervision of the radiation oncologist.

After the radiation therapy was completed, the radiation applicator was removed from the lumpectomy cavity. Medium clips were placed to mark the cavity. The incision was closed in layers with interrupted 3-0 Vicryl and running 4-0 Monocryl. The incisions were then infiltrated with 0.25 % Marcaine. Steri-strips and a gauze dressing were applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the PACU in stable condition.

Mastopexy/Breast Lift

149

John T. Heineman and Jerrod N. Keith

Indications

- Breast ptosis secondary to developmental deformity or acquired deformity secondary to weight gain/loss, pregnancy, breast feeding, aging, medications, or procedures (such as lumpectomy or mastectomy with reconstruction).
- Active smoking is an absolute contraindication. Relative contraindications include obesity, diabetes, cardiopulmonary disease, or severe ptosis.

Essential Steps

1. Position the patient to be able to sit upright during the operation.
2. Secure arms at slightly less than 90 degrees from the body on arm boards.
3. Pre-op antibiotics.
4. Prep and drape.
5. Pre-op time-out and checklist.
6. De-epithelize the inferior pedicle below the nipple and cut it in a pyramidal fashion down to the chest wall, while taking care to preserve vascularization on the pedicle.
7. Tuck and sew the de-epithelized tissue up into a tunnel made underneath the midportion of the breast.
8. De-epithelize the area around the nipple and down the vertical limb.
9. Sew the pillars together and tuck this central portion of the breast up into the mid-breast to provide upper pole volume.
10. Repeat steps 5–8 on the opposite breast.
11. Sit patient upright to evaluate for breast size, shape, and symmetry.
12. Close vertical limbs and periareolar incisions.
13. Close skin.
14. Place dressings.

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Note These Variations

- With or without augmentation: circumvertical, circumareolar, J- or L-shaped, or inverted T
- Combination with small-volume reduction
- Combination with liposuction and/or lipoaugmentation (fat grafting)

Complications

- Nipple/Skin necrosis

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_149

- Infection
- Hematoma
- Seroma
- Delayed wound healing
- Nipple malposition
- Asymmetry
- Unacceptable scaring/cosmetic result

Template Operative Dictation

Preoperative Diagnosis Bilateral grade II ptosis

Procedure Bilateral mastopexy, circumvertical technique

Postoperative Diagnosis Same

Indications This __ year-old, otherwise healthy female presented with bilateral grade II ptosis (nipple position below inframammary fold but above lower breast contour) secondary to *multiple pregnancies/significant intentional weight loss/other*. The patient is a nonsmoker. Written consent was obtained after risks, indications, and alternatives of mastopexy were discussed with the patient in detail. She was met and marked in the preoperative area today and is prepared for surgery.

Description of Procedure The patient was placed on the operating table in the supine position. All pressure points were padded. Functioning sequential compression devices were placed on bilateral lower extremities. Preoperative antibiotics were given. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, positioning, and additional critical information prior to beginning the procedure. General anesthesia was induced. Arms were positioned at slightly less than 90° from the body and secured to arm boards with gauze dressings. The patient was positioned to be able to sit upright during the operation. The chest was prepped and draped in the usual sterile fashion.

Starting on the *right/left* side, incisions were made along the inferior limb markings. The nipple-areolar complex opening was not cut at this time. We de-epithelized the inferiorly based pedicle below the nipple and cut it in a pyramidal fashion down to the chest wall, while taking care to preserve vascularization on the pedicle. A tunnel was created beneath the midportion of the breast tissue, but above the pectoralis fascia, to the upper pole of the breast. The de-epithelized tissue was tucked up into this tunnel and sewn to the pectoralis fascia with 2-0 ___ (*absorbable*) suture in a figure-of-eight fashion. We then tailor tacked the nipple and the tissue with a stapler and sat the patient upright to evaluate size and shape. The area around the nipple and down the vertical limb was de-epithelized. We made sure hemostasis was adequate. The pillars were then sewn together with interrupted 3-0 ___ (*absorbable*) suture, and this central portion of the breast was tucked up into the mid-breast to provide upper pole volume.

Our attention was then turned to the opposite breast where a similar technique was used. After completion, the patient was returned to the upright sitting position to evaluate for breast size, shape, and symmetry. When we were satisfied with our intended result, we began to close the vertical limbs using interrupted 3-0 ___ (*absorbable*) suture. The de-epithelized periareolar areas were closed with interrupted 4-0 ___ (*absorbable*) suture for the deep dermal layer and running 4-0 ___ (*barbed absorbable*) suture for the skin on the breasts bilaterally. ___ (*skin adhesive*) was applied.

Surgical incisions were dressed with fluff gauze pads +/− *surgical bra*. All sponge and instrument counts were correct at the end of procedure. The patient was extubated and awakened from anesthesia. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was taken to the postanesthesia care unit in satisfactory condition.

Breast Reconstruction with Implant/Tissue Expander

150

John T. Heineman and Jerrod N. Keith

Indications

- Need for immediate or delayed reconstruction status post unilateral or bilateral mastectomy for breast cancer treatment or prophylaxis for high-risk inherited gene mutation (i.e., BRCA1 or BRCA2 mutation).
- Good perfusion of skin flaps after skin-sparing or nipple-sparing mastectomies.
- Personal desire for shorter recovery time in comparison to autologous tissue reconstruction.
- Relative contraindications include advanced disease (stage III or higher), need for postoperative radiation therapy, and/or comorbidities such as active smoking, obesity (BMI >35), or cardiopulmonary disease.

Essential Steps

1. Position and secure arms at slightly less than 90° from body on arm boards.
2. Place Foley catheter for cases > 4 hours.
3. Pre-op antibiotics and re-dose at 4 h if necessary.
4. Re-prep and apply new drapes after mastectomies performed by surgical oncology.
5. Pre-op time-out and checklist.
6. Inspect skin flaps and ensure hemostasis. Consider indocyanine green intraoperative angiography if poor perfusion is suspected.
7. Create subpectoral pocket.
8. Suture acellular dermal matrix (ADM) to the chest wall (medially, inferiorly, and laterally) and partially to the pectoralis muscle (superiorly).
9. Place implant sizer into the pocket (if placing immediate implants).
10. Repeat steps 5–8 on opposite side.
11. Sit patient upright to evaluate for breast size, shape, and symmetry.
12. Place subpectoral and subcutaneous, round closed-suction drains bilaterally.
13. Irrigate ADM pockets with normal saline and triple antibiotic solution.
14. Place *implants/tissue expanders* via one-surgeon no-touch technique.
15. *If tissue expander placement, sew tabs in place.*
16. Close ADM pockets superiorly to pectoralis muscle.
17. Use indocyanine green intraoperative angiography for assessment of mastectomy flap perfusion as needed.
18. Close subcutaneous tissue and skin.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_150

19. *If tissue expander placement, fill expanders with butterfly needle technique.*
20. Place dressings.

Note These Variations

- One-stage reconstruction with implant (saline or silicone)
- Two-stage reconstruction; first stage placement of tissue expander and second-stage exchange for implant

Complications

- Infection
- Hematoma
- Seroma
- Mastectomy skin necrosis
- Implant/tissue expander deflation
- Implant malposition
- Capsular contracture

Template Operative Dictation

Preoperative Diagnosis *Breast cancer/BRCA gene mutation/other*

Procedure Immediate breast reconstruction with *implant/tissue expander*

Postoperative Diagnosis Same

Indications This __ year-old female presented with *need for mastectomy for breast cancer/desire for cancer prophylaxis for BRCA gene mutation/other*. The patient has been seen by surgical oncology and has elected to undergo *skin/nipple-sparing unilateral mastectomy for cancer treatment/bilateral prophylactic mastectomies/other*. After a thorough discussion of the risks, indications, and alternatives of immediate breast reconstruction, the patient elected to undergo *implant/tissue expander* placement. Written consent was obtained after all questions were answered. The patient was met and marked in the preoperative area today and is prepared for surgery.

Description of Procedure The patient was placed on the operating table in the supine position. All pressure points were padded. Functioning sequential compression devices were placed on bilateral lower extremities. Preoperative antibiotics were administered *and re-dosed 4 h after initiation of the procedure*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, positioning, availability of *implant/tissue expander*, and additional critical information prior to beginning the procedure. General anesthesia was induced. Arms were positioned at slightly less than 90° from the body and secured to arm boards with gauze dressings. A test sit-up with the bed was done prior to beginning the procedure. A Foley catheter was placed. The chest was prepped and draped in the usual sterile fashion.

The surgical oncology team proceeded with *skin/nipple-sparing unilateral mastectomy or bilateral mastectomies. The left-side specimen weighed __ grams and the right-side specimen weighed __ grams*. Please see their operative note for surgical details.

Upon completion of their portion of the procedure, we re-prepped and placed new drapes on the patient. Clean instruments were made available. We started by inspecting the mastectomy flap on the *left/right* side to assure hemostasis. Electrocautery was used to raise a subpectoral pocket, releasing it along its inferior attachments from the chest wall. The release was started laterally and moved medially until the pectoral sternal attachments were encountered. We measured acellular dermal matrix (ADM) __ cm by __ cm to fit the size of the pocket. After rinsing and soaking the ADM, we sewed it to the chest wall with 2-0 ___ *(absorbable)* running suture along the medial border of the breast, inferiorly at the inframammary fold, and curved laterally to recreate the footprint of the breast. We then started to close the ADM to the pectoralis muscle superiorly using 2-0 ___ *(absorbable)* suture. Once we had the pocket partially closed, we placed a ___ cc *round/shaped saline/silicone* sizer. We were satisfied with the size and shape of this side and stapled the incision together.

If bilateral: We then turned our attention to the opposite side. We performed the same technique by raising the pectoralis muscle and assuring hemostasis, sewing a __ cm by __ cm piece of ADM to the chest wall using 2-0 ___ *(absorbable)* suture and sewing the ADM to the pectoralis muscle superiorly with 2-0 ___ *(absorbable)* suture. Once we had this pocket made, we placed a ___ cc *round/shaped saline/silicone* sizer. We were also satisfied with the size and shape of this side and stapled the incision together. The patient was placed in the upright sitting position, and appropriate bilateral breast size, shape, and symmetry were observed.

We then started to prepare to place the *implants/tissue expanders*. The patient was placed back in the supine position. We opened the incisions and irrigated to assure hemostasis. We then placed subpectoral and subcutaneous round closed-suction drains bilaterally. We irrigated first with normal saline and then with 1 L of triple antibiotic solution in both pockets. Using clean gloves in a one-surgeon no-touch technique, the *implants/tissue expanders* were placed first on the *right/left* side and then on the opposing side in the same technique. The right side received the ___ cc *round/shaped saline/silicone implant or tissue expander* and the left side the ___ cc *round/shaped saline/silicone implant or tissue expander (change as appropriate if unilateral)*. ***If tissue expander:*** *The tabs of the tissue expander were sewed in place with 2-0 ___ (absorbable) suture.* The *implant/tissue expander* was irrigated with triple antibiotic solution as the wound was closed. Using clean instruments, the junction of pectoralis and ADM was closed under direct vision taking care not to injure the *implant/tissue expander* with 2-0 ___ *(absorbable)* suture. Once the pocket was completely closed, we then stapled the skin back together to provide sufficient contour while avoiding undue tension on the skin.

If indocyanine green was used: We then used indocyanine green intraoperative angiography for assessment of mastectomy flap perfusion, which was *adequate bilaterally/other*.

The injured wound edges were trimmed back until healthy bleeding was observed, and the skin was closed. This was done with 3-0 ___ *(absorbable)* suture to approximate the subcutaneous tissues, 3-0 interrupted ___ *(absorbable)* suture for the deep dermal layer, 4-0 ___ *(barbed absorbable)* running suture, and ___ *(skin adhesive).* The drains, two on each side, were sewn in with 3-0 nylon suture and placed to closed bulb suction.

If tissue expander: *The butterfly needle was used to inflate the tissue expanders after magnetic port detection. Using sterile saline, we inflated the right tissue expander with __ cc and the left with __ cc. There was still adequate skin pliability, good capillary refill and color, and no undue tension. Indocyanine green angiography could be performed again if necessary to reevaluate perfusion.*

Surgical incisions were dressed with ABD pads and tape. All sponge and instrument counts were correct at the end of procedure. The patient was extubated and awakened from anesthesia. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was then taken to the postanesthesia care unit in satisfactory condition.

151 Latissimus Dorsi Pedicled Musculocutaneous Flap Breast Reconstruction

Patrick J. Hawkes and Wei Chen

Indication

- Patient with absent breast without standard autologous breast reconstruction options
- Desire for prosthetic-based reconstruction in a patient who lacks a healthy skin envelope (i.e., due to radiation)
- +/− History of whole breast radiation therapy

Essential Preoperative Workup

- If reconstruction is performed in a delayed fashion, careful clinical evaluation looking for atrophy and lack of contraction of the latissimus muscle should be performed to identify possible prior injury to the thoracodorsal artery and nerve.

Essential Steps

1. Mark the patient in the preoperative area in a standing position. The skin island design is flexible and should fall on the latissimus muscle itself with placement planned to conceal the scar under the patient's bra.
2. Routine preoperative antibiotics and pharmacological DVT prophylaxis.
3. Incise the whole skin paddle circumferentially down to the fascia overlying the latissimus muscle.
4. Identify the borders of the latissimus muscle as well as the region of the muscle posteriorly where it becomes more tendinous, and divide the muscle at this location.
5. Elevate the latissimus muscle following the areolar tissue plane beneath the muscle from inferior to superior, until encountering the fat pad around the pedicle.
6. Create a tunnel in the axilla and temporarily place the flap in this pocket.
7. Place one or two surgical drains and close the donor site in layers.
8. The patient is then repositioned and prepped.
9. Make an incision over the pre-existing chest scar (unnecessary if performing immediate reconstruction).
10. Dissect the subpectoral space as you would for implant-based reconstruction (Chapter 150).
11. Rotate the flap and pass it through the tunnel. Ensure that there is no twisting or kinking of the vascular pedicle.
12. Perform flap inset by suturing the latissimus muscle medially to the sternal attachments of the inferior border of the pectoralis muscle, the pectoralis muscle superiorly and the inframammary crease, creating an inferior hammock.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_151

13. Insert a tissue expander under the pectoralis and latissimus muscles. Size tissue expander to match overall volume of the contralateral breast.
14. Tailor the overlying skin paddle to the remaining skin envelope. In order to obtain a good aesthetic result, areas of overlapping mastectomy flap can be trimmed, or underlying flap skin can be de-epithelialized as needed.
15. Place closed suction drains in the implant pocket and overlying the pectoralis muscle.
16. Dress the incisions.

Note These Variations

- An extended composite latissimus dorsi musculocutaneous flap with or without implant

Complications

- Seroma
- Bleeding/infection
- Flap compromise (can be arterial or venous)
- Wound healing complications

Template Operative Dictation

Preoperative Diagnosis Acquired right amastia status post right mastectomy and radiation therapy for breast cancer

Procedure (1) Autologous right/left/bilateral breast reconstruction with pedicled Latissimus flap procedure. (2) Dissection and elevation of the Latissimus flap including the inset of the flap into the right/left/bilateral chest wound. (3) Placement of tissue expander

Postoperative Diagnosis Same

Indications The patient is a ___-year-old female who previously underwent a *right/left/bilateral mastectomy and radiation therapy* for the treatment of *right/ left breast cancer*. ***Or:*** *The patient was evaluated and found to have significant radiation injury of the right/left chest skin. She also had a desire for implant-based reconstruction.* Given this finding, autologous reconstruction using the pedicled latissimus musculocutaneous flap was offered. The rationale, alternatives, risks, and benefits of the procedure were discussed. The patient expressed a clear understanding of these and wished to proceed. A consent form was signed.

Description of Procedure Skin markings were made with the patient in standing position. The patient was taken to the operating room. SCDs were placed. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Preoperative antibiotic was administered. General anesthesia was induced and a Foley catheter was inserted. The patient was placed in a *left/right* lateral decubitus position and all contact points appropriately padded. The operative site was prepped and draped in standard sterile fashion.

The skin was then incised around the flap circumferentially and carried down to the level of the fascia overlying the latissimus muscle. The borders of the pectoralis muscle were identified. The latissimus muscle was then divided inferiorly along the tendinous portion of the muscle. The flap was then elevated from inferior to superior until the thoracodorsal pedicle and its branch to the serratus muscle were encountered. The vessels were identified and protected. A subcutaneous pocket was then created in the axilla and the flap temporarily placed in this location. The donor site was then closed in two layers over two closed suction drains. Dressings were applied and the patient was repositioned in the supine position and prepped and draped.

The previous mastectomy scar was excised and the incision carried down to the pectoral fascia. The lateral border of the pectoralis muscle was identified and the inferior attachments divided up to the medial attachments with the sternum. The pectoralis muscle was raised off of the chest wall to create a pocket for the implant to sit under. The flap was then rotated and brought through the previously created subcutaneous tunnel, taking care to ensure there was no kinking or compression of the pedicle. The muscle was then fashioned and sutured into place along the inferior border of the pectoralis muscle and just inferior to the inframammary fold, creating a hammock to support an implant. A sizer was then placed in the pocket and tissue expander size determined. A _____ cc tissue expander was then placed within this pocket. A closed suction drain was placed in the pocket, which was then closed over the implant. Another closed suction drain was placed over the pectoralis muscle and sutured in place. Next, the excess flap tissue was trimmed off and then the flap was then inset into the mastectomy pocket. The flap was inset in layers.

All of the drains were secured with 3-0 nylon and all of the incisions were covered with benzoin and Steri-Strips. Bacitracin and drain gauze were applied to all the drain sites.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transferred to the PACU in satisfactory condition.

152 Transverse Rectus Abdominis Muscle (TRAM) Flap Breast Reconstruction

Patrick J. Hawkes and Wei Chen

Indication

- Absent breast with patient preference for autologous breast reconstruction with no microsurgical expertise available.
- History of whole breast radiation therapy does not exclude patient from this procedure. However, radiation therapy is an indication favoring autologous reconstruction.

Essential Preoperative Workup

- Ensure that the patient has sufficient amount of abdominal soft tissue from which to create a breast mound proportional to their body habitus.

Essential Steps

1. Mark the patient in the preoperative area including midline from the sternal notch to the vulvar commissure through the umbilicus, inframammary folds, breast footprint (correct for any asymmetry), lower incision border 5–7 cm superior to the vulvar commissure, and superior abdominal incision based on pinch test.
2. Pharmacologic DVT prophylaxis should be given prior to induction.
3. Routine preoperative antibiotics with appropriate re-dosing.
4. Compare the contralateral breast to aid in determination of the required tissue volume for symmetry.
5. Determine laterality of the flap (surgeon preference).
6. Begin dissection along the lower abdominal incision.
7. Identify and preserve the superficial epigastric veins bilaterally, ligating after obtaining approximately 5 cm in length.
8. Deepen incision down to the deep fascia.
9. Make the superior incision and carry down to the fascia.
10. If additional fat is needed, the incisions except the area over the pubis can be beveled to help incorporate more tissue. (Undermining laterally above the superior incision should be avoided in order to protect the blood supply to the abdominal skin flap).
11. Elevate the abdominal flap from lateral to medial direction until the lateral row of perforators is encountered. This is performed again from superior and inferior direction until the superior and inferior perforators are encountered, respectively.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_152

12. Elevate the contralateral side until the medial row perforators of the ipsilateral side are encountered.
13. Incise a rectangular piece of fascia, including a superior strip to aid in reinforcement and support of the pedicle.
14. Divide the rectus muscle inferiorly. Elevate the rectus muscle up to the costal margin and reflect the muscle superiorly. (Muscle sparing is optional).
15. Divide the eighth intercostal nerve to prevent a bulge in the upper abdomen.
16. A tunnel is fashioned overlying the rectus sheath at the level of the inframammary fold along its medial half and carried down to the undermined area of the abdomen, ensuring that the tunnel is wide enough for the flap to pass without compressing the pedicle.
17. Areas of poor perfusion can be marked for resection, including zone IV (the zone which is the furthest from the superior epigastric artery blood supply).
18. Rotate the flap and pass it through the tunnel.
19. Pull the abdominal flap down and secure it to the lower incision.
20. Mark and incise the new umbilical site (This should be based on the existing location of the umbilical stalk and should be determined with the abdominal flap on stretch).
21. Place closed suction drains.
22. Close the incision in the rectus fascia. If the patient has pre-existing fascial laxity, then primary closure is performed. If the defect can be closed primarily but with tension, then it is reinforced with an underlay mesh. If fascial defect is too large for closure then the defect is bridged with mesh.
23. Close the lower abdominal incision in layers.
24. Inset the umbilicus.
25. Begin to inset the flap by suspending it from the superior and superolateral pole. Trim the excess flap tissue and then inset the flap in layers.
26. The incisions are dressed and the procedure terminated.

Note These Variations

- If venous outflow is insufficient, the superficial inferior epigastric vein (SIEV) can be connected to a donor vein to improve venous outflow.
- Bipedicled TRAM using bilateral pedicles designed as above.
- Muscle sparing TRAM, splitting the rectus muscle and only transferring a portion of the muscle.

Complications

- Seroma
- Bleeding/infection
- Flap compromise (can be arterial or venous)
- Wound healing complications
- Hernia

Template Operative Dictation

Preoperative Diagnosis Acquired right amastia status post right mastectomy and radiation therapy for breast cancer

Procedure (1) Autologous right/left/bilateral breast reconstruction with pedicled TRAM flap procedure. (2) Dissection and elevation of the transverse abdominal musculocutaneous flap, trimming and sculpting of the TRAM flap including zone IV followed by inset of the flap into the right/left/bilateral chest wound

Postoperative Diagnosis Same

Indications The patient is a ___-year-old female who previously underwent a right/ left/ bilateral mastectomy and radiation therapy for the treatment of right/ left breast cancer. The patient was evaluated and found to have significant radiation injury of the right/ left chest skin. Given this finding, autologous reconstruction using the pedicled TRAM flap was offered. The rationale, alternatives, risks, and benefits of the procedure were discussed. The patient expressed a clear understanding of these and wished to proceed. A consent form was signed.

Description of Procedure Markings were made with the patient in standing position. The patient was taken to the operating room, placed in supine position. SCDs were placed. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Preoperative antibiotic was administered. General anesthesia was induced. A Foley catheter was inserted. The operative site was prepped and draped in standard sterile fashion.

The superior abdominal incision was determined by the superior border of the umbilicus, while the lower incision was determined by a pinch test. The finalized incision was at ___ cm above the vulvar commissure. The inferior incision was made using a scalpel. The incision was deepened through the subcutaneous tissue. The superficial inferior epigastric vein was encountered, carefully dissected out, clipped distally, and divided. The incision was deepened down to the abdominal fascia. Next, the superior abdominal incision was made and it was again deepened down to the abdominal fascia. The dissection was then carried in a lateral to medial fashion until we reached the lateral row of perforators. This was again performed superiorly, inferiorly, and medially stopping at the respective row of perforators. At this point the fascia was incised over the lateral, medial, and inferior aspects of the rectus muscle as well as a strip of fascia superiorly up to the level of the costal margin. The rectus muscle was incised inferiorly and reflected to visualize the underlying deep inferior epigastric vessels which were isolated and divided. The flap was then elevated, reflecting the rectus muscle superiorly up to the level of the costal margin. The eighth intercostal neurovascular bundle was identified and ligated. With this, the pedicle dissection was completed. The previous mastectomy incision was opened. A subcutaneous tunnel was then created from the medial half of the inframammary fold of the previous mastectomy site. Next, the flap was transferred through the subcutaneous tunnel to the chest and temporarily secured.

Closure of the abdominal wound was then performed. *Two/three* surgical drains were placed and brought out through the suprapubic skin centrally. Prior to closure, the umbilical position was determined and incised. The umbilicus was brought through the opening and inset with interrupted sutures. The fascial defect was found to have no tension with closure and was closed primarily. The abdominal incision was then closed in layers and dressed.

Inset of the flap was performed beginning with the superior and superolateral poles to “suspend” the flap. The lateral and medial inset was performed next, followed by gathering of the inferior aspect to provide projection of the reconstructed breast. A single surgical drain was placed and a layered closure performed to complete the inset.

All of the incisions were covered with benzoin and Steri-Strips. Bacitracin and drain gauze were applied to all the drain sites. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated was extubated and transferred to the PACU in satisfactory condition.

Deep Inferior Epigastric Artery Perforator (DIEP) Flap Breast Reconstruction

153

Patrick J. Hawkes and Wei Chen

Indication

- Absent breast with desire for autologous breast reconstruction. This may be performed in an immediate or delayed fashion.
- History of whole breast radiation therapy does not exclude patient from this procedure. However, radiation therapy is an indication favoring autologous reconstruction.

Essential Preoperative Workup

- Ensure that the patient has sufficient amount of abdominal soft tissue from which to create a breast mound proportional to their body habitus.
- Review patient history to ensure they have adequate recipient vessels (i.e., no history of CABG sacrificing the internal mammary artery (IMA)).

Essential Steps

1. Mark the patient in the preoperative area including midline from the sternal notch to the vulvar commissure through the umbilicus, inframammary folds, breast footprint (correct for any asymmetry), and lower incision border: 5–7 cm superior to the vulvar commissure and superior abdominal incision based on pinch test (occasionally the lower abdominal incision needs to be repositioned in order to allow the superior incision to be placed superior to the umbilicus in order to capture the periumbilical perforators).
2. Pharmacologic DVT prophylaxis should be given prior to induction.
3. Routine preoperative antibiotics with appropriate re-dosing.
4. The incision is a lens-shaped incision. Begin the dissection along the lower abdominal incision. Identify and preserve the superficial epigastric veins bilaterally, ligating after obtaining approximately 5 cm in length. Deepen incision down to the deep fascia.
5. Make the superior portion of incision and carry down to the fascia.
6. Begin flap dissection from lateral to medial (if there is a second surgeon both can work simultaneously).
7. Slow dissection upon reaching the semilunar line and begin identifying and preserving all perforators.
8. Determine the dominant perforator(s) depending on the size, pulsatility, and location with relationship to the flap (include more than one whenever possible).

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_153

9. Begin subfascial dissection by cutting the fascia around the perforator and extending the fascial incision inferiorly based on the course of the deep inferior epigastric pedicle until reaching the semilunar line inferiorly.
10. Begin intramuscular dissection by carefully splitting the rectus muscle. Carefully dissect the deep inferior epigastric pedicle while preserving the intercostal nerves and clipping and dividing all muscular branches. Occasionally intercostal nerves need to be divided to free up the pedicle; these should then be repaired.
11. Pedicle dissection is concluded upon obtaining an adequate pedicle caliber and length.
12. Follow the same process for the contralateral side if bilateral reconstruction is used. For unilateral dissection, only the side with the dominant perforator needs to be dissected.
13. Attention is turned to the chest. The donor vessels most frequently utilized are the internal mammary arteries and veins and this is what will be described. However, other donor vessels such as the thoracodorsal vessels can be used.
14. Dissection is carried down to the chest wall and the third through fifth ribs are identified. Based on ease of access, pick one of these ribs and excise a small window of pectoralis muscle to create a window over this rib in the parasternal region.
15. Remove a 2–3 cm section of rib via sub periosteal dissection.
16. The posterior perichondrium is then resected, exposing the internal mammary vessels.
17. Skeletonize the internal mammary artery and vein
18. Assess adequacy of the flap and excise inadequately perfused or drained areas of the flap.
19. Ligate the artery and vein then transfer the flap to the chest with careful attention payed to maintaining the orientation of the pedicle.
20. Temporarily inset the flap with staples and position the pedicle.
21. Arterial anastomosis is carried out with 9-0 or 10-0 nylon. The vein anastomosis is then completed with a coupler or hand-sewn technique.
22. Perfusion is verified clinically as well as confirmed with the use of Doppler ultrasound.
23. The abdominal dissection is completed by carrying the dissection superiorly to the level of the costal cartilage bilaterally and the xyphoid process at the midline.
24. The abdominal flap is then pulled down and secured to the lower incision and the new umbilical site marked and incised. This should be based on the existing location of the umbilical stalk and should be determined with the abdominal flap on stretch.
25. Closed suction drains are placed and secured.
26. The incision in the rectus fascia is closed and the lower abdominal incision is closed in layers.
27. The umbilicus is inset.
28. The flap inset is then performed starting with the superior and superolateral pole to suspend the flap. The excess flap tissue is trimmed off and then the flap is inset in layers.
29. The incisions are dressed and the procedure terminated.

Note These Variations

- If venous outflow is insufficient, the superficial inferior epigastric vein (SIEV) can be connected to a donor vein to improve venous outflow.

Complications

- Seroma
- Bleeding/infection
- Flap compromise (can be arterial or venous)
- Wound healing complications

Template Operative Dictation

Preoperative Diagnosis Acquired right amastia status post right mastectomy and radiation therapy for breast cancer

Procedure (1) Autologous *right/left/bilateral* breast reconstruction with DIEP flap procedure. (2) Dissection and elevation of the deep inferior epigastric artery perforator flap, microscopic anastomosis of the DIEP flap artery and veins to internal mammary artery and veins, trimming and sculpting of the DIEP flap including the inset of the flap into the *right/left/bilateral* chest wound

Postoperative Diagnosis Same

Indications The patient is a ___-year-old female who previously underwent a *right/left/bilateral* mastectomy *and radiation therapy* for the treatment of *right/ left breast cancer. The patient was evaluated and found to have significant radiation injury of the right/left chest skin*. Given this finding, autologous reconstruction using the DIEP flap was offered. The rationale, alternatives, risks, and benefits of the procedure were discussed. The patient expressed a clear understanding of these and wished to proceed. A consent form was signed.

Description of Procedure Markings were made with the patient in standing position. The patient was taken to the operating room, placed in supine position. The SCDs were placed. Preoperative antibiotic was administered. Five thousand units of subcutaneous heparin was given. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. A Foley catheter was inserted. The operative site was prepped and draped in standard sterile fashion.

The superior abdominal incision was determined by the superior border of the umbilicus, while the lower incision was determined by a pinch test. The finalized incision was at ___ cm above the vulvar commissure. The inferior incision was deepened through the subcutaneous tissue. The SIEV was encountered, carefully dissected out, clipped distally, and divided. The incision was deepened down to the abdominal fascia. Next, the superior abdominal incision was made and it was again deepened down to the abdominal fascia. The dissection was then carried in a lateral to medial fashion until the semilunar line is reached. Meticulous dissection was then performed in search for all of the perforators. All of the perforators encountered were dissected circumferentially above the fascia, and the dominant perforator(s) was selected. Retrograde dissection was performed to trace the dominant perforator proximally; intramuscular dissection was performed by splitting the muscle fibers and ligating the intramuscular branches. Retrorectus dissection was then performed until a pedicle of adequate length and caliber was obtained. With this, the pedicle dissection was completed. *The flap perfusion demonstrated excellent perfusion except for _____ of the flap which was completely excised/other findings*. The flap was left in situ and temporarily secured with staples.

The previous mastectomy incision was reopened, and dissection was carried down to expose the third through fifth ribs. A window was created by excising the pectoralis muscle to expose the costal cartilage of the fourth rib. A small portion of the rib was freed up circumferentially and excised, exposing the underlying internal mammary vessels. The posterior perichondrium was excised and the internal mammary vessels skeletonized.

At this point, flap perfusion was found to be *satisfactory/other findings* and the pedicle was ligated. The flap pedicle was flushed with heparinized saline. Next, the flap was transferred to the chest, temporarily secured, and the flap pedicle was brought into approximation with the IMV and IMA. The vein was measured and anastomosed with a *vein coupler/hand-sewn technique*. The arterial anastomosis was then performed using *9-0 nylon*. Upon completion of the anastomoses, all clamps were released, and the flap was found to have *excellent perfusion/other findings.* Doppler was performed and showed *excellent arterial and venous perforator signals/other findings.*

Closure of the abdominal wound began by elevating the abdominal flap to the costal margin and xyphoid process medially. *Two/three* surgical drains were placed and brought out through the suprapubic skin centrally. Prior to closure, the umbilical position was determined and incised. The umbilicus was brought through the opening and inset with interrupted sutures. The fascial defect was closed. The abdominal incision was then closed in layers and dressed.

Inset of the flap was performed beginning with the superior and superolateral poles to "suspend" the flap. The lateral and medial inset was performed next, followed by gathering of the inferior aspect to provide projection of the reconstructed breast. A single surgical drain was placed and a layered closure performed to complete the inset.

All of the incisions were covered with benzoin and Steri-Strips. Bacitracin and drain gauze were applied to all the drain sites. With this, the procedure was concluded.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transferred to the SICU in a satisfactory condition.

Part XII

General Surgery: Skin and Soft Tissue

Wide Local Excision of Melanoma 154

T.J. Henry and Hisakazu Hoshi

Indication

- Cutaneous melanoma

Essential Steps

1. Measure desired margin around the lesion (depending on Breslow depth, 1–2 cm).
2. Orient incision in skin line or directed longitudinally along the limb.
3. Excise down to but not including the fascia while maintaining perpendicular orientation to the skin.
4. Orient the specimen.
5. Elevate flaps to facilitate closure, if needed.
6. Ensure hemostasis.
7. Close in layers.

Note These Variations

- Choice of anesthesia.
- Width of margin varies.
- Reconstruction with skin grafts/flaps when unable to close primarily.
- May be combined with sentinel node biopsy (Chap. 155).

Complication

- Recurrence
- Wound separation
- Seroma
- Poor functional/cosmetic outcome

Template Operative Dictation

Preoperative Diagnosis Breslow depth melanoma of ___ (*location*) and TNM staging.

Procedure Wide local excision of melanoma with ___cm margin.

Postoperative Diagnosis Same

Indications This ___-year-old *male / female* had a pigmented lesion of (*location*) *biopsied / excised with narrow margins*. Pathology returned Breslow depth ___ melanoma. Wide local excision was indicated for local control.

Description of Procedure The patient was brought to the *operating room / minor surgery*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_154

suite. Timeouts were performed using both pre-induction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. *General / regional anesthesia was induced*.

The region around the melanoma was prepped and draped in the usual sterile fashion.

If sentinel node biopsy (Chap. 155): *Sentinel node biopsy performed prior to excision*.

If local anesthesia: *1% Xylocaine without epinephrine* (*or 50*:*50 mixture of 1% xylocaine and 0.25–0.5% bupivacaine*) *was used to infiltrate the region of the proposed incision. The lesion itself was not injected*.

A margin of *1–2 cm* (*specify*) on all sides of the *melanoma / biopsy site* was measured. An elliptical incision was made in the orientation of the *skin line / longitudinal axis of the limb* that completely encompassed the measured area. This incision was deepened to the fascia overlying the muscle. Skin and subcutaneous tissues were completely excised off the underlying fascia, with the fascia left intact. The specimen was then oriented *with clips / silk suture*.

Hemostasis was ensured, *flaps were raised at the fascial level*, and the wound was closed with a deep layer of interrupted or running 3-0 Vicryl suture(s) and *skin staples/a subcuticular closure/nylon mattress sutures*. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Michael Bonebrake, M.D. in the previous edition.

Sentinel Lymph Node Biopsy for Melanoma

155

T.J. Henry and Hisakazu Hoshi

Indications

- Thin melanoma (>0.75 mm) with *ulceration / involved deep margin / mitotic rate ≥ 1/mm²/* and clinically negative nodes
- Intermediate or thick melanoma (≥1.00 mm) with clinically negative nodes

Essential Steps

1. Inject radioisotope (Tc-99 sulfur colloid) intradermally in a four-quadrant fashion surrounding the lesion or previous biopsy site.
2. Obtain lymphoscintigram.
3. Three to 4 h later (or next morning), take the patient to the operating room.
4. Inject 1–3 mL of isosulfan blue intradermally in a four-quadrant fashion surrounding the lesion and gently massage.
5. Use handheld gamma probe to identify the node and make an incision over that spot.
6. Orient the incision so it can be easily incorporated into a future complete lymphadenectomy incision if necessary.
7. Record 10 s count in vivo and excise the node and then record 10 s ex vivo count.
8. Scan the nodal basin from which it was excised and continue to excise nodes until the focal basin radioactivity is less than 10 % of the hottest node excised.
9. Inspect for any grossly abnormal nodes; excise if found.
10. Close the incision.
11. *Perform wide local excision if not previously done* (Chap. 157).

Note These Variations

- Amount of isotope and use of isosulfan blue dye.
- More than one node may be identified.
- Isotope may localize to more than one nodal basin.
- Wide local excision (Chap. 157) may be done during this procedure.

Complications

- Failure to identify sentinel node
- Recurrence
- Lymphedema
- Nerve injury

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_155

Template Operative Dictation

Preoperative Diagnosis Melanoma of ___ (specify location) and TNM staging

Procedure Sentinel lymph node biopsy of ___ (specify location) *and wide local excision of melanoma*

Postoperative Diagnosis Same

Indications This ___-year-old *male / female* has *Breslow level* ___ melanoma of the ___ (specify location) diagnosed on *punch / incisional / excisional biopsy*. Sentinel lymph node biopsy *and wide local excision* were indicated for staging.

Description of Procedure In the nuclear medicine suite, the skin surrounding the lesion was injected with Tc-99 sulfur colloid, and lymphoscintigram was obtained. The patient and lymphoscintigrams were taken to the operating room. Timeouts were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced and endotracheal intubation performed. Patient was placed in the supine position, and all pressure points were adequately padded.

The four quadrants of the skin overlying the *melanoma / biopsy* site were injected intradermally with *1–3* mL of isosulfan blue dye, and the area was gently massaged for several minutes. The skin overlying *the right / left axilla / inguinal region* was prepped and draped in the usual sterile fashion.

A handheld gamma probe was used to identify the location of the hottest spot in the nodal basin. Prior to the incision, the counts were ___. An incision was made and a *blue* node was identified. The probe was placed in contact with the node and ___ counts were recorded. The node was excised in its entirety with *clipping / ligation* of lymph channels as they were encountered. Ex vivo, the node measured ___ counts and the residual nodal basin measured ___ counts. *If additional hot spot*: a second *blue* node was identified and the following counts registered: ___ prior to excision, ___ ex vivo node, and ___ residual bed. No additional hot spots or blue lymphatics were identified. No clinically abnormal nodes were palpated. The procedure was terminated. Hemostasis was achieved and the wound closed in layers with interrupted 3-0 Vicryl and *skin staples / subcuticular suture / other*.

If wide local excision (Chap. 157): *Attention was then turned to the primary site. The patient was repositioned* (*specify*). *The area surrounding the melanoma/biopsy site was prepped and draped in the usual sterile fashion. A margin of 1–2 cm* (*specify*) *on all sides of the melanoma / biopsy site was measured. An elliptical incision was made in the orientation of the skin line / longitudinal axis of the limb that completely encompassed the measured area. This incision was deepened to the fascia overlying the muscle. Skin and subcutaneous tissues were completely excised off the underlying fascia*, *with the fascia left intact. The specimen was then oriented with clips / silk suture with a long lateral and short superior stitch. Hemostasis was ensured*, *flaps were raised at the fascial level*, *and the wound was closed with a deep layer of interrupted or running 3-0 Vicryl sutures and skin staples / a subcuticular closure / nylon mattress sutures*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was awoken and extubated without difficulty and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Michael Bonebrake, M.D. in the previous edition.

Superficial Inguinal Lymph Node Dissection

156

T.J. Henry and Hisakazu Hoshi

Indications

- Clinical involvement of inguinal nodes from melanoma, squamous cell carcinoma of the anus, and carcinoma of the vulva, scrotum, penis, or distal urethra
- Positive sentinel lymph node biopsy, in the absence of distant metastasis

Essential Steps

1. Elliptical / vertical incision centered over femoral triangle.
2. Raise flaps.
3. Divide and ligate the greater saphenous vein distally.
4. Identify the femoral vessels.
5. Reflect the lymph nodes off the femoral vessels.
6. Ligate/clip tributaries of the greater saphenous vein as they are encountered.
7. Suture ligate the greater saphenous vein at the saphenofemoral junction.
8. Identify the inguinal ligament and detach the specimen.
9. Take abdominal wall fatty tissue 5 cm above the inguinal ligament.
10. Ensure hemostasis.
11. Detach the proximal sartorius muscle and swing medially to cover the defect over the femoral vessels.
12. Secure the sartorius to the external oblique aponeurosis / inguinal ligament with interrupted 3-0 PDS horizontal mattress sutures in a staggered fashion.
13. Place closed suction drains adjacent to the sartorius.
14. Approximate subcutaneous tissues with interrupted 3-0 Vicryl.
15. Close the skin with a subcuticular stitch / staples / other.
16. Apply dressing and compressive Ace bandage to the lower extremity.

Note These Variations

- Incision and variations to include any previous biopsy scars or skin lesions.
- Preservation of the greater saphenous vein (only in micrometastatic disease).
- Deep dissection may be performed in addition.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_156

Complications

- Wound breakdown
- Lymphocele
- Lymphedema
- Sensory deficit
- DVT
- Recurrence

Template Operative Dictation

Preoperative Diagnosis Malignant *melanoma / other* metastatic to inguinal nodes, TNM stage

Procedure *Right / left* superficial inguinal lymph node dissection and sartorius muscular flap

Postoperative Diagnosis Same

Indications This ___-year-old *male / female* was initially diagnosed with malignant *melanoma / other. Fine needle aspiration cytology of palpable node / sentinel lymph node biopsy was positive for metastatic melanoma / other*. Superficial inguinal node dissection was indicated for management.

Description of the Procedure The patient was brought to the operating room and placed supine on the operating table and monitors attached. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. Endotracheal intubation was performed and preoperative antibiotics were administered. The *right / left* lower extremity, groin, and lower abdominal wall were prepped and draped in the usual sterile fashion.

The junction of the sartorius and adductor longus was palpated inferiorly and the inguinal ligament was marked superiorly. A thin crescent of the skin was then incised, within the femoral triangle. (Alternatively: *A vertical incision centered over the femoral triangle was made, incorporating a 3–4 cm ellipse of the skin over the femoral triangle.*) The subcutaneous tissues were carefully dissected using electrocautery. Flaps were raised from the skin edges deep to Scarpa's fascia to the adductor longus and sartorius muscles. The saphenous vein was identified at the junction of the sartorius and adductor muscles inferiorly, clamped, divided, and ligated. Flaps were raised superiorly 5 cm above the inguinal ligament, medial to the pubic tubercle, and lateral to the anterior-superior iliac spine. The *spermatic cord / round ligament* was identified and preserved. Dissection on the anterior surface of the femoral vessels was performed toward the inguinal ligament. The lymph nodes were then reflected superiorly off the femoral vessels. Perforating arteries and veins were *ligated using 2-0 and 3-0 silk ties / clipped*. The saphenofemoral junction was then identified within the specimen. The saphenofemoral junction was clamped using a pediatric Potts vascular clamp. The saphenofemoral junction was then divided and suture ligated. The dissection was continued superiorly to dissect the lymph nodes off the femoral vessels. Abdominal wall fatty tissue 5 cm above the inguinal ligament was dissected off the external oblique fascia. The inguinal ligament was then identified and the specimen was completely separated from the vessels and passed off.

If sartorius flap is performed: The sartorius muscle was then divided in its superior aspect. It was transposed medially over the vessels and secured to the fascia of the external oblique using 3-0 PDS horizontal mattress sutures in a staggered fashion. The wound was carefully irrigated and inspected. There was no evidence of bleeding. A *round / flat* closed suction drain was placed within the bed of the dissection and brought out through a separate stab incision. The subcutaneous tissues were carefully approximated using interrupted 3-0 Vicryl sutures. The skin was closed with *staples / a subcuticular suture / other*. The wound was dressed with sterile gauze and Kerlix wrap. A compressive Ace bandage was applied circumferentially from the toes to the mid-thigh.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was awoken and extubated without difficulty, and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Michael Bonebrake, M.D., in the previous edition.

Inguinal and Pelvic Lymphadenectomy (Superficial and Deep Groin Dissection)

157

Hisakazu Hoshi

Indications

- Nodal metastatic melanoma, carcinoma

Essential Steps

1. Curvilinear incision crossing the inguinal ligament (*Option*: *combined incisions transverse incision above inguinal crease and longitudinal incision in femoral triangle*).
2. Flaps to expose the femoral triangle and aponeurosis of the external oblique.
3. Identify and preserve the spermatic cord in males.
4. Incise fascia overlying the medial border of the adductor longus muscle to the crossing of the sartorius.
5. Sweep the nodal tissue laterally.
6. Ligate and divide the saphenous vein at the apex of the femoral triangle (*Option*: *preservation of the greater saphenous vein*).
7. Incise fascia overlying the sartorius and sweep the nodal tissue off.
8. Clean anterior surfaces of the femoral vessels.
9. Ligate and divide the saphenous vein at the saphenofemoral junction (*Option*: *preservation of saphenofemoral junction*).
10. Identify and preserve the branches of the femoral nerve.
11. *If pelvic dissection*:
    - *Detach the inguinal ligament from the anterior superior iliac spine and reflect medially / separate transverse incision above the inguinal ligament and divide abdominal wall.*
    - *Dissect the nodal tissue along the external and common femoral vessels and obturator nerve, preserving the nerve, vessels, and ureter.*
12. Obtain hemostasis.
13. Reconstruct inguinal ligament.
14. Transpose the sartorius muscle medially.
15. Place closed suction drains.
16. Close the incision.

Note These Variations

- Choice of anesthesia
- Use of minimally invasive approach
- Orientation of incision
- Inclusion of pelvic dissection; division of inguinal ligament vs separate abdominal wall incision

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_157

Complications

- Lymphocele
- Necrosis of flaps
- Lymphedema
- Recurrence
- Wound infection with femoral artery blowout

Template Operative Dictation

Preoperative Diagnosis *Metastatic melanoma / carcinoma / positive sentinel node biopsy*. TNM stage

Procedure *Inguinal / pelvic lymphadenectomy* (*superficial and deep groin dissection*) *with sartorius muscular flap*

Postoperative Diagnosis Same

Indications This ___-year-old *male / female* with *melanoma / carcinoma of the* (*detail site*) metastatic to the inguinal nodes required lymphadenectomy for management

Description of Procedure The patient was brought to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General / regional anesthesia was induced. The right / left groin and lower abdominal wall were prepped and draped in the usual sterile fashion. *A curvilinear incision was made crossing the inguinal ligament / a longitudinal incision was made in the center portion of femoral triangle*, *and an additional transverse lower abdominal incision was made just above the inguinal crease to avoid incision over the inguinal area*. Flaps were developed to expose the aponeurosis of the external oblique 5 cm above the inguinal ligament and the femoral triangle. Dissection commenced at the adductor longus muscle just below the inguinal ligament. The fascia of the adductor muscle was incised and fatty and areolar tissue swept laterally. *At the apex of the femoral triangle*, *the greater saphenous vein was doubly ligated with 2-0 silk and divided / the greater saphenous vein was identified*, *dissected along the entire course up to saphenofemoral junction and preserved*. Dissection then proceeded cephalad along the sartorius muscle by *incising / leaving* investing fascia. The femoral artery and vein were then identified at the apex of the femoral triangle. Dissection on the anterior surface of the femoral vessels was performed toward the inguinal ligament. Areolar and fatty node-bearing tissue was reflected from the vessels proceeding cephalad. The femoral nerve and its branches were identified and protected. *The saphenous vein was identified entering the femoral vein and ligated and divided / the branches of saphenofemoral junction except the greater saphenous vein were ligated and divided*. The soft tissue covering the lower abdominal wall groin area was dissected from the abdominal wall. Remaining attachments were divided and the specimen removed.

If pelvic dissection

The inguinal ligament was divided from the anterior superior iliac spine and reflected medially and the abdominal wall was divided cephalad to expose the retroperitoneum / an incision was made through the aponeurosis of the external oblique, *the internal oblique*, *and the transversus to expose the retroperitoneum*.

The ureter was seen on the surface of retracted abdominal contents. The dissection started lateral to the iliac vessels, and the lateral femoral cutaneous nerve was identified and preserved. The soft tissue was dissected off the common and the external iliac vessels in a lateral to medial and cephalad to caudad fashion. The internal iliac vessels were exposed, and the soft tissue between the internal and the external vessels was dissected away from the obturator nerve. The specimen was removed en bloc. The inguinal ligament was approximated with interrupted 2-0 PDS / the abdominal wall incision was closed in layers with running 2-0 PDS.

Hemostasis was checked. The sartorius muscle was detached from its origin at the anterior superior iliac spine and transposed medially. It was brought to lie over the femoral vessels and secured in place with interrupted 3-0 PDS. Closed suction drains were placed under the flaps and brought out through separate stab wounds.

The incision was closed with interrupted 3-0 Vicryl and *skin staples* / *a subcuticular closure* / *other*. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Part XIII

General Surgery: Head and Neck

Parathyroidectomy for Adenoma

158

Jessica Maxwell and James R. Howe

Indication

- Parathyroid adenoma

Essential Steps

1. Develop subplatysmal flaps and divide the strap muscles in the midline.
2. Draw baseline PTH level.
3. Identify and excise the abnormal parathyroid gland.
4. Draw a post-excision PTH level.
5. Verify adequate drop in PTH level.

Note These Variations

- PTH drawn from internal jugular vein, peripheral vein, or arterial line
- Four gland exploration

Complications

- Hypocalcemia
- Residual/recurrent hyperparathyroidism
- Recurrent laryngeal nerve injury
- Post-op bleeding resulting in tracheal compression and airway obstruction

Template of Operative Dictation

Preoperative Diagnosis Parathyroid adenoma

Procedure *Right/left superior/inferior* parathyroidectomy with intraoperative PTH

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* with primary hyperparathyroidism was noted to have a parathyroid adenoma on workup for hypercalcemia. Preoperative studies localized the gland to the *right/left superior/inferior* gland. Parathyroidectomy is indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following smooth induction of general anesthesia, both arms were tucked at the sides and all bony prominences were padded. A soft roll was placed under the shoulders, and the patient was positioned in a modified beach chair position with

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_158

the neck extended. The neck and upper chest were prepped and draped in a sterile fashion.

A ___-cm incision was made in a skin crease positioned approximately two finger breadths superior to the sternal notch. The subcutaneous tissues and platysma were divided with electrocautery. Subplatysmal flaps were developed. The strap muscles were divided in the midline and retracted laterally.

The *right/left* thyroid lobe was rotated medially. The loose areolar attachments were dissected bluntly and using electrocautery. Baseline PTH level was drawn from the *peripheral IV/arterial line/internal jugular central venous catheter*. An abnormal-appearing *right/left superior/inferior* parathyroid gland was noted (*describe location of the gland relative to the thyroid and inferior thyroid artery*). The gland was gently dissected from the surrounding tissues down to its pedicle. The pedicle of the parathyroid gland was clamped and tied with a 3-0 silk suture. The parathyroid gland was excised and sent to pathology. Another PTH level was drawn 10–15 min post-excision from the *peripheral IV/arterial line/internal jugular central venous catheter*.

Pathology from the gland returned consistent with hypercellular parathyroid and the gland weighed ___ mg. The baseline PTH was (*note value*) and the 10–15 min post-excision PTH was (*note value*). This constituted a (*note percentage*) percent drop from baseline.

If the drop in the PTH was inadequate: *The right/left thyroid was retracted medially and exploration was continued inferiorly/superiorly. An abnormal-appearing right/left superior/inferior parathyroid gland was noted* (*describe location of the gland*). *The gland was gently dissected from the surrounding tissues down to its pedicle. The pedicle of the parathyroid gland was clamped and tied with a 3-0 silk suture. The parathyroid gland was excised and sent to pathology. Another PTH level was drawn 10–15 min post-excision of this gland. Pathology from the gland returned consistent with hypercellular parathyroid. Post-excision PTH was* (*note value*), *constituting a* (*note percentage*) *percent drop from baseline*.

The wound was copiously irrigated and hemostasis was achieved. The strap muscles and platysma were reapproximated with interrupted 3-0 Vicryl sutures. Approximately 10 cc of 0.25 % Marcaine was injected subcutaneously. The skin was reapproximated with a running 4-0 Monocryl subcuticular suture. Surgical glue was applied over the incision.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Joshua R. French, M.D. in the previous edition.

Radioisotope-Guided Parathyroidectomy

159

Jessica Maxwell and James R. Howe

Indications

- Primary hyperparathyroidism
- Neck re-exploration for primary hyperparathyroidism
- Persistent hyperparathyroidism

Essential Steps

1. Nuclear medicine injection of ^{99m}TcMIBI 15–30 min prior to surgery.
2. Use the gamma probe transcutaneously to plan incision.
3. Develop subplatysmal flaps and divide the strap muscles in the midline.
4. Draw baseline PTH level.
5. Use gamma probe to help identify and excise the abnormal parathyroid gland.
6. Obtain ex vivo and background counts.
7. Draw a post-excision PTH level.
8. Verify adequate drop in PTH level.
9. Obtain meticulous hemostasis and close without drains.

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Note This Variation

- PTH drawn from internal jugular vein, peripheral vein, or arterial line

Complications

- Hypocalcemia
- Recurrent laryngeal nerve injury
- Post-op bleeding resulting in tracheal compression and airway obstruction

Template of Operative Dictation

Preoperative Diagnosis *Parathyroid adenoma/persistent hyperparathyroidism*

Procedure Radioisotope-guided *right/left superior/inferior* parathyroidectomy with intraoperative PTH

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was noted to have a *parathyroid adenoma/persistent hyperparathyroidism* on workup for hypercalcemia. Preoperative studies localized the gland to _____. Radioisotope-guided parathyroidectomy is indicated.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_159

Description of Procedure Thirty to 60 min prior to surgery, the patient was taken to nuclear medicine, where injection of ____ mBq ^{99m}TcMIBI was performed. The patient was then transported to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following smooth induction of general anesthesia, both arms were tucked at the sides and all bony prominences were padded. A soft roll was placed under the shoulders and the patient was positioned in a modified beach chair position with the neck extended. The neck and upper chest were prepped and draped in a sterile fashion. Baseline PTH level was drawn was drawn from a *peripheral IV/arterial line*.

A ___-cm incision was marked in a skin crease after using the gamma probe to find the highest count transcutaneously. The skin was incised with a scalpel, and the subcutaneous tissues and platysma were divided with electrocautery. Subplatysmal flaps were developed. The strap muscles were dissected out and retracted.

The *right/left* thyroid lobe was rotated medially. The loose areolar attachments were dissected bluntly and using electrocautery. A baseline reading was obtained from the thyroid gland and the lateral tissues of the neck. The gamma probe was then used to guide further dissection. An abnormal-appearing *right/left superior/inferior* parathyroid gland was noted (*describe location of the gland*). In vivo count was (*note value*). The gland was gently dissected from the surrounding tissues down to its pedicle. The pedicle of the parathyroid gland was clamped and tied with a 3-0 silk suture. The parathyroid gland was excised. The ex vivo count was (*note value*). The gland was sent to pathology. The background count was (*note value*). Another PTH level was drawn 10–15 min post-excision.

Pathology from the gland returned consistent with hypercellular parathyroid and the gland weighed ___ mg. The baseline PTH was (*note value*) and the 10-min post-excision PTH was (*note value*). This constituted a (*note percentage*) percent drop from baseline.

The wound was copiously irrigated and hemostasis was achieved. The strap muscles and platysma were reapproximated with interrupted 3-0 Vicryl sutures. Approximately 10 cc of 0.25 % Marcaine was injected subcutaneously. The skin was reapproximated with a running 4-0 Monocryl subcuticular suture. Surgical glue was placed over the incision.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Joshua R. French, M.D. in the previous edition.

160 Parathyroidectomy for Secondary or Tertiary Hyperparathyroidism

Jessica Maxwell and James R. Howe

Indication

- Secondary hyperparathyroidism
- Tertiary hyperparathyroidism

Essential Steps

1. Develop subplatysmal flaps and divide the strap muscles in the midline.
2. Identify, biopsy, and excise all parathyroid glands, or leave viable remnant of one gland.
3. Verify that pathology of each excised gland is parathyroid tissue.
4. Reimplant small pieces of half a parathyroid gland into the brachioradialis muscle of the non-dominant forearm (for total parathyroidectomy).
5. Obtain meticulous hemostasis and close incision(s) without drains.

Note These Variations

- Three-and-a-half gland excision with half gland left on vascular pedicle
- Cryopreservation of parathyroid tissue

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Complications

- Hypocalcemia
- Recurrent laryngeal nerve injury
- Post-op bleeding resulting in tracheal compression and airway obstruction

Template of Operative Dictation

Preoperative Diagnosis *Secondary/tertiary* hyperparathyroidism

Procedure Total parathyroidectomy with autotransplantion into *right/left* forearm (*or three-and-a-half gland parathyroidectomy*)

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed *secondary/tertiary* hyperparathyroidism unresponsive to medical therapy. *Total/three-and-a-half gland* parathyroidectomy is indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following smooth induction of general anesthesia, both arms were tucked at the sides and all bony promi-

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_160

nences were padded. A soft roll was placed under the shoulders and the patient was positioned in a modified beach chair position with the neck extended. The neck and upper chest were prepped and draped in a sterile fashion. A baseline PTH was drawn from the *peripheral IV/arterial line. If three-and-a-half gland parathyroidectomy is performed*: *prior to the operation*, *the right/left superior/inferior gland was chosen for preservation*, *based on scintigraphic imaging*.

A ___-cm incision was made in a skin crease positioned approximately two fingerbreadths superior to the sternal notch. The subcutaneous tissues and platysma were divided with electrocautery. Subplatysmal flaps were developed. The strap muscles were divided in the midline and retracted laterally.

The right thyroid lobe was rotated medially. The loose areolar attachments were dissected bluntly and using electrocautery. The right *superior/inferior* parathyroid gland was identified (*describe location of the gland*). A biopsy of the gland was sent to pathology. The gland was gently dissected from the surrounding tissues down to its pedicle, which was clamped and tied with a 3-0 silk suture. The parathyroid gland was excised and placed in a labeled cup on ice. The right *superior/inferior* parathyroid gland was identified (*describe location of the gland*). It was biopsied and dissected from the surrounding tissues down to its pedicle, which was clamped and tied with a 3-0 silk suture. The parathyroid gland was excised and placed in a separate labeled cup on ice.

Next the left thyroid lobe was rotated medially and a similar procedure carried out to identify the left parathyroid glands. Each was excised, biopsied, and placed in separate labeled cups on ice. The left superior parathyroid gland was identified (*describe location of the gland*). The left inferior parathyroid gland was identified (*describe location of the gland*). Pathology from each gland returned consistent with parathyroid tissue. The cervical thymus was dissected free on both sides and removed, ligating its inferior veins with 3-0 silk suture. A post-excision PTH level was sent approximately 15 min after removal of the glands.

If three-and-a-half gland parathyroidectomy is performed: *the right/left superior/inferior gland was selected for preservation. A biopsy of the gland was sent to pathology. The gland was dissected free from surrounding tissues*, *keeping the artery and vein intact. The gland was divided sharply by placing a clip across it and then incising the parenchyma. The excised portion of the gland was placed in labeled cup of ice*.

The neck wound was copiously irrigated and hemostasis was achieved. The strap muscles and platysma were reapproximated with interrupted 3-0 Vicryl sutures. Approximately 10 cc of 0.25 % Marcaine was injected subcutaneously. The skin was reapproximated with a running 4-0 Monocryl subcuticular suture. Surgical glue was placed over the incision.

The *right/left* forearm was extended on an arm board and then prepped and draped in a sterile fashion. An incision was made in the *right/left* lateral forearm. Using blunt dissection, ____ pockets were carefully made in the belly of the brachioradialis muscle. Approximately half of the *right/left superior/inferior* parathyroid gland was divided into multiple 1–3 mm sections using a scalpel. Several pieces of parathyroid tissue were placed in each pocket. Each pocket was marked with a clip and closed with a 4-0 Prolene suture. The deep dermis was reapproximated with interrupted 3-0 Vicryl sutures. The skin was reapproximated with a running 4-0 Monocryl subcuticular suture.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Joshua R. French, M.D. in the previous edition.

161 Thyroid Lobectomy

Jessica Maxwell and James R. Howe

Indications

- Enlarging or suspicious thyroid nodule
- Follicular neoplasm on FNA
- Toxic nodule

Essential Steps

1. Develop subplatysmal flaps.
2. Divide the strap muscles in the midline.
3. Ligate and divide the middle thyroid vein.
4. Preserve the external branch of the superior laryngeal nerve.
5. Ligate and divide the superior pole vessels.
6. Mobilize the inferior pole of the thyroid.
7. Identify and preserve the recurrent laryngeal nerve.
8. Divide the inferior thyroid artery and branches distally.
9. Identify and preserve the superior and inferior parathyroid glands.
10. Dissect the thyroid free of the trachea.
11. Divide the thyroid lobe at the isthmus.

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Note These Variations

- Division of the strap muscles
- Division of isthmus prior to thyroid dissection
- Superior pole dissection prior to division of the middle thyroid vein
- Intraoperative recurrent laryngeal nerve monitoring
- Drain placement

Complications

- Post-op bleeding, resulting in tracheal compression and airway obstruction
- Recurrent laryngeal nerve injury
- Injury to the external branch of the superior laryngeal nerve
- Hypothyroidism

Template of Operative Dictation

Preoperative Diagnosis *Follicular neoplasm/hot nodule/enlarging or suspicious thyroid nodule*

Procedure *Right/left* thyroid lobectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was noted to have a thyroid nodule. On workup, it

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_161

was *enlarging/suspicious/a follicular neoplasm on FNA/a toxic nodule*. Thyroid lobectomy is indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following induction of general anesthesia, both arms were tucked at the sides and all bony prominences were padded. A roll was placed under the shoulders, and the patient was positioned in a modified beach chair position with the neck extended. The neck was prepped and draped in a sterile fashion.

A ___-cm incision was made in a skin crease positioned approximately two finger breadths superior to the sternal notch. The subcutaneous tissues and platysma were divided with electrocautery. Subplatysmal flaps were then raised inferiorly extending to the sternal notch and superiorly extending to the thyroid cartilage. The strap muscles were divided in the midline and retracted laterally.

The *right/left* thyroid lobe was mobilized from its areolar attachments using blunt dissection and electrocautery. The thyroid was gently retracted medially and the middle thyroid vein was identified. It was ligated with 3-0 silk sutures and divided. The thyroid gland was then gently retracted inferomedially. The superior pole vessels were ligated with 3-0 silk sutures and divided close to the thyroid gland, with careful attention not to injure the external branch of the superior laryngeal nerve.

Next, the thyroid gland was gently retracted medially and the muscles retracted laterally. The inferior thyroid artery was identified. Using blunt dissection, the recurrent laryngeal nerve was identified and followed superficially along its path to aid in continued safe dissection. The vessels to the thyroid in this vicinity were ligated with 3-0 silk ties and divided with great care to avoid injury to the recurrent laryngeal nerve and to preserve their distal branches. The superior and inferior parathyroid glands were identified and carefully mobilized off of the thyroid gland to preserve their blood supply.

Once the recurrent laryngeal nerve and parathyroid glands were safely dissected free, attention was turned to the mobilization of the inferior pole using blunt dissection. The trachea was exposed, and the thyroid was dissected medially from its attachments to the trachea up to the ligament of Berry using bipolar cautery. Small vessels were ligated using 3-0 silk suture. Dissection was extended to the isthmus, which was clamped with Kelly clamps, divided, and suture ligated with a 2-0 silk stitch. The specimen was marked with a suture at the superior pole for orientation and handed off to be sent to pathology.

The wound was copiously irrigated and hemostasis was achieved. The strap muscles were reapproximated with interrupted 3-0 Vicryl sutures. The platysma was reapproximated with interrupted 3-0 Vicryl sutures. Approximately 10 cc of 0.25 % Marcaine was injected subcutaneously. The skin was reapproximated with a running 4-0 Monocryl subcuticular suture. Surgical glue was placed over the incision. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was extubated in the operating room and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Joshua R. French, M.D. in the previous edition.

Total Thyroidectomy

162

Jessica Maxwell and James R. Howe

Indications

- Thyroid cancer
- Multiple endocrine neoplasia (MEN) 2A or 2B
- Symptomatic multinodular goiter
- Graves' disease

Essential Steps

1. Develop subplatysmal flaps.
2. Divide the strap muscles in the midline.
3. Ligate and divide the middle thyroid vein.
4. Preserve the external branch of the superior laryngeal nerve.
5. Ligate and divide the superior pole vessels.
6. Mobilize the inferior pole of the thyroid.
7. Identify and preserve the recurrent laryngeal nerve.
8. Divide the inferior thyroid artery and branches distally.
9. Identify and preserve the superior and inferior parathyroid glands.
10. Dissect the thyroid from the trachea to the level of the isthmus.
11. Repeat steps 3–9 on the opposite side.
12. Dissect the thyroid free of the trachea.
13. Obtain meticulous hemostasis and close without drains.

Note These Variations

- Division of the strap muscles
- Division of isthmus prior to thyroid dissection
- Superior pole dissection prior to division of the middle thyroid vein
- Intraoperative recurrent laryngeal nerve monitoring
- Drain placement
- Reimplantation of a parathyroid gland
- Central neck lymph node dissection

Complications

- Post-op bleeding, resulting in tracheal compression and airway obstruction
- Recurrent laryngeal nerve injury
- Injury to the external branch of the superior laryngeal nerve
- Hypocalcemia

Template of Operative Dictation

Preoperative Diagnosis *Thyroid cancer/MEN 2/symptomatic multinodular goiter/Graves' disease*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_162

Procedure Total thyroidectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was noted to have *a thyroid cancer on FNA/familial MEN 2/symptomatic multinodular goiter/Graves' disease* on workup. Total thyroidectomy is indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following induction of general anesthesia, both arms were tucked at the sides and all bony prominences were padded. A roll was placed under the shoulders, and the patient was positioned in a modified beach chair position with the neck extended. The neck was prepped and draped in a sterile fashion.

A ___-cm incision was made in a skin crease positioned approximately two finger breadths superior to the sternal notch. The subcutaneous tissues and platysma were divided with electrocautery. Subplatysmal flaps were then raised inferiorly extending to the sternal notch and superiorly extending to the thyroid cartilage. The strap muscles were divided in the midline and retracted laterally.

The right thyroid lobe was mobilized from its areolar attachments using blunt dissection and electrocautery. The thyroid was gently retracted medially and the middle thyroid vein was identified. It was ligated with 3-0 silk sutures and divided. The thyroid gland was then gently retracted inferomedially. The superior pole vessels were ligated with 3-0 silk sutures and divided close to the thyroid gland, with careful attention not to injure the external branch of the superior laryngeal nerve.

Next, the thyroid gland was gently retracted medially and the muscles retracted laterally. The inferior thyroid artery was identified. Using blunt dissection, the right recurrent laryngeal nerve was identified and followed superficially along its path to aid in continued safe dissection. The vessels to the thyroid in this vicinity were ligated with 3-0 silk ties and divided with great care to avoid injury to the recurrent laryngeal nerve and to preserve their distal branches. The right superior and inferior parathyroid glands were identified and carefully mobilized off of the thyroid gland to preserve their blood supply. Once the recurrent laryngeal nerve and parathyroid glands were safely dissected free, attention was turned to mobilization of the inferior pole using blunt dissection. The trachea was exposed, and the thyroid was dissected medially from its attachments to the trachea up to the ligament of Berry using bipolar cautery. Small vessels were ligated using 3-0 silk suture. Dissection was extended to the isthmus.

The pyramidal lobe was identified. It was dissected free circumferentially of its attachments over the thyroid cartilage. It was divided as high as possible and then reflected inferiorly down to the isthmus.

A similar procedure was then carried out on the left. The left recurrent laryngeal nerve was identified and carefully followed superficially along its course superiorly to ensure it was not injured. The left superior and inferior parathyroid glands were identified and preserved. Dissection was extended to the isthmus, dissecting the thyroid free from the trachea. The specimen was marked with a suture at the right superior pole for orientation and handed off to be sent to pathology.

If a central neck dissection is performed: *A Level VI lymph node dissection was performed by removing the lymphatic tissue in the central neck, extending laterally to the carotid sheath, inferiorly to the sternal notch, and superiorly to the hyoid bone. The specimen was sent to pathology.*

If any parathyroids were reimplanted: *The right/left superior/inferior parathyroid gland was divided into multiple 1–3 mm sections using a scalpel. Using blunt dissection, two pockets were made in the belly of right/left sternocleidomastoid muscle. Several pieces of parathyroid tissue were placed in each pocket. The pocket was marked with a clip, and a 4-0 Prolene suture was used to close each pocket.*

The wound was copiously irrigated and hemostasis was achieved. The strap muscles and platysma were reapproximated with interrupted 3-0 Vicryl sutures. Approximately 10 cc of 0.25 % Marcaine was injected subcutaneously. The skin was reapproximated with a running 4-0 Monocryl subcuticular suture. Surgical glue was placed over the incision.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated and taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Joshua R. French, M.D. in the previous edition.

163 Neck Dissection

Tyson J. Nielsen and Audrey B. Erman

Indications

- Elective in setting of clinically occult metastases
  - Selective neck dissection: N_0 (no clinical evidence of nodal metastases) or for very limited cervical metastases
- Therapeutic in setting of clinical metastases
  - Modified radical neck dissection: cervical clearance of levels I–V with preservation of one or more of the following structures – sternocleidomastoid muscle, spinal accessory nerve (CN XI), and internal jugular vein
  - Radical neck dissection: extensive cervical lymph node involvement with extracapsular spread involving sternocleidomastoid muscle and/or internal jugular vein and/or spinal accessory nerve (CN XI)
  - Extended neck dissection: resection of additional lymphatic groups or nonlymphatic structures not included in a modified/radical neck dissection

Nodal Levels

- Level I
  - Level Ia (submental triangle) – bounded by anterior bellies of the bilateral digastric muscles and deeply by the mylohyoid between the hyoid bone and body of the mandible
  - Level Ib (submandibular triangle) – bounded by anterior and posterior bellies of the digastric muscle between the hyoid bone and body of the mandible
- Level II – bounded by the skull base and hyoid bone, between the posterior edge of sternocleidomastoid muscle (SCM) and stylohyoid muscle
  - Transected obliquely by spinal accessory nerve (CN XI) subdividing into level IIa (anterior to CN XI) and level IIb (posterior to CN XI)
- Level III – bounded by hyoid bone and inferior border of cricoid cartilage between sternohyoid muscle and posterior border of SCM
- Level IV – bounded by inferior border of cricoid cartilage and clavicle, between sternohyoid muscle and posterior border of SCM
- Level V – bounded by posterior border of SCM and anterior border of trapezius, between mastoid and clavicle
  - Can be subdivided along a horizontal line extending from level of cricoid cartilage into level Va superiorly and level Vb inferiorly

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_163

- Level VI – bounded laterally by the carotid arteries, superiorly by the hyoid bone, and inferiorly by the suprasternal notch

Essential Steps

1. Incision and development of subplatysmal flaps.
2. Identify external jugular vein and greater auricular nerve (+/− transection).
3. Superior flap is elevated to identify submandibular salivary gland.
4. Submandibular gland fascia incised inferiorly to marginal mandibular nerve.
5. Submental triangle (level IA) lymph nodes resected.
6. Hypoglossal nerve (CN XII) and lingual nerve identified and preserved.
7. Submandibular duct and vessels ligated (+/− ligation of facial artery/vein).
8. Submandibular triangle (Level IB) lymph nodes and gland resected.
9. External jugular vein ligated.
10. Identify and preserve spinal accessory nerve (CN XI).
11. Level IIa/IIb lymph nodes resected.
12. Carotid sheath identified and preserved.
13. Level III lymph nodes resected.
14. Level IV lymph nodes resected.
15. Closure.

Note These Variations

- A variety of incisions have been described – the skin crease incision described here is the most common.
- Resection of sternocleidomastoid, internal jugular vein, and spinal accessory nerve.
- Drain placement.
- Repeat steps 6–14 on opposite side for bilateral neck dissection (avoid bilateral internal jugular vein ligation).

Complications

- Failure of incision to heal properly resulting in exposure of carotid artery
- Post-op bleeding, resulting in tracheal compression and airway obstruction
- Marginal mandibular, spinal accessory, hypoglossal, and/or lingual nerve injury
- Loss of cutaneous sensation in distribution of cervical plexus
- Injury to thoracic duct or other lymphatic structures and subsequent chyle leak

Template of Operative Dictation

Preoperative Diagnosis *Metastatic squamous cell carcinoma/malignant melanoma/thyroid cancer*

Procedure Anterolateral neck dissection (selective)

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was noted to have *cervical lymphadenopathy* in the setting of *squamous cell carcinoma/malignant melanoma/thyroid cancer* on work-up. Selective anterolateral neck dissection is indicated.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Following induction of general anesthesia, both arms were tucked at the sides and all bony prominences were padded. A roll was placed under the shoulders and the patient was positioned with the neck extended. The neck was prepped and draped in a sterile fashion.

A ___-cm incision was made in a skin crease positioned approximately at the level of the hyoid bone. The subcutaneous tissues and platysma were divided with identification of the external jugular vein and greater auricular nerve (+/− *transection*). Superiorly, subplatysmal flaps were then raised to the level of the submandibular glands with the fascia overlying the gland incised on the inferior portion of the gland to preserve the marginal mandibular branch of the facial nerve within the elevated flap. Inferiorly, subplatysmal flaps were elevated to expose the superior border of the clavicle.

Level Ia (submental triangle) was then resected using electrocautery from between the body of the mandible and the level of the hyoid bone beginning at the contralateral anterior belly of the digastric muscle and proceeding to the ipsilateral anterior belly of the digastric muscle with the mylohyoid muscle serving as the deep boundary. After elevating the fascia covering the submandibular gland to preserve the marginal mandibular branch of the facial nerve and identifying the facial artery and vein with blunt dissection, the submandibular triangle (level Ib) was resected from between the anterior and posterior bellies of the digastric muscle with the mylohyoid muscle again serving as the deep boundary. The mylohyoid muscle was then retracted anteriorly, and the lingual nerve, submandibular duct, and hypoglossal nerve (CN XII) were then identified. The submandibular duct was then clamped and ligated taking care to preserve the lingual nerve.

Next the external jugular vein was divided and ligated with 3-0 silk suture. The fascia overlying the posterior belly of the digastric muscle was divided up to the anterior border of the SCM. The fascia surrounding the SCM was then dissected with identification and preservation of the spinal accessory nerve (CN XI). Levels IIa and IIb were then resected away from posterior edge of the SCM with the scalene muscles of the neck serving as the deep boundary.

Dissection continued along posterior edge of sternocleidomastoid muscle into level III and subsequently into level IV. The carotid sheath was then identified and preserved with anterior traction placed on level II/III/IV specimen with lymph node contents from level II/III/IV carefully dissected en bloc off of carotid sheath using a scalpel with the superior border of the clavicle serving as the inferior border for completion of level IV dissection.

If bilateral neck dissection is indicated: *Process repeated on opposite side of the neck beginning with resection of submandibular triangle (level IB) contents and proceeding to remove lymph nodes from levels II, III, and IV.*

If a modified radical neck dissection is performed: *A modified type __ (I/II/III) neck dissection was performed by removing the lymphatic tissue from levels I–V including resection/preservation of the __ (sternocleidomastoid/spinal accessory nerve/internal jugular vein), extending laterally to the anterior border of the trapezius, inferiorly to the clavicle, and superiorly to the body of the mandible/mastoid tip.*

If a radical neck dissection is performed: *A radical neck dissection was performed by removing the lymphatic tissue from levels I–V including resection of the __ (sternocleidomastoid/spinal accessory nerve/internal jugular vein), extending laterally to the anterior border of the trapezius, inferiorly to the clavicle, and superiorly to the body of the mandible/mastoid tip.*

If an extended neck dissection is performed: *A modified/radical neck dissection was performed removing the lymphatic tissue from levels I–V including resection/preservation of the __ (sternocleidomastoid/spinal accessory nerve/internal jugular vein), extending laterally to the anterior border of the trapezius, inferiorly to the clavicle, and superiorly to the body of the mandible/mastoid tip along with resection of __ (additional lymphatic groups or nonlymphatic structures).*

All specimens were submitted to pathology. A Valsalva maneuver was performed with no evidence of chyle leak. A drain was placed deep to the SCM exiting the neck laterally and a second drain was placed medially deep to platysmal flaps. The wound was copiously irrigated and hemostasis was achieved. The platysma and dermis were re-approximated with interrupted 3-0 Vicryl sutures. The skin was re-approximated with *staples/sutures*. Bacitracin was placed over the length of the incision. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was extubated, and was taken to the postanesthesia care unit in stable condition.

Superficial Parotidectomy

164

Carol E.H. Scott-Conner

Indications

- Tumor of the superficial lobe of the parotid gland
- As part of lymphadenectomy for facial melanoma (rare)

Essential Steps

1. General anesthesia, the head turned, cotton wad in the ear, corner of the mouth, and the eyelid draped into field.
2. Y-shaped incision, with extension posterior to the tragus.
3. Develop flaps deep to the platysma and superficial to the parotid (anterior and inferior to the margin of the parotid gland, cephalad to the zygomatic process, and posterior to the sternocleidomastoid muscle).
4. Identify the great auricular nerve and divide the branch that enters the parotid gland.
5. Identify and ligate the external jugular vein just posterior to the parotid gland.
6. Expose the anterior border of the sternocleidomastoid muscle and develop the plane between the muscle and the mastoid.
7. Divide the temporoparotid fascia.
8. Identify the main trunk of the facial nerve (*a small branch of the posterior auricular artery may be encountered and divided*).
9. Apply traction to the superficial lobe of the parotid gland.
10. Dissect in the plane between the parotid gland and facial nerve branches, tracing and preserving each branch of the facial nerve.
11. Identify and ligate Stensen's duct with absorbable sutures.
12. Remove the superficial lobe.
13. Achieve hemostasis with fine ligatures; avoid use of electrocautery close to the nerve.
14. Close with drainage.

Note These Variations

- Dissection under the facial nerve and removal of part of the deep lobe
- Sacrifice of the facial nerve branch with nerve graft reconstruction
- Use of nerve stimulator

Complications

- Salivary fistula
- Injury to the facial nerve
- Gustatory sweating (Frey's syndrome)

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_164

Template Operative Dictation

Preoperative Diagnosis Tumor of the superficial lobe of the *right/left* parotid gland

Procedure *Right/left* superficial parotidectomy

Postoperative Diagnosis Same *with component involving deep lobe*

Indications This ___-year-old *male/female* developed a swelling anterior to the *right/left* ear consistent with a parotid tumor on *clinical examination/ultrasound/fine needle aspiration cytology*. Decision was made to proceed with surgical excision.

Description of Procedure The patient was positioned supine with the head turned to the *right/left* side. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. A ball of sterile cotton was placed in the external auditory meatus. The field was prepped in the usual fashion and draped so as to include the corner of the mouth and the lateral canthus of the eye. A Y-shaped incision was made in a natural skin crease just anterior to the tragus, progressing inferiorly along a line parallel to the sternocleidomastoid muscle and terminating just below the angle of the mandible with a short extension beneath the tragus to the mastoid process. The incision was deepened through the platysma muscle and hemostasis achieved with electrocautery.

A flap was raised between the anterior surface of the parotid gland and the platysma muscle, taking care not to injure the peripheral branches of the facial nerve, until the medial and inferior borders of the parotid gland were reached. Superiorly the flap was elevated to the zygomatic process and posteriorly the sternocleidomastoid muscle, the mastoid process, and the cartilage of the external auditory canal were exposed.

The great auricular nerve was identified and a small branch entering the substance of the parotid gland was divided sharply. The external jugular vein was identified, doubly ligated with 2-0 silk, and divided.

Dissection then progressed cephalad along the anterior border of the sternocleidomastoid muscle to expose the anterior surface of the mastoid. The temporoparotid fascia was divided and the main trunk of the facial nerve identified.

The main trunk of the facial nerve was traced into the parotid gland and the main branches identified. The superficial lobe of the parotid gland was elevated and dissected free of these branches, removing the tumor completely. Care was taken throughout to avoid injury to the branches of the facial nerve. Stensen's duct was identified and ligated with 2-0 Vicryl and divided. The gland was removed. Hemostasis was achieved with fine ligatures of 4-0 silk.

The facial nerve branches were identified and noted to be intact.

A *closed suction/small Penrose* drain was placed.

The operative field was closed with interrupted 3-0 Vicryl sutures and a running subcuticular suture of 4-0 monocryl.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Part XIV

General Surgery: Miscellaneous Procedures

165 Cricothyroidotomy

Nora Cheung

Indications

- Emergency airway access in the setting of imminent respiratory failure and inability to perform oro- or nasotracheal intubation (e.g., major facial trauma, airway edema, airway foreign body)

Essential Steps

1. Essential equipment: Several sizes of endotracheal or tracheostomy tubes available (usually a #6 tube for adult male and #5 tube for adult female), scalpel, hemostat, and preferably also a tracheal dilator.
2. Hyperextend the neck (*if no cervical spine fracture*).
3. Palpate landmarks: Cricoid and thyroid cartilages, hyoid bone.
4. Stabilize larynx with the nondominant hand.
5. Transverse skin incision above the cricoid cartilage (vertical incision if landmarks are unclear).
6. *If endotracheal tube is in place*, *withdraw to the level of the cords*.
7. Transverse incision through the cricothyroid membrane along the superior border of cricoid cartilage.
8. Dilate the tract.
9. Insert endotracheal or tracheostomy tube.
10. Confirm placement.
11. Secure tube.
12. Achieve hemostasis.

Note These Variations

- Do not hyperextend the neck if cervical spine injury is possible or confirmed.
- Transverse vs. vertical skin incision.
- Rarely performed over an endotracheal tube.
- Size and type of tube.

Complications

- Bleeding
- Subglottic stenosis
- Damage to cricoid cartilage

Template of Operative Dictation

Preoperative Diagnosis *Airway obstruction/facial trauma/failed intubation and loss of airway/other with imminent respiratory failure*

Procedure Cricothyroidotomy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_165

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* required emergent airway access due to *airway obstruction/facial trauma/failed intubation/airway foreign body/other* with loss of airway and imminent respiratory failure.

Description of Procedure The patient was positioned supine and the neck was *hyperextended/kept in a neutral position to protect the cervical spine*. The neck and anterior chest were prepped and draped in the usual sterile fashion. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The thyroid and cricoid cartilages and hyoid bone were palpated and the skin and subcutaneous tissue in this area were anesthetized with 1 % lidocaine *with epinephrine*. The thyroid cartilage was stabilized with the *left/right* hand and the cricothyroid space palpated. A 1.5-cm *transverse/vertical* skin incision was made with a #15 blade over the cricothyroid space. A hemostat was used to bluntly dissect down to the cricothyroid membrane. *The endotracheal tube was withdrawn to the level of the cords*. A #11 scalpel blade was used to puncture the cricothyroid membrane with a transverse incision along the superior border of the cricoid cartilage, and a *tracheal dilator/hemostat* was used to dilate the tract.

A #___ *endotracheal/tracheostomy* tube was inserted and advanced *as the endotracheal tube was withdrawn completely*. Position was confirmed by *end-tidal* CO_2*/other*. Hemostasis was achieved in the incision with *direct pressure/electrocautery/ties/packing*. The *endotracheal/tracheostomy* tube was *secured/sutured* in place *and tracheostomy ties placed and tied around the neck*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was *taken to the PACU/surgical intensive care unit* in *stable/critical* condition.

Acknowledgment This chapter was contributed by Amy Bobis Stanfill, M.D., in the previous edition.

Tracheostomy

166

Nora Cheung

Indications

- Airway obstruction or trauma at or above the level of the larynx
- Prolonged mechanical ventilation needs
- Inability to manage secretions
- Chronic aspiration
- Adjunct to major surgery of the mouth, jaw, or larynx

Essential Steps

1. Best performed as elective procedure over the endotracheal tube.
2. Have several sizes of tubes available:
   - # 8 or #7 tracheostomy tube is the standard for adults or same size as existing endotracheal tube.
   - One size smaller in case of difficulty.
3. Prepare tracheostomy: test tracheostomy balloon for competence, insert obturator, and lubricate entire apparatus.
4. Hyperextend neck (*if no cervical spine fracture*).
5. Palpate midline landmarks: mental protuberance, hyoid bone, thyroid and cricoid cartilages, and sternal notch.
6. *Vertical midline/transverse* incision one fingerbreadth above sternal notch.
7. Dissect in midline to the trachea.
8. Partially withdraw endotracheal tube.
9. Retract the strap muscles laterally and thyroid isthmus superiorly (*or divide it*).
10. Palpate the cricoid cartilage and tracheal rings.
11. Insert tracheostomy hook between the first and second tracheal rings and retract the trachea superiorly.
12. *Place stay suture(s) with monofilament on second or third tracheal ring*.
13. *Vertical incision through the second and third tracheal rings/transverse incision between the second and third rings/cruciate/H-shaped/T-shaped incision*.
14. Dilate the tract.
15. Insert tracheostomy tube as endotracheal tube is withdrawn.
16. Remove obturator and replace with inner cannula.
17. Confirm placement.
18. Achieve hemostasis.
19. Secure tube.

Note These Variations

- Do not hyperextend the neck if cervical spine injury is possible or confirmed.
- Transverse vs. vertical skin incision.
- Presence of stay sutures.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_166

- Location, orientation, and shape of incision into the trachea
- Size of tube.
- Percutaneous dilatational tracheostomy is an increasingly popular alternative (Chap. 167).

Complications

- Bleeding
- Erosion into the innominate artery with tracheoinnominate artery fistula

Template of Operative Dictation

Preoperative Diagnosis *Airway obstruction/need for prolonged airway management/other*

Procedure Tracheostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* required tracheostomy for *airway obstruction/prolonged airway management/other*.

Description of Procedure The patient was positioned supine, and the neck was *hyperextended with a roll under the shoulders/stabilized in neutral position due to known/suspected cervical spinal injury*. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The neck and anterior chest were prepped and draped in the usual sterile fashion. The tracheostomy tube was inspected for damage and the balloon tested for competence.

The mental protuberance, hyoid bone, thyroid and cricoid cartilages, and sternal notch were palpated and the skin and subcutaneous tissue in this area were anesthetized with 1 % lidocaine *with epinephrine*. A *vertical midline incision was made from the middle of the thyroid cartilage to just superior to the sternal notch/transverse incision one fingerbreadth above the sternal notch was made*. A hemostat was used to bluntly dissect down to the thyroid isthmus. The strap muscles were retracted laterally. The plane between the thyroid isthmus and the trachea was developed with a blunt-tipped hemostat, and the thyroid isthmus was retracted superiorly (*rarely*, *divided between hemostats and suture-ligated/doubly clamped and oversewn*). The pretracheal fascia was dissected in order to improve visualization. The endotracheal tube was withdrawn to the level of the vocal cords. The second tracheal ring was identified. A tracheostomy hook was placed between the first and second tracheal rings and the trachea was retracted superiorly. *Stay suture(s) was/were placed laterally on the second/third tracheal ring and left long to assist in retraction. A vertical incision was made through the second and third rings/a transverse incision was made between the second and third rings/a cruciate/H-shaped/T-shaped incision was made over the second and third rings* with a #11 scalpel blade. A tracheal dilator was used to dilate the tract.

A #___ tracheostomy tube was inserted and advanced as the endotracheal tube was withdrawn completely. Position was confirmed by *end-tidal CO_2/other*. Hemostasis was achieved in the incision with *electrocautery/ties/packing*. The tracheostomy tube was sutured in place and tracheostomy ties placed and tied around the neck. The stay suture(s) *was/were left in place/removed*.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Amy Bobis Stanfill, M.D., in the previous edition.

Percutaneous Tracheostomy

167

Ryan Conway and Luis Garcia

Indications

- Airway obstruction at or above the level of the larynx
- Chronic respiratory failure requiring prolonged intubation
- Airway protection in anticipation of head and neck surgery
- Inability to manage secretions

Essential Steps

1. Best performed as an elective procedure with bronchoscopic airway lumen visualization through existing endotracheal tube.
2. Have several sizes of tube available:
   - Same size as the endotracheal tube
   - One size smaller in case of difficulty
3. Hyperextend the neck (*if no cervical spine fracture*). Place towel roll under shoulder blades to facilitate exposure.
4. Palpate the cricoid and thyroid cartilages.
5. Perform a vertical midline incision (avoids inadvertent injury to the anterior jugular veins).
6. Blunt dissection in the midline, down to the trachea.
7. Perform a controlled partial extubation by partially withdrawing the endotracheal tube to reposition the tip of the tube below the vocal cords and just above the likely tracheostomy entry point below the second tracheal ring.
8. Palpate the trachea and access the trachea under direct brochoscopic visualization using the introducer needle and syringe until air is aspirated from the trachea.
9. Advance the guidewire through the needle. Use the Seldinger technique to serially dilate the tract, first with the small dilator and then with the 38-Fr Blue Rhino dilator.
10. Insert the tracheostomy tube and corresponding dilator over the guidewire.
11. Confirm placement with direct bronchoscopy through the tracheostomy tube.
12. Withdraw the endotracheal tube once tracheostomy placement verified.
13. Secure the tracheostomy tube in four positions around the base with 3-0 Prolene suture. Place a tracheostomy strap for added safety.

Note These Variations

- Do not hyperextend the neck if cervical spine injury is possible or confirmed.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_167

- Vertical vs. horizontal incision. Vertical incision is preferred to avoid injury to the anterior jugular veins.
- May be done as totally percutaneous technique or modified with dissection down to the trachea.
- Occasionally an extended tracheostomy tube is required due to patient's body habitus.

Complications

- Bleeding. Always make sure to check coagulation panel and platelet count prior to procedure. Percutaneous technique is relatively contraindicated in patients that are thrombocytopenic or coagulopathic due to higher incidence of bleeding. In these patients, the open approach is preferred because it allows meticulous hemostasis to be attained.
- Trauma to the back wall of the trachea.
- Improper placement.
- Inadvertent complete extubation.
- Erosion into the innominate artery with tracheoinnominate artery fistula.

Template of Operative Dictation

Preoperative Diagnosis *Airway obstruction/need for prolonged airway management/other*

Procedure Percutaneous tracheostomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* required tracheostomy for *airway obstruction/prolonged airway management/other*.

Description of Procedure The patient was positioned supine and the neck was hyperextended. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The neck and anterior chest were prepped and draped in the usual sterile fashion.

The thyroid and cricoid cartilage were palpated and the skin and subcutaneous tissue in this area anesthetized with 1 % lidocaine *with epinephrine*.

Next, the bronchoscope was inserted down through the previously placed endotracheal tube until the carina was well visualized. *Detail the extent of bronchoscopic examination and findings*. The endotracheal tube was slowly withdrawn up to the point where no tracheal rings were visualized.

The trachea was again palpated and stabilized in the midline. A small *vertical midline/transverse* incision was made and the soft tissue dissected bluntly down to the trachea at the level of the second and third tracheal rings. Under direct bronchoscopic visualization, the trachea was then entered using an introducer needle and syringe until air was aspirated from the trachea.

A guidewire was then inserted using Seldinger technique and passed distally under bronchoscopic visualization. The tracheotomy tract was then serially dilated first with the small dilator and then with the tapered #38 French Blue Rhino dilator. Next, a #___ French cuffed tracheostomy tube was then inserted using a #___ French dilator as the inner cannula. Proper tracheostomy tube placement was confirmed with direct bronchoscopy through the tracheostomy tube. The tracheostomy tube cuff was inflated. The endotracheal tube was then removed and the ventilator connection was switched to the tracheostomy tube. The tracheostomy tube was then secured in place in four positions around the base with 3-0 Prolene skin stitches. A tracheostomy strap was also placed for added safety. The patient tolerated the procedure well without any immediate complications. A debriefing checklist was completed to share information critical to postoperative care of the patient.

Acknowledgment This chapter was contributed by Carol E.H. Scott-Conner, M.D., in the previous edition.

Placement of Subclavian Central Venous Catheter

168

Martin Kosztowski and Neelima Katragunta

Indications

- Central venous access
- Central venous pressure monitoring
- Placement of Swan-Ganz catheter
- Hemodialysis

Essential Steps

1. Position patient supine and in a slight Trendelenburg position.
2. Prep the skin and set your sterile drapes over the field. Include the neck on the chosen side in case of change to an internal jugular line.
3. Apply local anesthesia.
4. Identify your landmarks and insert the needle at 30° aiming for the sternal notch.
5. Once the vein is located, place catheter via Seldinger technique.
6. Ensure catheter is working properly: aspirate from each port and then flush each port with saline/heparinized saline.
7. Secure the catheter in place and apply sterile dressing.
8. Obtain a chest x-ray to assess proper line placement, and rule out complications such as hemothorax or pneumothorax.

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Note These Variations

- Use of ultrasound guidance.
- Hickman catheter.
- Subcutaneous port.
- Kits vary; be familiar with the one you are using.
- Passage of Swan-Ganz catheter.

Complications

- Pneumothorax
- Hemothorax
- Venous air embolus
- Arterial puncture
- Line infection
- Venous thrombosis
- Hematoma

Template of Operative Dictation

Preoperative Diagnosis *Hemodynamic instability/need for total parenteral nutrition/other*

Procedure Placement of central venous catheter via *right/left* subclavian route

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_168

Indications This ___-year-old *male/female* required central venous access for *hemodynamic monitoring/central venous nutrition/other* due to complications of ___. The subclavian route was chosen.

Description of Procedure Informed consent was obtained. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was supine and the bed was placed in a 15-degree Trendelenburg position. The skin over the left/right clavicle was inspected for any signs of infection. The skin was scrubbed thoroughly with chlorhexidine and the site was draped.

The central line kit was opened, and each of the central line lumens was flushed with saline/heparinized saline. The skin and subcutaneous tissue were anesthetized with *1% lidocaine*. Anatomic landmarks were identified, and a site was chosen for puncture 2 cm lateral and 2 cm inferior to the bend of the clavicle. The needle was inserted at an angle of 30° to the skin with the long axis of the needle aimed at the sternal notch. The needle was advanced parallel and just posterior to the clavicle until the vein was accessed. The needle was stabilized while the syringe was removed, and the hub of the needle was occluded with a finger. The J-tipped end of the guidewire was then introduced into the needle and advanced without resistance. No arrhythmias were seen on the EKG monitor while advancing the guidewire. The needle was removed over the guidewire leaving the guidewire in place. A 2 mm skin incision was made at the base of the guidewire. The guidewire was held in place while a dilator was gently advanced and removed over the guidewire. The catheter was advanced over the guidewire to the desired depth, and then the guidewire was removed.

All of the catheter ports were checked for return of blood and flushed with *saline/heparinized saline*. The catheter was secured in place with *3-0 silk sutures* and a sterile dressing was applied. The patient tolerated the procedure well and there were no immediate complications. A debriefing checklist was completed to share information critical to postoperative care of the patient. A chest x-ray was obtained demonstrating the *catheter tip at the junction of the SVC and the right atrium* (*describe any other findings*).

Acknowledgment This chapter was contributed by Amy Bobis Stanfill, M.D., in the previous edition.

169 Ultrasound-Guided Placement of Subclavian Central Venous Catheter

Justin Walpole and Neelima Katragunta

Indications

- Central venous pressure monitoring
- Placement of Swan–Ganz catheter
- Delivery of sclerotic medications or agents
- Central access in patient with a C-collar
- Hemodialysis
- Emergency access when other routes fail

Essential Steps

1. Confirm patient and indication.
2. Review any local protocols or guidelines regarding central venous catheter insertion.
3. Gather supplies – always have an extra kit in the room, confirm ultrasound is functioning, and gather sterile personal protective equipment, syringes, flushes, and dressing kit.
4. Place ultrasound monitor at shoulder level opposite side of planned insertion site.
5. Place patient supine, in slight Trendelenburg with the head turned to opposite side of planned insertion site.
6. Use ultrasound to confirm vein is in expected location, is patent, is compressible, and has nonpulsatile venous flow. Store pictures if the ultrasound machine is so equipped.
7. Prepare and drape patient to include the neck and chest on the side of insertion.
8. Have the assistant pass onto the field the catheter kit, the ultrasound probe cover and conducting gel, and the ultrasound probe, flushes, syringes, and dressing kits.
9. Use the ultrasound probe to identify the vein again. Do not forget your traditional landmarks and positioning. If using the infraclavicular approach, the insertion site will likely be more lateral than expected.
10. Anesthetize the overlying skin and soft tissue with local anesthetic.
11. While holding the ultrasound probe in the nondominant hand (or using a fully gowned assistant), insert the 16-guage needle at a *flat* angle to the skin about 1–2 cm lateral to the ultrasound probe, in the same plane.
12. The operator should see on the ultrasound monitor the tip of the needle and the tissue of the vein move with the needle insertion. Once dark venous blood return is confirmed, remove the syringe, and confirm absence of any pulsatile blood return from the needle. Advance the guidewire, and visualize it with the ultrasound. Obtain a picture, and pass off the ultrasound probe.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_169

13. After making a small incision at the wire entry site with an 11 blade, insert the dilator and the central line using Seldinger technique. *Ensure that the wire is always secured between the fingers while doing this*.
14. Remember:
    - Visualizing and cannulating the vein is more challenging than the internal jugular approach.
    - Ultrasound-guided internal jugular venous access is the most preferred method.
    - The complication rate increases exponentially with each attempt. Reassess, reposition, and request assistance early.

Variations

- Kits vary. Be familiar with the one you are using. Include kit name/manufacturer in your dictation.
- Ultrasounds vary. Be familiar with the one you are using. Include ultrasound manufacturer and probe frequency in the dictation.
- Some operators use a supraclavicular approach which can also be done with ultrasound guidance.
- Some central venous catheters are tunneled, cuffed, or have a port attached. The technique of identifying and accessing the vein is the same.

Complications

- Pneumothorax
- Hemothorax
- Arterial puncture, cannulation, or injury
- Vein laceration
- Venous air embolus
- Cardiac perforation with cardiac tamponade
- Cardiac arrhythmia

Template of Operative Dictation

Preoperative Diagnosis *Hemodynamic instability requiring central venous monitoring/inability to obtain peripheral venous access/ other*

Procedure Ultrasound-guided left/right subclavian central venous catheter insertion

Postoperative Diagnosis As above

Indications This ____-year-old *male/female* requires central venous access for *hemodynamic monitoring/due to the absence of peripheral venous access/other reasons*.

Description of Procedure The indications, consent, and relevant medical record were reviewed. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Patient was placed supine, in slight Trendelenburg, with the head turned to the contralateral side. The *right/left* neck and chest were prepped and widely draped using an approved topical antiseptic and full barrier precautions. An ultrasound was used to confirm that the subclavian veins were in their usual anatomic location and was patent and compressible and had nonpulsatile venous blood flow (see attached photos). The central line ports were flushed. The skin and subcutaneous tissues were anesthetized with _____ ml of _____% lidocaine.

Using ultrasound guidance, a 16-guage needle was inserted, and the tip of the needle followed as it was inserted into the vein. The guidewire was inserted and advanced without resistance or difficulty, and its entry into the vein was confirmed with ultrasound. Using an 11 blade, a skin nick was made at the insertion site. Using the Seldinger technique, the needle was removed, and a dilator was passed over the wire to dilate the subcutaneous tissue. The dilator was exchanged for the catheter, and the catheter smoothly advanced to the desired depth. The guidewire was removed without difficulty, and the catheter ports were aspirated, flushed with saline, and capped without complication. The catheter was secured with *sutures*, and a sterile dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, and there were no complications. A post-procedure chest X-ray was ordered to verify catheter tip location and rule out a pneumothorax. The catheter tip was noted to be in the appropriate position (*describe*), and no pneumothorax was noted/*describe other findings*.

Acknowledgment This chapter was contributed by Timothy D. Light, M.D., in the previous edition.

170 Placement of Internal Jugular Central Venous Catheter

Justin Walpole and Neelima Katragunta

Indications

- Central venous pressure monitoring
- Placement of Swan-Ganz catheter
- Delivery of central venous nutrition or medications
- Hemodialysis
- Emergency access when other routes fail

Essential Steps

1. Confirm patient and indication.
2. Gather supplies including central line kit, sterile personal protective equipment, and dressing kit.
3. Position patient supine, in a Trendelenburg position with the head turned away from the side of placement. The right side is generally preferred due to a more favorable anatomy.
4. Prepare the skin and square off for sterile field:
   - Include the upper chest on the chosen side in case of change to the subclavian site.
5. Local anesthesia with 1–2 % lidocaine.
6. Locate the internal jugular vein with 16-gauge needle: insert the needle at the apex of the triangle formed by the clavicular and sternal heads of the sternocleidomastoid muscle (with the clavicle as a base), and aim toward the ipsilateral nipple.
7. Once the vein is located, introduce the wire, and exchange for a dilator after making a small incision with an 11 blade. Then place catheter via Seldinger technique.
8. Ensure catheter is working properly.
   - Aspirate from each port and then flush each with heparin.
9. Secure catheter in place with a suture and apply sterile dressing.
10. Upright chest X-ray to assess line placement and check for pneumothorax.

Note These Variations

- Ultrasound guidance (Chap. 171).
- Hickman catheter.
- Subcutaneous port.
- Kits vary; be familiar with the one you are using.
- Passage of Swan-Ganz catheter.

Complications

- Pneumothorax
- Hemothorax

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_170

- Venous air embolus
- Cannulation of artery
- Line infection
- Bleeding from the site

Template of Operative Dictation

Preoperative Diagnosis *Hemodynamic instability/need for total parenteral nutrition/others*

Procedure Placement of central venous catheter via *right/left* internal jugular vein route

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* required central venous access for *hemodynamic monitoring/central venous nutrition/others* due to complications of ___. The internal jugular route was chosen.

Description of Procedure The patient was placed supine with the head turned to the contralateral side. The bed was placed in slight Trendelenburg position, and the *right/left* chest and neck were prepped and draped with sterile technique. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The central catheter was flushed with heparin to ensure function of each port. Landmarks were identified, and a skin entry site was chosen at the apex of the triangle formed by the sternal and clavicular heads of the sternocleidomastoid muscle (with the clavicle as a base). The skin and subcutaneous tissue were anesthetized with 1 % lidocaine.

The carotid pulse was palpated, and a 16-gauge needle was inserted with the bevel down at the apex of the triangle, lateral to the carotid artery pulsation. The needle was directed toward the ipsilateral nipple, and entry into the vein was confirmed by aspiration of dark venous blood. The needle position was secured and the syringe removed. The absence of any pulsatile flow was confirmed, and the hub was occluded to prevent venous air embolus. The guidewire was inserted and passed easily. A small incision was then made at the point of wire entry. The needle was removed, while the wire was securely held in place. The dilator was placed over the wire ensuring a firm grasp of the wire at all times and the tract gently dilated. The cap was removed from the port and the clamp opened on the catheter to be fed over the wire. The catheter was fed over the wire, ensuring the wire exited from the port before advancing the catheter. The catheter was inserted to the desired depth while securing the wire, and the wire was removed. Each port was aspirated to ensure adequate blood flow and then flushed with heparin. The catheter was secured in place with 2-0 silk sutures and a sterile dressing applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and there were no complications. An upright chest X-ray was obtained to evaluate the location of the catheter tip and check for any pneumothorax. The catheter tip was noted to be in the appropriate position (*describe*), and no pneumothorax was noted/*describe other findings*.

Acknowledgment This chapter was contributed by Amy Bobis Stanfill, M.D., in the previous edition.

Ultrasound-Guided Placement of Internal Jugular Central Venous Catheter

171

Anna Marjan and Luis Garcia

Indications

- Central venous pressure monitoring
- Delivery of sclerotic medications or agents
- Lack of peripheral venous access
- Hemodialysis (preferred location as it avoids subclavian vein stenosis)
- Administration of total parenteral nutrition

Contraindications

- Cellulitis overlying vessel
- Coagulopathy (relative contraindication)
- Thrombosed internal jugular vein
- Elevated intracranial pressure
- Cervical spine injury and the need for cervical spine immobilization

Essential Steps

1. Confirm patient identity with two identifiers (e.g., name, birth date). Review anatomy, history, and relevant lab studies to avoid predictable difficulties, i.e., neck surgery, radiation at planned site, or coagulopathy.
2. Review any local protocols or guidelines regarding central venous catheter insertion. Be sure to conform to them or to dictate the justification for varying from them.
3. Gather supplies – always get two kits. Confirm ultrasound is functioning. Gather syringes, flushes, and dressing kit.
4. Know anatomy: aim for apex of triangle formed by clavicle and two heads of sternocleidomastoid.
5. Place ultrasound machine on opposite side of planned insertion site.
6. Place patient supine, in slight Trendelenburg with the head turned to side opposite from planned insertion site.
7. Stand at the head of the bed, slightly to the side of the planned site of insertion.
8. Use ultrasound probe to confirm the vein is in expected location and is patent and compressible and has non-pulsatile venous flow. Take photos if the ultrasound machine is equipped to do so.
9. Prep and drape the patient.
10. Have the assistant pass onto the field the catheter kit, the ultrasound probe cover with conducting gel, ultrasound probe, flushes, syringes, and dressing kits.
11. Use the ultrasound probe to identify the vein again. Do not forget your traditional landmarks and positioning.
12. Anesthetize the overlying skin and soft tissue with local anesthetic.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_171

13. The ultrasound probe should be centered over the vein in cross-sectional view. The needle tip should be centered with the probe. While holding the ultrasound probe in the non-dominant hand (or using a fully gowned assistant), insert the 16-gauge needle at a 45° angle to the skin about 1–2 cm cephalad to the ultrasound probe, in the same plane. The operator should see the tissue of the vein move with the needle insertion.
14. Apply negative pressure to the syringe as the needle is slowly advanced. When blood returns, advance the guidewire using typical Seldinger techniques. The guidewire should be seen in the vein. Obtaining a picture at this point is a good practice.
15. Pass off the ultrasound probe, and finish the procedure as described in the previous chapter.
16. Remember that the complication rate increases exponentially with each attempt. Reassess, reposition, and request assistance early.

Variations

- Kits vary. Be familiar with the one you are using. Include kit name/manufacturer in your dictation.
- Ultrasounds vary. Be familiar with the one you are using. Include ultrasound manufacturer and probe frequency in the dictation.
- Needle guides and jigs are available but may prove cumbersome.
- Some operators use posterior, anterior, or low approaches which can also be done with ultrasound guidance. These all require slightly different patient, operator, and ultrasound monitor positioning.
- Some central venous catheters are tunneled, cuffed, or have a port attached. The technique of identifying and accessing the vein is the same.

Complications

- Pneumothorax
- Hemothorax
- Neck hematoma
- Arterial puncture, cannulation, or injury
- Vein laceration
- Venous air embolus
- Cardiac perforation with cardiac tamponade
- Cardiac arrhythmia

Template Operative Dictation

Preoperative Diagnosis This _____-year-old *male/female* requires central venous access because peripheral access is neither available nor appropriate for the medications she/he will receive (*the underlying medical condition or diagnosis might also be added here*).

Procedure Ultrasound-guided *left/right* internal jugular central venous catheter insertion

Postoperative Diagnosis As above

Indications The preoperative diagnosis can be repeated here. *Some commentary about why the IJ site* (*instead of the subclavian site*) *was chosen might be useful here*. Ultrasound guidance was used because _____.

Description of Procedure After a review of the indications, consent, and relevant medical record, time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Patient was placed supine, in slight Trendelenburg, with the neck turned to the contralateral side. The *right/left* neck and chest were prepped and widely draped using an approved topical antiseptic and full barrier precautions. A _____ brand ultrasound machine with _____ MHz probe was used to confirm the internal jugular vein was in its usual anatomic location and was patent and pliable and had non-pulsatile venous blood flow (see attached photos). A _____ brand central venous catheter kit was used. All parts were flushed and tested prior to use. The skin and subcutaneous tissues were anesthetized with _____ ml of _____% lidocaine.

Using a 16-gauge needle, the vein was punctured, and the guidewire advanced under direct ultrasonic visualization (see attached photos). The guidewire advanced without resistance or difficulty. A skin nick was made at the insertion site, and using Seldinger technique, a dilator was passed over the wire to dilate the subcutaneous tissue. The dilator was exchanged for the catheter, and the catheter smoothly advanced. The guidewire was removed without difficulty, and the catheter ports were aspirated, flushed with saline, and capped without complication. The catheter was secured with multiple *sutures*/*staples* at the desired depth, and a dressing applied. Patient tolerated the procedure well, and a post-procedure chest X-ray was ordered.

Acknowledgment This chapter was contributed by Timothy D. Light, M.D., in the previous edition.

172 Insertion of Peritoneal Dialysis Catheter

Thomas E. Collins

Indication

- Long-term access for peritoneal dialysis

Essential Steps

1. Access the peritoneal cavity.
2. Insert the catheter into the peritoneal cavity.
3. Place the proximal cuff in the pre-peritoneal space.
4. Create a tunnel from the catheter entrance to exit site.
5. Place the distal cuff in the subcutaneous tissue.
6. Close the abdomen.
7. Flush the catheter and allow contents to run out.

Note These Variations

- Laparoscopic versus open
- Type and size of catheter
- Positioning of exit site

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Complications

- Bacterial or fungal peritonitis
- Bowel perforation
- Catheter site infection
- Catheter migration
- Catheter obstruction

Template Operative Dictation

Preoperative Diagnosis *End-stage renal disease*

Procedure Insertion of peritoneal dialysis catheter

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* required dialysis for end-stage renal disease secondary to ______. Peritoneal access was chosen for dialysis.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General endotracheal anesthesia was induced. Preoperative antibiotics were given. The abdomen was prepped and draped in the usual sterile fashion.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_172

If open: A 4-cm vertical incision was made in the midline approximately 2–3 cm below the umbilicus. The incision was deepened through the subcutaneous tissues using electrocautery. Hemostasis was assured. The anterior rectus sheath was opened and the muscle fibers bluntly dissected. The posterior rectus sheath was sharply incised and the abdominal cavity entered. *Adhesions were lysed sharply under direct vision with Metzenbaum scissors*. Adequate area for peritoneal dialysis was visualized within the abdominal cavity. The patient was placed in the Trendelenburg position, and the catheter was placed over a stylet and advanced into the peritoneal cavity. The intraperitoneal segment was advanced into the peritoneal cavity and the cuff into the pre-peritoneal space. The peritoneum and rectus sheaths were closed with *#0/#1 absorbable suture* ensuring that the catheter was not caught in the suture line. A tunnel was created to the exit site *lateral/caudal* to the entrance site. The distal cuff was placed subcutaneously 3–4 cm from the exit site. The wound was copiously irrigated. Scarpa's fascia was closed with *3/4-0 Vicryl*. The skin was closed with *4/5-0 Monocryl/Vicryl/staples*.

If laparoscopic: A 2-cm infraumbilical incision was made in the midline using a scalpel. The umbilicus was grasped and elevated. The anterior and posterior rectus sheaths were opened sharply in the midline and the abdominal cavity entered. A 5-mm trocar was inserted and insufflated with CO_2. The patient was placed in Trendelenburg position, and a 5-mm 0°/30° scope was inserted and diagnostic laparoscopy performed. A 5-mm port was inserted under direct vision into the pre-peritoneal space at the planned catheter exit site *lateral/caudal* to the insertion site. *Adhesions were lysed using laparoscopic shears/LigaSure/Harmonic scalpel/others*. A double-cuffed peritoneal dialysis catheter was inserted through the infraumbilical port.

If unsatisfactory catheter placement: *Placement of the catheter was not satisfactory and an additional 5-mm port was placed. The catheter was grasped and positioned into the pelvis*. The periumbilical port was removed, and the catheter was tunneled to the exit site with the proximal cuff positioned in the tunnel. All trocars were removed and hemostasis was assured. The fascia was closed with *3/4-0 Vicryl* and the skin with *4/5-0 Monocryl/Vicryl*.

The catheter was flushed with saline and the incision was inspected for leakage, and none was noted. The saline was allowed to drain and showed no evidence of hemoperitoneum or fecal contamination.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Acknowledgment This chapter was contributed by Philip M. Spanheimer, M.D., in the previous edition.

173 Kidney Transplantation

Zoe Ann Stewart

Indications

- End-stage renal disease may be due to:
  - Diabetes mellitus
  - Hypertensive nephropathy
  - Focal segmental glomerulosclerosis
  - Reflux nephropathy
  - Polycystic kidney disease
  - Other congenital or inherited diseases

Essential Steps

1. Verify recipient and donor blood type compatibility, and match UNOS ID on the donor kidney packaging and documentation.
2. Back table preparation of the donor kidney.
3. Bladder catheterization with a three-way Foley catheter.
4. Immunosuppression induction therapy and preoperative antibiotics.
5. Gibson oblique lower abdominal incision.
6. Divide abdominal wall muscles and inferior epigastric vessels.
7. Expose the extraperitoneal space.
8. Dissect the external iliac vessels.
9. End-to-side venous anastomosis.
10. End-to-side arterial anastomosis.
11. Kidney reperfusion.
12. Ureteroneocystostomy over double-J stent.
13. Hemostasis.
14. Close the abdomen.

Note These Variations

- Planned blood type incompatible living donor kidney transplant after recipient desensitization.
- Midline incision with intra-abdominal placement of the kidney (small pediatric recipients or adult recipient with prior bilateral extraperitoneal transplants).
- Common iliac vessels and/or aorta/inferior vena cava may be used in small pediatric recipients or adult recipients with contraindications to the use of the external iliac vessels.
- Multiple donor arteries (may reconstruct into single anastomosis, implant separately, or implant on common aortic Carrel patch).
- Multiple donor veins (can usually ligate smaller vein; if equivalent size can reconstruct into single anastomosis or implant separately).
- Double ureter (may reconstruct into single anastomosis or implant separately).
- Pediatric en bloc transplant of both kidneys from a small pediatric donor.
- Dual adult renal transplant (the two kidneys can be placed ipsilateral or bilateral in the recipient).

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_173

- Ureteroureterostomy using recipient's ipsilateral ureter.
- Ureteral implant to ileal conduit.
- Jackson–Pratt drain placement.
- Creation of peritoneal window.
- Removal of peritoneal dialysis catheter (if present preoperatively).

Complications

- Bleeding
- Wound infection/dehiscence
- Ureteral leak or stricture
- Lymphocele
- Renal artery and/or vein stenosis or thrombosis
- Recipient iliac arterial dissection

Template Operative Dictation

Preoperative Diagnosis End-stage renal disease

Procedure

1. Back table preparation of the kidney
2. Kidney transplant – *deceased brain death donor/deceased cardiac death donor/living related donor/living unrelated donor*
3. *Removal of peritoneal dialysis catheter*

Postoperative Diagnosis End-stage renal disease s/p kidney transplant

Indications Patient is a ___-year-old *male/female* with end-stage renal disease due to *diabetes mellitus/hypertensive nephropathy/focal segmental glomerulosclerosis/reflux nephropathy/polycystic kidney disease/other. He/she* presents for a *deceased donor/living related/living unrelated* kidney transplant *and removal of peritoneal dialysis catheter*.

Description of Procedure The patient was brought into the operating room and placed in a supine position on the operating room table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. In addition, I verified with a second healthcare provider that the *A/B/O/AB* blood type of the recipient is compatible with the *A/B/O/AB* blood type of the donor and that the UNOS ID on the packaging matched that on the organ documentation.

After induction of general endotracheal anesthesia, *arterial/central venous* lines were placed by the anesthesia team. The urinary bladder was catheterized with a three-way Foley catheter attached to *methylene blue/antibiotic*-containing irrigation fluid. All pressure points were padded, and there was no tension on the axillae. Sequential compression devices were placed on the lower extremities, as were upper and lower body warmers. The abdomen was prepped and draped in usual sterile fashion. Induction immunosuppression was administered per protocol to include *Thymoglobulin/Basiliximab/Mycophenolic Acid/Solumedrol*.

Choose One

If deceased donor: The kidney was prepared on the back table by dissecting free the surrounding connective tissue (*state if double artery or variant anatomy*). The vena cava and aortic cuff were trimmed and fashioned according to the size of the renal vein and renal artery (*state if right renal vein extension performed using donor vena cava*). Small vessels and lymphatics were ligated with 4-0 silk ties. The ureter and surrounding tissue were left intact to preserve the blood supply. The perinephric fat was dissected free from the capsule of the kidney. The kidney was sterilely packed in preservation solution on ice.

If living related/unrelated: The kidney was prepared on the back table by dissecting free the surrounding connective tissue from the artery and vein (*state if double artery or variant anatomy*). Small vessels and lymphatics were ligated with 4-0 silk ties. The ureter and surrounding tissue were left intact to preserve the blood supply. The perinephric fat was dissected free from the capsule of the kidney. The kidney was sterilely packed in preservation solution on ice. (*Note*: *the living donor back table is typically performed after exposure of the external iliac vessels in the* *recipient if the donor and recipient surgeries are being performed concurrently by multiple teams.*)

If pediatric en bloc: The kidneys were prepared on the back table by dissecting free the surrounding connective tissue from the aorta and inferior vena cava. The proximal end of the aorta and vena cava was closed using running 6-0 Prolene. The ureters and surrounding tissue were left intact to preserve the blood supply. The perinephric fat was dissected free from the capsule of the kidneys. The kidneys were sterilely packed in preservation solution on ice.

A *right/left* oblique Gibson lower abdominal renal transplant incision was made with a scalpel. The subcutaneous tissues were divided down to the abdominal wall fascia with electrocautery. The fascia was entered lateral to the border of the abdominal rectus.

If male: *The spermatic cord was identified gently retracted medially with a Penrose drain.*

If female: *The round ligament was identified and ligated with 2-0 silk ties.*

The peritoneum was dissected off the abdominal wall, and the insertion of the oblique and transversus abdominis was divided according to the length and direction of the skin incision. The transversalis fascia was divided to access the extraperitoneal tissues, which were retracted medially to expose the external iliac vessels. The inferior epigastric vessels were identified and divided between 2-0 silk ties. A self-retaining retractor was placed. The lymphatics overlying the external iliac artery and vein were ligated and the vessels dissected free from surrounding tissue for a length compatible with anastomosis.

The kidney was brought to the operative field at *date/time*. Venous control of the *right/left* external iliac vein was obtained with a vascular clamp. A longitudinal venotomy was made with a #11 scalpel and lengthened with a Potts scissors. The vein was flushed with heparinized saline, and an end-to-side renal vein to external iliac vein anastomosis was performed using running 6-0 Prolene. Arterial control of the *right/left* external iliac artery was obtained with a vascular clamp. An arteriotomy was made with a #11 scalpel, and the artery was flushed with heparinized saline. A *4.0-/4.5-/4.8*-mm aortic punch was used to appropriately size the arteriotomy for anastomosis. An end-to-side *renal artery/aortic Carrel patch* to external iliac artery anastomosis was performed using running 6-0 Prolene. Furosemide and mannitol were administered to the patient to promote diuresis immediately before renal perfusion. The kidney was reperfused at *date/time*. The anastomosis time was ___ minutes. The cold ischemia time was ___ minutes.

After hemostasis was obtained, attention was directed to the ureteral anastomosis. The bladder was filled with irrigation solution. The perivesical fat and muscles on the dome of the bladder were divided with electrocautery to expose the bladder mucosa. The ureter was cut to the appropriate length for anastomosis and spatulated posteriorly. The bladder mucosa was incised, and an end-to-side anastomosis was performed between the ureter and bladder with 5-0 PDS over a double-J 6 French stent. The anastomosis was inspected for any evidence of leak. The bladder detrusor muscle was gently approximated over the anastomosis with 3-0 PDS.

The abdomen was irrigated with warm saline. A final check for hemostasis was performed. *A Jackson–Pratt drain was placed into the perinephric space and secured to the skin with a 3-0 nylon suture*. With the kidney well perfused and sitting without tension on the anastomoses, the retractors were removed, and the abdominal wall was closed in two layers with #1 Prolene suture. The dermis was approximated with 3-0 Vicryl. The skin was closed with *staples/subcuticular suture*, and sterile dressings were applied.

Attention was then turned to removal of the peritoneal dialysis catheter. The exit-site cuff was excised with an ellipse of skin, and electrocautery was used to dissect the cuff from the subcutaneous tissue. The umbilical incision was opened with a scalpel and cautery used to mobilize the catheter to the insertion on the fascia; *this was opened sharply, and the cuff was freed from peritoneum. The catheter was passed off the operative field. The fascia was closed with interrupted #1 Prolene sutures. After ensuring hemostasis*, *the subcutaneous tissues were irrigated, the skin was closed with staples, and sterile dressings were applied.*

At the end of the case, the needle, sponge, and instrument counts were all correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was extubated in the operating room. The patient was brought to the PACU in stable condition.

Acknowledgment This chapter was contributed by Susan Skaff Hagen, M.D., MSPH, in the previous edition.

174 Liver Transplantation

Zoe Ann Stewart

Indications

- End-stage liver disease due to:
  - Hepatitis C and hepatitis B
  - Nonalcoholic fatty liver disease
  - Alcohol abuse
  - Primary sclerosing cholangitis
  - Primary biliary cirrhosis
  - Autoimmune hepatitis
  - Biliary atresia
  - Drug toxicity
  - Hepatocellular carcinoma
  - Other inherited diseases

Essential Steps

1. Verify donor and recipient blood type compatibility and matching UNOS ID on the donor kidney packaging and documentation.
2. Anesthesia with placement of central venous and arterial lines, pulmonary artery catheter, and nasogastric tube.
3. Back table preparation of the donor liver.
4. Bilateral subcostal abdominal incision.
5. Divide the left triangular ligament and gastrohepatic ligament.
6. Ligate and divide of the hepatic artery, common bile duct, and portal vein.
7. Mobilize the right hepatic lobe.
8. Divide the caudate lobe venous branches to the vena cava.
9. Divide the right hepatic vein.
10. Complete recipient hepatectomy.
11. Immunosuppression induction therapy.
12. Construct hepatic vein confluence suprahepatic vena cava anastomosis.
13. Portal vein anastomosis.
14. Liver reperfusion and hemostasis.
15. Hepatic artery anastomosis.
16. Donor cholecystectomy.
17. Bile duct anastomosis.
18. Hemostasis.
19. Place Jackson-Pratt drains.
20. Close the abdomen.

Note These Variations

- Replaced hepatic arteries in donor graft requiring back table reconstruction
- Roux-en-Y hepaticojejunostomy for biliary reconstruction
- Caval anastomosis: side-to-side cavocavostomy or end-to-end caval interposition
- Use of venovenous bypass
- Supraceliac or infrarenal aortic conduit for hepatic artery inflow

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_174

- Superior mesenteric vein jump graft for portal vein inflow
- Split liver or living donor liver transplantation

Complications

- Bleeding
- Hepatic artery or portal vein thrombosis or stenosis
- Biliary anastomotic stricture or leak
- Wound infection/dehiscence

Template Operative Dictation

Preoperative Diagnosis End-stage liver disease

Procedure
1. Back table preparation of the liver
2. Liver transplant – *deceased brain death donor/deceased cardiac death donor/living related donor/living unrelated donor*

Postoperative Diagnosis End-stage liver disease s/p liver transplant

Indications Patient is a ___-year-old *male/female* with end-stage liver disease due to *hepatitis C/fatty liver disease/alcoholic liver disease/other. He/she* presents for a *deceased donor/living related/living unrelated* liver transplant.

Description of Procedure The patient was brought into the operating room and placed in a supine position on the operating room table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. In addition, I verified with a second healthcare provider that the *A/B/O/AB* blood type of the recipient is compatible with the *A/B/O/AB* blood type of the donor and that the UNOS ID on the packaging matched that on the organ documentation. Donor aortic cross clamp time was *date/time*.

After induction of general endotracheal anesthesia, arterial and central venous lines, a pulmonary artery catheter, and a nasogastric tube were placed by the anesthesia team. The urinary bladder was catheterized with a Foley catheter. The left arm was placed on an arm board and the right arm tucked at the patient's side. There was no tension on the axillae and all pressure points were padded. Sequential compression devices were placed on the lower extremities, as were upper and lower body warmers. The abdomen, chest, and bilateral groins were prepped and draped in usual sterile fashion.

Prior to the start of the operation, the donor liver was prepared on the back table. The diaphragm attached to the right and left lobes was dissected free and discarded. The vena cava was cleared of its perivascular tissues, and the adrenal and lumbar branches were ligated. The suprahepatic vena cava was inspected to identify and ligate the phrenic branches. The portal vein was dissected free distally to its bifurcation and its small branches ligated. The donor graft had the following arterial anatomy: *normal/replaced left hepatic artery from the left gastric artery/replaced right hepatic artery from the superior mesenteric artery/completely replaced hepatic artery/other*. This required the following reconstruction on the back table: *none/anastomosis of the superior mesenteric artery to the splenic artery/anastomosis of the superior mesenteric artery to the common hepatic artery/other*. The bile duct was gently probed to identify the right and left biliary branches and flushed with cold preservation solution.

A bilateral subcostal incision *with extension up the midline* was performed with a scalpel through the skin and electrocautery through the deeper layers. The abdominal cavity was opened and the teres ligament was ligated and divided. The falciform was divided to the level of the hepatic veins. The left triangular ligament was divided to the left hepatic vein. The gastrohepatic ligament was opened to the level of the diaphragm. *A replaced left hepatic artery was identified in the gastrohepatic ligament*, *ligated with 2-0 silk ties*, *and divided*. A Thompson self-retaining retractor was placed.

The porta hepatis was carefully dissected to identify the hepatic artery, portal vein, and common bile duct. The artery was dissected and the recipient arterial configuration was found to be *standard/replaced left hepatic artery from the left gastric artery/replaced right hepatic artery from the superior mesenteric artery/completely replaced hepatic artery/other*. The bifurcation of the right and left hepatic arteries was identified, and both were ligated with 2-0 silk ties and divided. The hepatic artery dissection was continued to the common hepatic artery *with/without* division of the gastroduodenal artery. The common bile duct was dissected for an adequate length, ligated, and divided. The portal vein was dissected from its bifurcation to the superior border of the pancreas. Attention was next directed to the right side of the liver where the right triangular ligament was taken down, exposing the bare area of the liver and the vena cava.

At this point, venovenous bypass was established. A left transverse axillary incision was made with a scalpel and deepened through subcutaneous tissue with electrocautery. The left axillary vein was exposed and dissected. The vein was ligated distally and controlled proximally with a silastic vessel loop. The axillary vein was cannulated with a ___ French cannula which was secured to the vein. A modified Seldinger technique was used to access and insert a cannula into the left femoral vein. Both the axillary and femoral cannulas were de-aired and connected to bypass circuit tubing. Tubing clamps were removed and venovenous bypass was initiated. Adequate flows were established. At the completion of bypass, cannulas were removed. Pressure was held on the femoral cannulation site until hemostasis was achieved and then the site was closed with a figure-of-eight nylon suture. The proximal axillary vein was ligated and the axillary site was closed in layers using interrupted 3-0 Vicryl sutures for the subcutaneous tissue and staples for the skin.

For Hepatic Vein Confluence Piggyback

The portal vein was divided at its bifurcation with an endovascular stapler. The liver was taken off the vena cava by dividing the short hepatic veins from the caudate and right lobes directly to the vena cava. The suprahepatic vena cava was dissected, and the right hepatic vein was dissected free and divided with an endovascular stapler. An Allis clamp was placed on the right hepatic vein staple line, and all three hepatic veins were drawn up into a vascular clamp, incorporating the front wall of the vena cava between the right and middle left veins. The middle and left hepatic veins were transected in the liver, and the liver was passed off of the operative field. Hemostasis was performed in the retroperitoneum. Induction immunosuppression was administered by anesthesia.

Attention was turned to preparation of the recipient hepatic vein orifices for the vena cava anastomosis. A common opening was made into all three hepatic vein orifices and across the front of the vena cava. The liver was brought to the operative field at *date/time*. The donor suprahepatic vena cava was sewn to the common hepatic vein opening using a running 3-0 Prolene suture. The liver was then flushed via the portal vein with 1 l of cold Lactated Ringer's solution with efflux through the donor infrahepatic inferior vena cava. The infrahepatic inferior vena cava was then closed with an endovascular stapler.

Next, the recipient portal vein was clamped and flushed after removal of the vascular staple line. The donor portal vein was cut to the appropriate length and sewn end-to-end to the recipient portal vein as a running anastomosis with 6-0 Prolene, incorporating a 2 cm "growth factor" when tying the knot to allow for adequate expansion of the portal vein. Once this was completed, anesthesia was notified and the hepatic outflow was opened followed by the portal vein. Reperfusion on the portal vein occurred at *date/time*.

For Side-to-Side Cavocavostomy

The portal vein was divided at its bifurcation with an endovascular stapler. The liver was taken off the vena cava by dividing the short hepatic veins from the caudate and right lobes directly to the vena cava. The suprahepatic vena cava was dissected. The right, middle, and left hepatic veins were dissected free and divided with an endovascular stapler, and the liver was passed off of the operative field. Hemostasis was performed in the retroperitoneum. Induction immunosuppression was administered by anesthesia.

Attention was turned to preparation of the donor vena cava for anastomosis. The suprahepatic and infrahepatic donor vena cava were closed with an endovascular TA stapler. The liver was brought to the operative field at *date/time*. A vascular clamp was placed longitudinally on the recipient vena cava. A venotomy was made on the vena cava with a #11 blade and extended with Potts scissors for an appropriate length for the cavocavostomy anastomosis. A venotomy was made along the posterior side of the donor cava to create a longitudinal opening to match the recipient vena cava venotomy. The anastomosis was performed with a running 3-0 Prolene suture. The liver was flushed via the portal vein using 1 l of cold Lactated Ringer's solution during completion of the anastomosis.

Next, the recipient portal vein was clamped and flushed after removal of the vascular staple line. The donor portal vein was cut to appropriate length and sewn end-to-end to the recipient portal vein as a continuous anastomosis with 6-0 Prolene, incorporating a 2 cm "growth factor" when tying the knot to allow for adequate expansion of the portal vein. Once this was completed, anesthesia was notified and the hepatic outflow was opened followed by the portal vein. Reperfusion on the portal vein occurred at *date/time*.

For End-to-End Caval Interposition

The portal vein was divided at its bifurcation with an endovascular stapler. The infrahepatic inferior vena cava was dissected and encircled with an umbilical tape. The liver was rotated to the right, and the left side of the vena cava was dissected superiorly to the left phrenic vein. The suprahepatic vena cava was dissected to allow visualization of the right, middle, and left hepatic veins. The liver was rotated to the left, and the right side of the vena cava was dissected superiorly past the right hepatic vein. The suprahepatic vena cava was dissected circumferentially and encircled with an umbilical tape. The posterior of the vena cava was freed from its tissue attachments, and the right adrenal vein was ligated and divided. Vascular clamps were placed on the suprahepatic and infrahepatic inferior vena cava; these were divided and the liver was passed off of the operative field. Hemostasis was performed in the retroperitoneum. Induction immunosuppression was administered by anesthesia.

The liver was brought to the operative field at *date/time*. The suprahepatic vena cava was performed using 3-0 Prolene. The infrahepatic vein anastomosis was performed using 4-0 Prolene; this was not tied to allow the liver to be flushed via the portal vein with 1 l of cold Lactated Ringer's solution with efflux through the infrahepatic inferior vena cava anastomosis. Next, the recipient portal vein was clamped and flushed after removal of the vascular staple line. The donor portal vein was cut to appropriate length and sewn end-to-end to the recipient portal vein as a continuous anastomosis with 6-0 Prolene, incorporating a 2 cm "growth factor" when tying the knot to allow for adequate expansion of the portal vein. The portal vein was flushed through the infrahepatic inferior vena cava for ~300 mL prior to re-clamping the portal vein. The infrahepatic inferior vena cava was then tied. Once this was completed, anesthesia was notified and all vascular clamps were removed. Reperfusion on the portal vein occurred at *date/time*.

After a few minutes, the liver became pink and looked to be well perfused. The caval and portal vein anastomoses were inspected for hemostasis. Attention was then turned to completion of the hepatic artery anastomosis. Arterial inflow was provided to the graft by sewing an end-to-end anastomosis between the recipient *right-left hepatic artery branch patch/gastroduodenal-common hepatic artery branch patch/other* to the donor *celiac trunk/common hepatic artery/other* using a running 6-0 Prolene. Hepatic arterial reperfusion occurred at *date/time*. The warm ischemia time (vena cava and portal vein anastomotic time) was ___ minutes. The cold ischemia time was ___ minutes.

Attention was next turned to the donor cholecystectomy. The gallbladder was removed from the gallbladder fossa in a top-down fashion with electrocautery. The cystic duct and artery were identified, ligated, and divided, and the donor gallbladder was passed off the operative field. Attention was next directed to completion of the biliary anastomosis. The donor bile duct was cut and active bleeding from the peri-choledochal vessels was controlled with 6-0 Prolene sutures. Biliary reconstruction was then performed end-to-end between the donor and recipient bile ducts using a running 6-0 PDS suture. *Alternative*: *Biliary reconstruction was performed with a Roux-en-Y hepaticojejunostomy between the donor bile duct and a Roux loop. The jejunum 30 cm distal to the ligament of Treitz was divided with a GIA stapler. The staple lines were oversewn with 3-0 silk Lembert sutures. The mesentery was ligated with 3-0 silk ties and divided until there was adequate mobilization to bring the Roux limb to the porta hepatis through the mesocolon in a retrocolic position. Attention was next turned to completion of the hepaticojejunostomy. Electrocautery was used to make an opening on the antimesenteric border of the Roux limb. The anastomosis was completed by placing a posterior row of interrupted 5-0 PDS sutures with the sutures tied on the inside of the biliary anastomosis. A 5 French pediatric feeding tube was secured across the anastomosis with a 4-0 Vicryl suture. The anterior layer of the hepaticojejunostomy was completed with interrupted 5-0 PDS sutures with external knots. At the conclusion of the anastomosis*, *the Roux limb was lying without tension and was tacked to the porta hepatis with interrupted silk sutures. The Roux limb was secured where it passed through the mesocolon with interrupted 3-0 silk sutures. Next, a side-to-side jejunojejunostomy was performed with a running inner 3-0 Vicryl layer and interrupted outer 3-0 silk layer 50 cm distal to where the bowel had been divided. The mesenteric defect was closed with interrupted 3-0 silk sutures*.

A final check for hemostasis was made, and three Jackson-Pratt drains were placed through separate incisions below the transverse abdominal incision. The lateral drains were positioned along each side of the vena cava, and the middle drain was positioned at the biliary anastomosis. The abdomen was irrigated with several liters of warm saline and closed using running #1 Prolene suture. The subcutaneous tissue was irrigated, and the skin was closed with staples. At the end of the case, all instrument, needle, and sponge counts were correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was taken to the surgical intensive care unit in critical but hemodynamically stable condition.

175 Pancreas Transplantation

Zoe Ann Stewart

Indications

- Simultaneous pancreas-kidney transplant (SPK): type I diabetes and ESRD
- Pancreas transplant alone (PTA): type I diabetes with hypoglycemic unawareness, preserved renal function

Essential Steps

1. Verify donor and recipient blood type compatibility and matching UNOS ID on the donor pancreas/kidney packaging and documentation.
2. Anesthesia with placement of central venous and arterial lines and nasogastric tube.
3. Back table preparation of the donor pancreas with donor iliac arterial “Y”-graft.
4. Back table preparation of the donor kidney.
5. Bladder catheterization with a three-way Foley catheter.
6. Immunosuppression induction therapy and preoperative antibiotics.
7. Midline abdominal incision.
8. Mobilize the right colon (Cattell-Braasch maneuver).
9. Dissect the inferior vena cava (IVC) and the right common iliac artery (CIA).
10. Pancreatic venous anastomosis: donor portal vein to recipient IVC.
11. Pancreatic arterial anastomosis: donor Y-graft to recipient right CIA.
12. Pancreas reperfusion and hemostasis.
13. Side-to-side loop duodeno-enterostomy.
14. Mobilize the left colon (Mattox maneuver).
15. Dissect the left external iliac artery (EIA) and left external iliac vein (EIV).
16. Kidney venous anastomosis: donor renal vein to recipient left EIV.
17. Kidney arterial anastomosis: donor renal artery to recipient EIA.
18. Kidney reperfusion.
19. Ureteroneocystostomy over double-J stent.
20. Hemostasis.
21. Place Jackson-Pratt drain(s).
22. Close the abdomen.

Note These Variations

- Roux limb for pancreatic exocrine drainage
- Bladder drainage for pancreatic exocrine drainage
- Venous graft for short donor portal vein

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_175

Complications

- Bleeding
- Pancreatic portal vein thrombosis
- Pancreatic duodenal anastomotic leak
- Pancreatic arterial Y-graft kinking/thrombosis
- Recipient iliac arterial dissection
- Ureteral leak/stricture
- Wound infection/dehiscence
- Graft rejection
- Graft pancreatitis

Template Operative Dictation

Preoperative Diagnosis Type I diabetes mellitus *with ESRD and/or hypoglycemic unawareness*

Procedure
1. Back table preparation of the pancreas with donor iliac arterial Y-graft
2. *If PKA*: *Back table preparation of the kidney*
3. Pancreas transplant
4. *If PKA*: *Kidney transplant*
5. *Appendectomy*
6. *Removal of peritoneal dialysis catheter*

Postoperative Diagnosis Type I diabetes mellitus s/p *simultaneous pancreas transplant/pancreas transplant alone*

Indications Patient is a ___-year-old *male/female* with type I diabetes and *ESRD/hypoglycemic unawareness. He/she* presents for a deceased donor *simultaneous pancreas-kidney transplant/pancreas transplant alone*.

Description of Procedure The patient was brought into the operating room and placed in a supine position on the operating room table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, timely administration of antibiotics, and additional critical information prior to beginning the procedure. In addition, I verified with a second healthcare provider that the *A/B/O/AB* blood type of the recipient is compatible with the *A/B/O/AB* blood type of the donor and that the UNOS ID on the packaging matched that on the organ documentation. Donor aortic cross clamp time was *date/time*.

After induction of general endotracheal anesthesia, the anesthesia team placed arterial and central venous lines and a nasogastric tube. The urinary bladder was catheterized with a three-way Foley catheter attached to *methylene blue/antibiotic*-containing irrigation fluid. All pressure points were padded and there was no tension on the axillae. Sequential compression devices were placed on the lower extremities, as were upper and lower body warmers. The abdomen was prepped and draped in usual sterile fashion. Induction immunosuppression was administered per protocol to include *thymoglobulin/basiliximab/mycophenolic acid/Solu-Medrol*.

Prior to the start of the operation, the donor pancreas was prepared on the back table. The spleen was removed by ligating and dividing the splenic vessels with silk ties. The pancreas was cleared of the surrounding fatty soft tissues. The duodenal ends were shortened with a GIA stapler, and the staple lines oversewn with 3-0 silk Lembert sutures. The small bowel mesenteric vessels were reinforced with a running, locked 4-0 Prolene suture. The portal vein outflow was dissected for maximal length. Arterial reconstruction was performed using a donor iliac Y-graft reconstruction to the superior mesenteric artery and splenic artery with 6-0 Prolene sutures. All vascular anastomoses and closures were checked for hemostasis by flushing with preservation solution. The pancreas was sterilely packed in preservation solution on ice.

If SPK: The kidney was prepared on the back table by dissecting free the surrounding connective tissue (*state if double artery or variant anatomy*). The vena cava and aortic cuff were trimmed and fashioned according to the size of the renal vein and renal artery. (*State if right renal vein extension performed using donor vena cava.*) Small vessels and lymphatics were ligated with 4-0 silk ties. The ureter and surrounding tissue were left intact to preserve the blood supply. The perinephric fat was dissected free from the capsule of the kidney. The kidney was sterilely packed in preservation solution on ice.

A midline abdominal incision was performed with a scalpel through the skin and electrocautery through the deeper layers. The abdominal cavity was opened and the teres ligament was ligated and divided. A *Bookwalter/Omni* self-retaining retractor was placed. *Attention was then turned to removal of the peritoneal dialysis catheter. The exit site cuff was excised with an ellipse of skin and electrocautery was used to dissect the cuff from the subcutaneous tissue. Electrocautery was used to mobilize the catheter to the insertion on the fascia; this was opened sharply and the cuff was freed from peritoneum. The catheter was passed off the operative field. The fascia was closed with interrupted #1 Prolene sutures. After ensuring hemostasis, the subcutaneous tissues were irrigated, and the skin was closed with staples.*

A Cattell-Braasch maneuver was performed to fully mobilize the right colon and duodenum to the root of the small bowel. A moist laparotomy pad was placed over the bowel, which was packed behind retractors to facilitate exposure of the IVC and right CIA. The native ureter was identified and preserved. The lymphatics overlying the IVC and right CIA were dissected free for a length compatible with anastomosis. The pancreas was brought to the operative field at *date/time*. Venous control of the IVC was obtained with a vascular clamp. A longitudinal venotomy was made with a #11 scalpel and lengthened with a Potts scissors. The vein was flushed with heparinized saline, and an end-to-side donor portal vein to recipient IVC anastomosis was performed using running 6-0 Prolene. Arterial control of the right CIA was obtained with a vascular clamp. An arteriotomy was made with a #11 scalpel, and the artery was flushed with heparinized saline. A *4.0/4.5/4.8 mm* aortic punch was used to appropriately size the arteriotomy for anastomosis. An end-to-side donor iliac Y-graft to right CIA anastomosis was performed using running 6-0 Prolene. The pancreas was reperfused at *date/time*. The anastomosis time was ___ minutes. The cold ischemia time was ___ minutes.

After hemostasis was obtained, attention was directed to the duodenal anastomosis. The bowel was released and a two-layer, handsewn side-to-side loop duodeno-enterostomy was performed between the donor duodenum and recipient ileum approximately 50 cm proximal to the cecum.

If SPK: After another check for hemostasis, the retractors were repositioned to facilitate exposure of the left retroperitoneum. A Mattox maneuver was performed to mobilize the left colon. A moist laparotomy pad was placed over the bowel, which was packed behind retractors to facilitate exposure of the left EIV and left EIA. The native ureter was identified and preserved. The lymphatics overlying the left EIV and left EIA were dissected free for a length compatible with anastomosis. The kidney was brought to the operative field at *date/time*. Venous control of the EIV was obtained with a vascular clamp. A longitudinal venotomy was made with a #11 scalpel and lengthened with a Potts scissors. The vein was flushed with heparinized saline, and an end-to-side donor renal vein to recipient EIV anastomosis was performed using running 6-0 Prolene. Arterial control of the left EIA was obtained with a vascular clamp. An arteriotomy was made with a #11 scalpel, and the artery was flushed with heparinized saline. A *4.0/4.5/4.8 mm* aortic punch was used to appropriately size the arteriotomy for anastomosis. An end-to-side *donor renal artery/aortic Carrel patch* to left EIA anastomosis was performed using running 6-0 Prolene. The kidney was reperfused at *date/time*. The anastomosis time was ___ minutes. The cold ischemia time was ___ minutes.

After hemostasis was obtained, attention was directed to the ureteral anastomosis. The bladder was filled with irrigation solution. The perivesical fat and muscles on the dome of the bladder were divided with electrocautery to expose the bladder mucosa. The ureter was cut to the appropriate length for anastomosis and spatulated posteriorly. The bladder mucosa was incised and an end-to-side anastomosis was performed between the ureter and bladder with 5-0 PDS over a double-J 6 French stent. The anastomosis was inspected for any evidence of leak. The bladder detrusor muscle was gently approximated over the anastomosis with 3-0 PDS.

Attention was then turned to removing the appendix. The mesoappendix was divided seri-

ally between 3-0 silk ties until the base of the appendix was visualized. The base of the appendix was crushed with a clamp and then tied with a 2-0 chromic suture. A #15 blade was used to divide the appendix, *which was passed off the field for permanent pathology. The appendiceal stump mucosa was cauterized and then inverted with 3-0 silk Lembert sutures*.

The abdomen was irrigated with warm saline. A final check for hemostasis was performed. A Jackson-Pratt drain was placed at the pancreatic enteric anastomosis and secured to the skin with a 3-0 nylon suture. *A Jackson-Pratt drain was placed into the perinephric space and secured to the skin with a 3-0 nylon suture*. With the pancreas and kidney well perfused and sitting without tension on the anastomoses, the retractors were removed and the abdominal wall was closed in single layers with running #1 Prolene suture. The skin was closed with staples and sterile dressings were applied.

The patient tolerated the procedure well and was extubated in the operating room. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was brought to the SICU in stable condition. At the end of the case, the needle, sponge, and instrument counts were all correct.

176 Left Adrenalectomy

Faek R. Jamali

Indications

- Adrenocortical carcinoma
- Aldosteronoma
- Cortisol-secreting adenoma (Cushing's syndrome)
- Pheochromocytoma (sporadic or familial)
- Virilizing or feminizing tumors
- Incidentaloma (>4 cm in size)
- Solitary adrenal metastasis

Essential Steps

1. Optimize the patients medically (e.g., correct electrolyte abnormalities, control hypertension, preoperative alpha-blockade in pheochromocytoma, stress steroids in Cushing's disease. Prophylactic Pneumovax administration is recommended in reoperative cases).
2. Enter the abdomen through an extended left subcostal incision. Exposure for this approach may be facilitated by elevating the left flank using a roll. *Alternatively a midline incision can be used*.
3. Explore the abdomen.
4. Mobilize the splenic flexure of the colon.
5. Mobilize the spleen and tail of pancreas medially.
6. Dissect retroperitoneal structures including Gerota's fascia, left renal hilum, para-aortic space.
7. Identify, ligate, and divide the left adrenal vein.
8. Dissect all the left suprarenal tissues, including the left adrenal gland with en bloc resection of retroperitoneal fat from the superior pole of the left kidney to the diaphragm.

Note These Variations

- If the spleen and pancreas cannot be mobilized away from the adrenal because of tumor involvement, then the lesser sac should be opened to allow access to the pancreas and splenic hilum.
- Large malignant tumors on the left may require en bloc resection of the spleen, tail of the pancreas, and even the kidney. These tumors are best approached via laparotomy.
- Adrenal tumors should be removed along with a generous margin of retroperitoneal fat and Gerota's fascia.
- In cases of primary adrenal cortical malignancies, periaortic lymph nodes medial to the adrenal should be removed along with the tumor from the left crus to the level of the left renal vein.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_176

Complications

- Tumor rupture with spillage and seeding
- Bleeding from large raw surface in the retroperitoneum or from accessory lumbar veins
- Left diaphragmatic injury leading to pneumothorax
- Splenic injury requiring splenectomy
- Distal pancreatic injury
- Injury to renal hilar vessels
- Gastric perforation during spleno-pancreatic mobilization

Template Operative Dictation

Preoperative Diagnosis List specific pathology indicating surgery (*see indications above*), e.g., *pheochromocytoma of the left adrenal gland*.

Procedure Open left adrenalectomy

Postoperative Diagnosis List specific intraoperative findings, e.g., *pheochromocytoma of the left adrenal gland*.

Indications This ___-year-old *male/female* patient was found to have a *specific diagnosis of left adrenal gland pathology*. Preoperative biochemical workup showed evidence of (*list specific hormonal activity if present*). Imaging confirmed a ___ cm left adrenal lesion. The patient underwent preoperative preparation (*see point one of essential steps*) and is now presenting for elective left adrenalectomy. The indications, alternatives, risks, and benefits of the surgery were discussed with the patient and informed consent was obtained.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Intravenous antibiotic and subcutaneous heparin were administered. After induction of general endotracheal anesthesia, a Foley catheter was inserted. A roll (or beanbag) was placed under the patient's left flank to allow slight medial rotation of the left side. All extremities were well padded. The abdomen was clipped and prepped in the usual sterile fashion.

The abdomen was approached via a standard extended subcostal incision. The skin was incised two finger breadths below the left costal margin starting from the mid-axillary line and extending to the midline. The incision was deepened through the skin and subcutaneous tissue. Scarpa's fascia was opened and the incision taken down to the level of the abdominal wall. Using electrocautery the abdominal wall musculature was divided. The external, internal, and transversalis fascia were divided using electrocautery. The anterior rectus sheath was opened and the left rectus muscle was split using electrocautery with control of the epigastric vessels. The posterior rectus sheath was also divided.

Exploration of the abdominal cavity was then carried out to rule out evidence of metastatic disease. The procedure was started by mobilizing the splenic flexure of the colon. This was done starting by mobilization of the white line of Toldt along the descending colon. This mobilization was then carried up to the level of the splenic flexure. The attachment of the omentum to the distal transverse was also divided using electrocautery allowing access into the lesser sac to further facilitate the complete takedown of the splenic flexure. Once the splenic flexure of the colon was completely mobilized, the splenorenal and retroperitoneal attachments of the spleen were divided with electrocautery. The spleno-phrenic attachments were also divided and the spleen along with the tail of the pancreas rotated medially. Care was taken to avoid any injury to the splenic vein in the course of this dissection.

Once the splenic flexure of the colon, the tail of the pancreas, and the spleen were rotated medially, exposure of the adrenal gland in the retroperitoneum was achieved. Gerota's fascia, the upper border of the left kidney, and the left renal hilum were identified and dissected. Dissection of the left renal vein and its upper border lead to the identification of the left adrenal vein which was doubly ligated and divided. Using *electrocautery/an appropriate energy device*, the retroperitoneal fat of the left suprarenal region was elevated of the superior pole of the left kidney and gently dissected off the lateral abdominal wall and then posteriorly off the left quadratus lumborum muscle. The arterial supply of the left adrenal gland was controlled and divided as it was encountered along this dissection. It usually consists of three main arterial branches, from the left renal artery, the aorta, and the left phrenic artery. The cephalad attachments of the adrenal and retroperitoneal tissue to the left diaphragm were then divided. The left adrenal gland was then gently retracted laterally to allow for the completion of the medial dissection. The medial dissection was carried as far medially as possible to ensure a negative margin. Care was taken to avoid injury to the capsule of the adrenal gland. The medial dissection was carried out by removing all of the contents of the suprarenal region all the way up to the paravertebral space. If cancer: *An en bloc dissection of the para-aortic nodes was also carried out as part of the medial extent of the dissection of the suprarenal region. The specimen is then removed en bloc*.

Irrigation of the suprarenal region was carried out and confirmation of hemostasis was achieved. The spleen and pancreatic tail were then allowed to return back to their normal anatomical position. Closure of the abdomen in layers was then carried out using a running 0 PDS/___ stitch, followed by closure of the skin with a skin stapler. The patient tolerated the procedure well. There were no complications and the blood loss was minimal. The instrument and sponge count was correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and returned to the recovery room in stable satisfactory condition.

Laparoscopic Left Adrenalectomy

177

Faek R. Jamali

Indications

- Aldosteronoma
- Cortisol-secreting adenoma (Cushing's syndrome)
- Pheochromocytoma (sporadic or familial)
- Virilizing or feminizing tumors
- Incidentaloma (>4 cm in size)
- Solitary adrenal metastasis

Essential Steps

1. Optimize the patients medically (e.g., correct electrolyte abnormalities, control hypertension, preoperative alpha-blockade in pheochromocytoma, stress steroids in Cushing's disease. Prophylactic Pneumovax administration is recommended in reoperative cases).
2. Position the patient in the full left lateral decubitus position with appropriate padding.
3. Establish pneumoperitoneum and place trocars along subcostal margin.
4. Explore the abdomen.
5. Mobilize the splenic flexure of the colon.
6. Medially mobilize the spleen and tail of pancreas.
7. Dissect retroperitoneal structures including Gerota's fascia, left renal hilum, and para-aortic space.
8. Identify, secure, and divide the left adrenal vein.
9. Dissect all the left suprarenal tissues, including the left adrenal gland, and resect the retroperitoneal fat en bloc from the superior pole of the left kidney to the diaphragm.

Complications

- Tumor rupture with spillage and seeding
- Bleeding from large raw surface in the retroperitoneum or from accessory lumbar veins
- Left diaphragmatic injury leading to pneumothorax
- Splenic injury requiring splenectomy
- Distal pancreatic injury
- Injury to renal hilar vessels
- Gastric perforation during spleno-pancreatic mobilization
- Missed bowel injury

Template Operative Dictation

Preoperative Diagnosis List specific pathology indicating surgery (*see indications above*), e.g., *pheochromocytoma of the left adrenal gland*.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_177

Procedure Laparoscopic left adrenalectomy

Postoperative Diagnosis List specific intraoperative findings, e.g., *pheochromocytoma of the left adrenal gland*.

Indications This ___-year-old *male/female* patient was found to have a left adrenal _____. Preoperative biochemical workup showed evidence of (*list specific hormonal activity if present*). Imaging confirmed a ___ cm left adrenal lesion. The patient underwent preoperative preparation and is now presenting for elective laparoscopic left adrenalectomy. The indications, alternatives, and risks and benefits of the surgery were discussed with the patient and informed consent was obtained.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Intravenous antibiotic and subcutaneous heparin were administered. After induction of general endotracheal anesthesia, a Foley catheter was inserted. The abdomen was prepped in the usual sterile fashion. The patient was then positioned in the full left lateral decubitus position with appropriate padding.

The abdomen was approached under direct vision using optical 10-mm trocar and pneumoperitoneum was induced. The first (10 mm) trocar was placed at the mid-level of the subcostal margin on the left side. Two additional 5-mm trocars were placed at the level of the costal margin, 8–10 cm away to the right and left of the camera port. The third 5-mm trocar was placed at the level of the mid-axillary or posterior axillary line for the assistant's use. Exploration of the abdominal cavity was carried out followed by mobilization of the splenic flexure of the colon by incising the white line of Toldt, facilitated by the left lateral decubitus position.

The attention was turned toward the mobilization of the spleen. The splenorenal and retroperitoneal attachments of the spleen were divided with electrocautery or an appropriate energy device. This incision of the peritoneum was carried out to the level of the left diaphragm allowing visualization of the fundus of the stomach. Facilitated by the effect of gravity and the weight of the spleen, the spleen and tail of the pancreas were then rotated medially by gentle dissection of the loose areolar space between the pancreas and the retroperitoneum. Care was taken to avoid injury to the splenic vein during the course of this dissection.

At this point, the suprarenal tissue and its contents (adrenal gland and retroperitoneal fat) were visible. Gerota's fascia, the upper border of the left kidney, and the left renal hilum were then identified and dissected. Dissection of the left renal vein and its upper border led to the identification of the left adrenal vein which was dissected and divided using *a clip or energy device*. The dissection was then carried out along the medial aspect of the adrenal gland down to the level of the quadratus lumborum muscle in the retroperitoneum indicating complete removal of all the fat in the suprarenal space. *An accessory adrenal vein running along the medial aspect of the gland and draining into the phrenic vein was encountered and divided*. Using *electrocautery/energy device*, the retroperitoneal fat of the left suprarenal space was elevated off the superior pole of the left kidney. The dissection of all the suprarenal tissue was then completed in a stepwise fashion. The arterial supply of the left adrenal gland was controlled and divided as it was encountered along this dissection until the gland and its surrounding tissues were completely mobilized.

Irrigation of the operative bed was then carried with the confirmation of hemostasis. The adrenal gland and all surrounding fat were then placed in a specimen retrieval bag and extracted after enlarging the 10-mm port via a muscle-splitting incision. The extraction site was then sutured closed in layers using an 0 PDS/ ___ stitch. Re-insufflation of the abdominal cavity was then carried out and hemostasis was confirmed. The trocars were removed under direct vision, and the fascia was closed on all trocar sites >10 mm using ___ suture. The skin was closed with 4-0 Monocryl. The patient tolerated the procedure well. There were no complications and blood loss was minimal. Instrument and sponge count was correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and returned to the postanesthesia care unit in stable condition.

Right Adrenalectomy

178

Faek R. Jamali

Indications

- Aldosteronoma
- Cortisol-secreting adenoma (Cushing's syndrome or subclinical Cushing)
- Pheochromocytoma (sporadic or familial)
- Virilizing or feminizing tumors
- Nonfunctioning unilateral tumor size >4 cm
- Adrenal nodule with imaging features atypical for adenoma, myelolipoma, or cyst
- Adrenocortical carcinoma
- Solitary unilateral adrenal metastasis

Essential Steps

1. Prepare the patient adequately (e.g., correct electrolyte abnormalities, control hypertension, preoperative alpha-blockade in pheochromocytoma, stress steroids in Cushing's disease).
2. Enter the abdomen through an extended right subcostal incision. Exposure for this approach may be facilitated by elevating the right flank using a roll under the right side.
3. Explore the abdomen.
4. Mobilize the triangular ligament of the liver and medial rotation of the right liver lobe to expose IVC.
5. Dissect the right border of the IVC.
6. Identify, dissect, and clip the right adrenal vein.
7. Dissect all the right suprarenal tissue, including the right adrenal gland and en bloc resection of retroperitoneal fat and any attached organ (liver, kidney, diaphragm) as needed to ensure complete tumor resection.

Note These Variations

- Large malignant tumors on the right may require en bloc resection of a liver segment (segment VIII) and even the kidney.
- Adrenal tumors should be removed along with a generous margin of retroperitoneal fat and Gerota's fascia.
- In cases of primary adrenal cortical malignancies, periaortic lymph nodes medial to the right renal hilum should be removed along with the tumor.

Complications

- Tumor rupture with spillage and seeding
- Injury to the right hepatic vein or IVC
- Bleeding from large raw surface in the retroperitoneum or from accessory lumbar veins

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_178

- Right diaphragmatic injury leading to the pneumothorax
- Injury to renal hilar vessels

Template Operative Dictation

Preoperative Diagnosis List specific pathology indicating surgery *(see indications above),* e.g., *pheochromocytoma of the right adrenal gland*.

Procedure Open right adrenalectomy

Postoperative Diagnosis List specific intraoperative findings, e.g., *pheochromocytoma of right adrenal gland*.

Indications This ___-year-old *male/female* patient was found to have a *specific diagnosis of right adrenal gland pathology*. Preoperative biochemical workup showed evidence of *(list specific hormonal activity if present)*. Imaging confirmed a ___ cm right adrenal lesion. The patient underwent preoperative preparation *(see point one of essential steps)* and is now presenting for elective right adrenalectomy. The indications, alternatives, risks, and benefits of the surgery were discussed with the patient and informed consent was obtained.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Intravenous antibiotic and subcutaneous heparin were administered. After induction of general endotracheal anesthesia, a Foley catheter was inserted. A roll (or beanbag) was placed under the patient's right flank to allow slight medial rotation of the right side. All extremities were well padded. The abdomen was clipped and prepped in the usual sterile fashion.

The abdomen was approached via a standard extended subcostal incision. The skin was incised two fingerbreadths below the right costal margin starting from the mid-axillary line and extending to the midline. The incision was deepened through the skin and subcutaneous tissue. Scarpa's fascia was opened and the incision taken down to the level of the abdominal wall. The anterior rectus sheath was opened and the right rectus muscle was split using electrocautery with control of the epigastric vessels. The posterior rectus sheath was also divided. Using electrocautery, the lateral abdominal wall musculature was divided. The external, internal, and transversalis fascia were divided using electrocautery.

Exploration of the abdominal cavity was then carried out to rule out evidence of metastatic disease. The procedure was started by mobilizing the triangular ligament of the liver and rotating the right hepatic lobe medially to allow exposure of the IVC and of the adrenal gland in the retroperitoneum. Dissection of the right border of the IVC was then carried out by incising the peritoneal reflection overlying the suprarenal lodge along the right border of the IVC all the way up to the diaphragm. Care was taken not to injure the right hepatic vein. Gentle dissection along the right border of the IVC led to the identification of the right adrenal vein which was then ligated and divided. The dissection along the right border of the IVC was then carried further posteriorly until reaching the quadratus lumborum muscle and then inferiorly until reaching the right renal hilum.

The right suprarenal lodge was then dissected and removed as one block. Using *electrocautery/energy device*, the retroperitoneal fat of the right suprarenal lodge was elevated off the superior pole of the right kidney and gently dissected off the lateral abdominal wall, posteriorly off the right quadratus lumborum muscle, and superiorly off the diaphragm. The arterial supply of the right adrenal gland was controlled and divided as it was encountered along this dissection. *(It usually consists of three main arterial branches, from the right renal artery, the aorta, and the right phrenic artery.)* Care was taken not to injure any accessory right renal arteries that may easily be confounded for adrenal arterial branches originating from the renal artery. Care was also taken to avoid injury to the capsule of the adrenal gland. *If cancer: An en bloc dissection of the para-aortic nodes was also carried out as part of the medial extent of the dissection of the suprarenal tissue. The specimen is then removed en bloc (when indicated for ACC).*

Irrigation of the suprarenal region was carried out and confirmation of hemostasis was achieved. The right lobe of the liver was then allowed to return back to its normal anatomical position. Closure of the abdomen in layers was then carried out using a running 0 PDS/ ___ stitch. The patient tolerated the procedure well. There were no complications and the blood loss was minimal. The instrument and sponge count was correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and returned to the recovery room in stable satisfactory condition.

179 Laparoscopic Right Adrenalectomy

Faek R. Jamali

Indications

- Aldosteronoma.
- Cortisol-secreting adenoma (Cushing syndrome).
- Pheochromocytoma (sporadic or familial).
- Virilizing or feminizing tumors.
- Incidentaloma (>4 cm in size).
- Solitary adrenal metastasis.

Essential Steps

1. Optimize the patient's medically (e.g., correct electrolyte abnormalities, control hypertension, preoperative alpha-blockade in pheochromocytoma, stress steroids in Cushing's disease).
2. Position the patient in the full right lateral decubitus position with appropriate padding.
3. Establish pneumoperitoneum and place trocars along subcostal margin.
4. Explore the abdomen.
5. Mobilize the triangular ligament of the liver and elevate the right lobe of the liver.
6. Dissect the right border of the inferior vena cava.
7. Identify, dissect, secure, and divide the right adrenal vein.
8. Dissect all the right supra-renal tissues, including right adrenal gland and perform en bloc resection of retroperitoneal fat from the superior pole of the right kidney to the diaphragm.

Complications

- Tumor rupture with spillage and seeding.
- Injury to right hepatic vein or IVC.
- Bleeding from large raw surface in the retroperitoneum or from accessory lumbar veins.
- Right diaphragmatic injury leading to pneumothorax.
- Injury to renal hilar vessels.
- Missed bowel injury

Template Operative Dictation

Preoperative Diagnosis List specific pathology indicating surgery *(see indications above),* e.g., *pheochromocytoma of the right adrenal gland*.

Procedure Laparoscopic right adrenalectomy.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_179

Postoperative Diagnosis List specific intraoperative findings, e.g., *pheochromocytoma of right adrenal gland*.

Indications This ___-year-old *male/female* patient was found to have a right adrenal ___. Preoperative biochemical workup showed evidence of ____ *(list specific hormonal activity if present)*. Imaging confirmed a ___cm right adrenal lesion. The patient underwent preoperative preparation *(see point one of essential steps)* and is now presenting for elective laparoscopic right adrenalectomy. The indications, alternatives, and risks and benefits of the surgery were discussed with the patient and informed consent was obtained.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. Timeouts were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Intravenous antibiotic and subcutaneous heparin were administered. After induction of general endotracheal anesthesia, a Foley catheter was inserted. The abdomen was prepped in the usual sterile fashion. The patient was then positioned in the full right lateral decubitus position with appropriate padding.

The abdomen was approached under direct vision using optical 10 mm trocar and pneumoperitoneum was induced. The first (10 mm) trocar was placed at the mid-level of the subcostal margin on the right side. Two additional 5-mm trocars were placed at the level of the costal margin, 8–10 cm away to the right and right of the camera port. The third 5-mm trocar was placed to at the level of the mid-axillary or posterior axillary line for the assistant's use. Exploration of the abdominal cavity was carried out followed by mobilization of the triangular ligament of the liver and elevation/rotation of the right hepatic lobe medially using a 5-mm curved tip retractor and hook electrocautery to allow exposure of the IVC and the adrenal gland in the retroperitoneum.

Dissection of the right border of the IVC was then carried out by incising the peritoneal reflection overlying the suprarenal tissues along the right border of the IVC all the way up to the diaphragm using *hook electrocautery/energy device*. Care was taken not to injure the right hepatic vein. Gentle dissection along the right border of the IVC led to the identification of the right adrenal vein which was then *ligated and divided/secured with an endoscopic stapler with a vascular load, energy device or clip*. The dissection along the right border of the IVC was then carried further posteriorly until reaching the quadratus lumborum muscle and then inferiorly until reaching the right renal hilum with clear identification of the right renal vein. The right suprarenal tissues were then dissected and removed en bloc. Using *electrocautery/energy device*, the retroperitoneal fat of the right suprarenal space was elevated off its superior attachments to the diaphragm, the superior pole of the right kidney and gently dissected off the lateral abdominal wall. The posterior dissection was carried out to the level of the right quadratus lumborum muscle ensuring complete removal of the all the adrenal gland and suprarenal tissue as one block. The arterial supply of the right adrenal gland was controlled and divided using an appropriate energy source, as it was encountered along this dissection. Care was taken not to injure any accessory right renal arteries. Care was also taken to avoid injury to the capsule of the adrenal gland.

Irrigation of the operative bed was then carried with the confirmation of hemostasis. The adrenal gland and all surrounding fat were then placed in a specimen retrieval bag and extracted after enlarging the 10-mm port via a muscle splitting incision. The extraction site was then sutured closed in layers using an 0 PDS/ ___ stitch. Re-insufflation of the abdominal cavity was then carried out and hemostasis was confirmed. The trocars were removed under direct vision and the fascia was closed on all trocars sites >10 mm using ___ suture. The skin was closed with 4-0 Monocryl. The patient tolerated the procedure well. There were no complications and blood loss was minimal. Instrument and sponge count was correct. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and returned to the post anesthesia care unit in stable condition.

Operations for Infected Abdominal Wound Dehiscence and Necrotizing Soft Tissue Infection of the Abdominal Wall

180

Kristen C. Sihler

Indications

- Infected fascial dehiscence.
- Infection of abdominal wall not responsive to antibiotics.

Essential Steps

1. Prep an area much wider than the area of visible infection
2. *Midline incision/incision that encompasses apparent borders of tissue necrosis.*
3. Widely debride obviously infected tissue with scalpel or electrocautery. Consider sending tissue for quantitative cultures.
4. Secure hemostasis as you debride with judicious and sparing use of electrocautery.
5. Open and debride necrotic tissue, including fascia, taking care not to injure the adherent bowel.
6. Assess the entire abdomen for abscesses. If found, send a sample for gram stain and culture.
7. Irrigate the incision and abdomen copiously.
8. *Close fascia with multiple through-and-through sutures and consider use of retention sutures/ if unable to approximate fascia, insert biologic or absorbable mesh or consider doing a damage control closure such as a vacuum dressing and performing a second-look operation in 24–48 h with mesh placement or staged abdominal closure (if needed) at that time.*
9. If fascia is closed or mesh placed, leave the skin and subcutaneous tissue open.
10. Pack with saline-moistened or Dakin's moistened gauze or place a superficial vacuum dressing if not doing a damage control closure.

Note These Variations

- Document extent of debridement including the layers debrided.
- Primary vs. mesh closure.
- Type of mesh placed.

Complications

- Sepsis.
- Ventral hernia.
- Enterocutaneous fistula.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_180

Template Operative Dictation

Preoperative Diagnosis *Necrotizing soft tissue infection of the abdominal wall/infected abdominal wound dehiscence.*

Procedure *Debridement of the abdominal wall/wound, drainage of intra-abdominal abscess, washout of the abdomen, insertion of mesh/reapproximation of fascia/temporary closure with planned re-operating.*

Postoperative Diagnosis *Same/intra-abdominal abscess.*

Indications This ____-year-old *male/female* with a past medical history significant for *diabetes/malignancy/alcohol abuse/malnutrition/obesity/abdominal wound with devitalized tissue/peripheral vascular disease/previous abdominal operation* presented with *spreading erythema/induration/fever/increased white blood cell count/hemodynamic instability/dehiscence/evisceration.* Gram stain showed many *gram-positive/negative/mixed organisms.* Operative debridement, washout, and repair were indicated as an emergency procedure.

Description of Procedure The patient was placed in a supine position. Timeouts were performed using both pre-induction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. The abdomen, upper thighs, and chest were prepped and draped in a standard surgical fashion. A midline incision was carried out through skin and fat, down to the level of the fascia. All grossly infected tissues *including subcutaneous tissue, fat, rectus muscle,* etc., were sharply excised and hemostasis was achieved with suture ligation of bleeding vessels and judicious use of electrocautery. *Prior fascial sutures were found to have pulled through the fascia/broken/suffered knot failure.* Next, the *fascia was incised/prior sutures were removed*, taking care to avoid damaging the underlying bowel. Necrotic fascia was debrided. All four quadrants of the abdomen were explored for intra-abdominal abscesses. *Abscesses were found in (specify locations) and drained.* The abdomen was then irrigated copiously with warmed saline. *The fascia was reapproximated using multiple through-and-through retention sutures of ____/ a Smead-Jones closure with interrupted ____/ a ____ (size) sheet of (specify type) mesh was sutured to the fascial edges so as to cover the fascial defect. An abdominal vacuum dressing was placed.* The skin was left open and covered with *saline-moistened gauze/a vacuum dressing.*

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was *awakened and taken to the postanesthesia care unit/ left intubated and taken to the PACU/surgical intensive care unit* in *stable/critical* condition.

Part XV

General Surgery: Pediatric

181 Pediatric Inguinal Hernia Repair

Ryan Conway and Graeme Pitcher

Indication

- Patent processus vaginalis with hydrocele or hernia

Essential Steps

1. Supine position.
2. Prep the operative site from the upper thighs to above the umbilicus.
3. Make a curvilinear incision in the skin crease centered over the mid-inguinal point.
    - Correct placement of the incision is important for reasons of cosmesis as well as affording good access to the structures in the inguinal canal. This incision satisfies both requirements.
4. Elevate Scarpa's fascia with toothed forceps and divide it with electrocautery.
5. When the window of fibroareolar tissue above the external oblique aponeurosis is seen, develop this plane further by blunt dissection.
    - Visualize the inguinal ligament as well as the external ring at this stage.
    - This allows you to exclude the rare femoral hernia.
    - It also ensures that you open the external oblique in the proper position to allow good access to the structures in the inguinal canal.
6. Identify the sac.
    - Look inferior to the ilioinguinal nerve beneath the curving fibers of the internal oblique.
    - Slight downward pressure on the two retractors providing exposure can make the sac more prominent at this stage.
7. Elevate the sac by separating the cremaster fibers and grasping it with a forcep.
    - Further exposure is best achieved at this stage by holding it up and peeling the cremaster fibers away from it bluntly with a DeBakey forcep.
8. At this stage, there are two options to proceed:
    - In patients with large, thin-walled sacs, especially in small babies, one may deliberately open the sac and perform further dissection from within. This is the author's preference.
    - In patients with more manageable sacs, the sac can be dissected from the cord structures without the need to open it.
    - Note that in females it is important to open the sac in all cases to ensure that the operator is not ligating a fallopian tube (which may loop into the sac) in error.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_181

9. If *the sac is opened:* Open the sac between two hemostats. Dissect posteriorly toward the cord structures while serially applying small hemostats to the proximal sac margin. Ultimately one will have a narrow bridge of sac between the last two hemostats that can be safely negotiated with the vessels and vas in the background and the dissection accomplished safely under direct vision.
10. If *the sac is left closed*: Seek a plane between the posterior wall of the sac and the vessels and vas deferens. This can be achieved either by dissecting with the tip of a hemostat or scissors or by rolling the sac over ones nondominant hand index finger and entering the plane with a scissors in that way. If the sac is inadvertently opened, one can revert to the open sac approach if the operation becomes difficult.
11. Once the sac is dissected free and controlled, clamp it with a single hemostat. Further dissection both superiorly and inferiorly around the internal ring with sustained traction on the sac will allow identification of the proper site of suture ligation flush with the fascia transversalis and lateral to the inferior epigastric vessels.
12. In girls, the round ligament can be ligated with the same suture as the sac and afford a sound closure. The distal portion of the round ligament is usually ligated for hemostasis.
13. Transfix the sac with a 4.0 Vicryl suture and suture ligate it. High-risk hernias can be double ligated.
14. Pull the scrotal contents down into the scrotum at this stage to prevent iatrogenic ascending testis and to allow easier closure of the external oblique.
15. In a boy with a communicating hydrocele, drain the distal entrapped fluid by presenting it up to the incision with pressure from below and creating a wide fenestration in the tunica vaginalis.
    - If this step is omitted, this postoperative hydrocele will cause parental anxiety and will require later drainage or aspiration.
16. Close the external oblique aponeurosis with a running suture of 4.0 Vicryl starting at the external ring and running laterally to the end.
    - Place the bites at varying depths to avoid weakening the aponeurosis with a parallel line of sutures – the "tear off postage stamp effect."
    - Avoid entrapping the ilioinguinal nerve in the suture line.
17. Close Scarpa's fascia with one to three buried interrupted sutures of 4.0 Vicryl.
18. Close the skin with a running subcuticular suture.

Note These Variations

- In babies with extremely large internal rings expanded by giant hernias, it may be necessary to bolster the fascia transversalis with some fine Prolene sutures (in the form of a medial interfoveolar ligament or Marcy repair) to minimize recurrence.
  – This is controversial.
- Occasionally, a sliding hernia involving the cecum or sigmoid will form the wall of the sac.
  – Under these circumstances, it can be dissected off the sac, returned to the abdominal cavity, and the sac closed with a running suture of 5.0 Prolene or equivalent to achieve sound closure.
- In certain situations, it may be advisable to rule out contralateral hernia by laparoscopy.
  – To do this, a modified purse-string suture is placed around the open sac. A 2-/3-mm port is placed in the sac into the peritoneal cavity and the sac tied temporarily around it. A pneumoperitoneum of 8–10 mmHg is achieved, and a 2.7-mm 70° lens is introduced. This is passed horizontally across the abdomen and usually affords a good view of the opposite internal ring.
- When faced with strangulated bowel in an indirect inguinal hernia, the initial steps are the same.
  – The sac is opened and the bowel inspected and returned to the abdominal cavity if intact.
  – In some cases, the internal ring will have to be opened slightly with a lateral incision to release the strangulated bowel.

– If the operator is comfortable, bowel resection, anastomosis, and hernia repair can all be carried out through the groin access. Alternatively, a small laparotomy can be helpful.

Complications

- Recurrence
- Testicular atrophy
- Injury to vas deferens
- Superficial wound infection
- Postoperative hematoma
- Postoperative hydrocele

Template Operative Dictation

Preoperative Diagnosis Inguinal hernia or hydrocele

Procedure Inguinal herniotomy

Postoperative Diagnosis Same

Indications This ___-*day/week/month/year*-old *male/female* presented with a *groin bulge or inguinal hernia or hydrocele*.

Description of Procedure The patient was brought into the operating room and placed supine on the operating table. Time-outs were performed using both preinduction and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. All pressure points were padded. The groin and lower abdomen was prepped and draped in a sterile fashion.

An incision was then made in a skin crease over the mid-inguinal point. The external oblique aponeurosis was opened longitudinally parallel to the inguinal ligament. The sac was identified and carefully dissected free from the other structures of the spermatic cord. The sac contained ____, which was reduced into the peritoneal cavity. A high ligation was performed with a transfixing suture of 4.0 Vicryl. The external oblique aponeurosis was closed with a running suture of 4-0 Vicryl from medial to lateral. The Scarpa's fascia was approximated by *two/three* buried 4-0 Vicryl interrupted sutures. The skin was closed with a running subcuticular suture of 5-0 Monocryl. *A sterile dressing/ surgical skin glue* was placed over the incision at the end of the case.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well, was awakened from anesthesia, and taken to the postanesthesia care unit in a satisfactory condition.

Laparoscopic Pyloromyotomy 182

Ryan Conway and Graeme Pitcher

Indication

- Infantile hypertrophic pyloric stenosis.

Essential Steps

1. Supine position. The patient is orientated transversely across operating table.
2. The anesthesiologist places a size 8- or 10-F nasogastric tube.
3. Palpate the pylorus while the patient is anesthetized.
4. Prep the abdomen in the usual sterile manner from the pubis to the nipple line.
5. Obtain pneumoperitoneum by a modified Hasson technique by dilating the umbilical cicatrix and passing a blunt instrument into the peritoneal cavity, ensuring that no injury is made to the liver.
6. Place a size 2/3/5 mm port in the umbilical position and obtain a pneumoperitoneum of 7–10 mmHg.
7. Pass a short 30° laparoscope into the abdomen and confirm the presence of a hypertrophic pylorus.
8. Rotate the lens to view the anterior abdominal wall and make a stab incision using a #11 blade approximately in the right midclavicular line, 2–3 cm below the costal margin.
9. Introduce an atraumatic grasper through this incision without the use of a port.
10. Make a similar incision at the same level on the patients left side just medial to the midclavicular line.
    - Make this incision sufficiently lateral enough so as not to allow the formation of muscular defects, which can occur if the incision is made too close to the midline.
11. Occasionally, a stay suture around the falciform ligament (passed extracorporeally) is helpful to elevate the liver away from the pylorus.
12. An arthrotomy knife or electrocautery device (hereafter referred to as "knife") that will be used to divide the pyloric muscle, is inserted through this incision without the use of a port. An extra long, protected blade type device, used with a low level of pure cut current is recommended and is our preference.
13. Grasp the duodenum distal to the hypertrophic area with the left hand, with a grip that is firm yet gentle and not too tight, and bring it forward into view.
14. Determine the limits of the hypertrophic muscle by palpating with the blunt tip of the knife in the right hand with the blade protected.
15. Make a longitudinal incision from just short of the distal limit of the muscle to the level of

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_182

the gastric wall using the knife. When the cautery is used, the instrument may be passed to the depth of the protecting sleeve – approximately 3 mm depth. When the arthrotome is used, the blade is protruded to approximately 2 mm.

16. Withdraw the blade and insert the blunt tip of the knife into the incision in the muscle and rotate it to begin spreading the fibers.
17. Insert the specialized spreader into the pyloric muscle incision and open it.
    - This usually allows the first visualization of the mucosa.
    - Errant fibers will sometimes require the repeated passage of the knife to divide them followed by repeated spreading.
18. Take great care not to divide the distal fibers too close to the distal extent of division, as it is there that the duodenal mucosa is most superficial and where inadvertent mucosal injuries are most likely to occur.
19. Examine the mucosa to determine that it is intact.
20. Remove the knife and exchange it for a second atraumatic grasper.
21. Grasp the upper and lower leaves of muscle in the two graspers.
22. The pyloromyotomy is complete when the two halves can be moved independently from one another.
23. An air insufflation test should be performed to test the mucosal integrity by the passage of 40–60 cc of air into the nasogastric tube by the anesthesiologist. The mucosal surface is inspected for bubbling.
24. Carefully remove the instruments in the stab incisions and check these incisions for hemostasis.
25. Deflate the abdomen and remove the port from the umbilicus.
26. Close the defect in the sheath of the umbilicus with a horizontal, vertical, or figure of eight type suture of 4.0 Vicryl.
27. Close the skin with tissue glue at the umbilicus as well as at the site of the two stab incisions.
    - No deep closure is performed at these two sites.

Note These Variations

- A 5-mm lens may be used if no smaller lens is available.
- The operator may elect to grasp the stomach with the right hand and to perform the pyloromyotomy with the left hand. This allows grasping on the more robust stomach wall as apposed to the more vulnerable duodenal wall.
- A standard protected electrocautery tip may substitute for the arthrotomy blade. The incision is then made on a low blend setting with a power of 10. The extent of the incision is usually scored first on the surface using the coagulation mode. The electrocautery tip doubles as a blunt spreader very effectively. Care must be taken to coordinate activation of the current so as not to cause inadvertent injury during spreading.
- An air insufflation test can be performed to test the mucosal integrity by the passage of 40–60 cc of air into the nasogastric tube by the anesthesiologist. The mucosal surface is inspected for bubbling.

Complications

- Mucosal perforation.
- Wound infection.
- Prolonged postoperative emesis.
- Incomplete pyloromyotomy.
- Injury to the liver or duodenum.
- Port site hernias or dehiscence (rare).

Template Operative Dictation

Preoperative Diagnosis Hypertrophic pyloric stenosis.

Procedure Laparoscopic pyloromyotomy.

Postoperative Diagnosis Same.

Indications This ___-week-old *male/female* presented with forceful vomiting and was found to have clinical, radiological, and ultrasound features to support the diagnosis of hypertrophic pyloric stenosis.

Description of Procedure The patient was brought into the operating room, and placed supine on the operating table. Timeouts were performed using both pre-induction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. The patient was then repositioned transversely across the operating table. A nasogastric tubes was placed. All pressure points were padded. The abdomen was prepped and draped in a sterile fashion.

The abdomen was entered with a modified Hasson technique by dilating the umbilical cicatrix and passing a blunt instrument into the peritoneal cavity. A trocar was introduced into the abdomen under direct vision. The abdomen was insufflated with carbon dioxide to a pressure of *8 mmHg*. The patient tolerated insufflation well. The laparoscope was then inserted and the abdomen was inspected. There was no injury to the liver or bowel noted from initial trocar placement. The stomach was identified and the pylorus could also easily be seen and appeared hypertrophic. A stab incision was then made on the right side of the abdomen within the rectus sheath under direct vision. An atraumatic grasper was placed into the abdomen and the duodenum was grasped. A second stab incision was then made on the left side of the abdomen and an *electrocautery device/arthrotomy knife* was introduced. The pyloric muscle was incised approximating 2 cm in length extending from just proximal to the duodenum and onto the stomach. The electrocautery tip/retracted arthrotomy blade was used to start the myotomy. The pyloric spreader was then used to complete the pyloromyotomy. The mucosa was seen bulging but intact. Both halves were independently movable indicating an adequate pyloromyotomy. There was no gross bleeding. An air insufflation test was performed to test the mucosal integrity by clamping the duodenum and passing 40–60 cc of air into the nasogastric tube. The mucosal surface appeared intact without bubbling. Instruments were then removed and the abdomen desufflated. The defect in the umbilicus was closed with a buried interrupted 4-0 Vicryl stitch. Surgical skin glue was placed on the umbilical and both subcostal incisions. The NG tube was removed at the end of the case.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was awakened from anesthesia and taken to the postanesthesia care unit in a satisfactory condition.

183 Pediatric Laparoscopic Nissen Fundoplication

Joel Shilyansky

Indications

- Patients with GERD complicated by:
  - Failure to thrive
  - Aspiration
  - Laryngospasm associated with reflux and leading to severe cyanotic or apneic events
- Failure of medical therapy of GERD:
  - Persistent esophagitis
  - Pain
  - Regurgitation and vomiting resulting in significant impact on the quality of life
- Barrett's esophagus (intestinal metaplasia)
- Hiatal or paraesophageal hernia

Essential Steps

1. Supine position or low lithotomy position to allow the surgeon to stand at the foot of the bed, moderate reverse Trendelenburg (~20° head up).
2. Port placement:
   (a) Port size is variable and depends on surgeon's preference and the size of the child. Five 5-mm ports can accommodate most circumstances. Some surgeons prefer 3-mm trocars in a small baby.
   (b) 30° laparoscope.
3. Elevate the left lateral segment of the liver using a retractor placed through the right lateral port.
4. Divide the short gastric vessels (*this maneuver is not always needed and performed based on surgeon preference*):
   (a) Enter the lesser sac along the greater curve of the stomach through an avascular window to the left of the body or fundus.
   (b) Take great care not to injure the spleen especially as the vessel gets shorter superiorly.
5. Retract the stomach inferiorly.
6. Incise the gastrohepatic and the phreno-esophageal ligament.
7. Dissect the right crus:
   (a) Make sure enough crus is exposed.
8. Dissect the esophagus posteriorly and create a large enough window to accommodate the fundus:
   (a) Take great care not to injure the:
      i. Esophagus
      ii. Vagus nerve
      iii. Aorta
   (b) Avoid extensive dissection in the mediastinum:
      i. By identifying the junction of the right and left crura, one can avoid getting lost.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_183

ii. Some dissection of the mediastinal esophagus may be needed to gain greater intra-abdominal length of the esophagus.

(c) Avoid dissecting into the left pleural space, as it may result in tension pneumothorax. If pneumothorax occurs, place a chest tube on the left. Tube may be removed at the end of procedure after pneumoperitoneum is evacuated.

9. Close the crus with a bougie in the esophagus:
   (a) Place the crural stitch.
   (b) Ask the anesthesiologist to insert the bougie:
      i. Protect the airway since accidental extubation during passage of bougie can occur.
   (c) Make sure that the thick part of the bougie is past the gastroesophageal junction.
   (d) Withdraw the bougie into the thoracic esophagus to facilitate the next step.
10. Bring a fold of the fundus behind the esophagus.
11. Bring a fold of the fundus anteriorly to the esophagus.
12. Place three fundoplication sutures spanning 1–1.5 cm from the superior to the inferior:
   (a) Place the first, superior suture, then advance the bougie, and tie it over the bougie.
   (b) If the tie is not perfect, you can replace it later.
   (c) Place the remaining sutures:
      i. Incorporate the anterior esophagus in the fundoplication sutures to prevent it from sliding down. Take a bite of anterior fold of fundus, then the anterior wall of the esophagus, and then the posterior fold of fundus.
      ii. If the first suture is too loose, replace it.
   (d) The fundoplication should surround the intra-abdominal esophagus.
   (e) Remove the bougie.
   (f) Tack the fundoplication to the crus to prevent the wrap from herniating into the chest.
13. Withdraw instruments.
14. Close umbilical fascial defect.

Complications

- Patient selection is critical for the success of the procedure. The procedure is very effective at preventing retrograde flow of gastric contents, gastroesophageal reflux disease. Patients with gastric outlet obstruction, severely delayed gastric emptying, retching, aspiration of saliva, and obesity have less than satisfactory outcomes and may suffer exacerbation of their symptoms and early failure of fundoplication.
- Injury to esophagus.
- Injury to spleen.
- Injury to vagus nerves.
- Injury to aorta.
- Pneumothorax.
- Failed fundoplication.
- Dysphagia.

Template Operative Dictation

Preoperative Diagnosis *Refractory gastroesophageal reflux/hiatal hernia/paraesophageal hernia*

Procedure Laparoscopic Nissen fundoplication

Postoperative Diagnosis Same

Indications This _____-*month/year*-old *male/female* had *refractory gastroesophageal reflux with _____/hiatal hernia/paraesophageal hernia*. Medical management failed and laparoscopic Nissen fundoplication was indicated for definitive treatment.

Description of Procedure The patient was positioned supine in the operating room table. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced. An orogastric tube was inserted. The child was then placed at the end of the table (*optional*: *in low lithotomy position*). The abdomen was prepped and draped. The patient was then placed in reverse Trendelenburg at 20° angle.

An umbilical incision was created. The fascia was incised and traction sutures were placed in the fascia. (*Optional*: *An occult umbilical hernia defect was chosen for entry site into the fascia.*) *A 5-mm port was introduced into the peritoneal cavity under direct vision/a Veress needle was inserted* and the abdomen was insufflated. *If Veress needle*: *A 5-mm port was then placed*.

The abdomen was examined. Four additional 5-mm ports were placed, the two operating ports in subcostal position at the midclavicular line on both the left and on the right and two retracting ports along the right and left anterior axillary line. *To mobilize the fundus*, *short gastric vessels were divided using the ligasure/harmonic scalpel*. The gastrohepatic ligament was divided. The presence of a replaced left hepatic artery was evaluated *(and if present: it was avoided)*. The stomach was retracted inferiorly. The esophagophrenic ligament was divided. The right diaphragmatic crus was identified and dissected. The cardia and esophagus were freed at the hiatus using a combination of blunt and sharp dissection. The posterior dissection was carried out from right to left taking great care not to injure the esophagus. The anterior and posterior vagus nerves were visualized and spared. The left diaphragmatic crus was identified. The posterior aspect of the esophagus was freed for sufficient length to allow the fundus to pass without tension. Dissection of the mediastinal esophagus was performed to allow for sufficient intra-abdominal esophageal length.

A _____ French bougie was atraumatically passed into the esophagus. Crural repair was performed posteriorly using 2-0 Ethibond sutures. The sutures were tied with a bougie placed within the esophagus. Next a 360° fundoplication was performed. The bougie was partially withdrawn into the thoracic esophagus. A fold of the fundus was passed behind the esophagus. The remainder of the fundus was folded anteriorly to the esophagus. The twofold of the fundus was brought together to create a 1–1.5-cm long fundoplication. The superior fundoplication suture was placed (2-0 Ethibond is commonly used). The bougie was passed back into the stomach prior to tying the first fundoplication suture. Two additional fundoplication sutures were then placed and tied with the bougie in the esophagus. The two superior sutures incorporated the esophagus at the hiatus. The most inferior suture was at or just above the level of the gastroesophageal junction. The bougie was removed. The fundoplication was tacked to the diaphragmatic crus using two 2-0 Ethibond sutures to prevent the wrap from migrating into the chest.

The laparoscopic instruments were then withdrawn. The umbilical fascial defect was closed with _____. The skin incisions were closed with absorbable ____ sutures and a dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

184 Ladd's Procedure for Malrotation (Laparoscopic and Open)

Amir M. Alhajjat

Indications

- Surgical treatment for patients with intestinal malrotation with or without volvulus

Essential Steps

1. *Obtain safe entry into the abdominal cavity*.
   (a) Laparoscopic approach.
      - Port size is variable and depends on surgeon's preference and the size of the child. Three 5-mm ports can accommodate most circumstances. Some surgeons prefer 3-mm trocars in a small baby.
      - 30° Laparoscope.
   (b) If midgut volvulus is present, open laparotomy is preferred.
2. *Examine bowel for midgut volvulus or bowel ischemia/necrosis.*
   If midgut volvulus is present:
   - Reduce midgut volvulus by counterclockwise twisting. Detorsion usually requires two to three twists.
   - Assess the viability of the bowel. Resect grossly necrotic bowel. Perform primary anastomosis or create stoma at the surgeon's discretion.
   - If multiple areas of uncertain viability are present, consider second-look laparotomy in 24 h.
3. *Divide Ladd's bands.*
   - These are fibrous bands that attach the cecum to the posterolateral abdominal wall, duodenum, gallbladder, and liver.
4. *Widen the base of the mesentery.*
   - Score the anterior peritoneal leaflet to widen the mesenteric base.
5. *Appendectomy.*
6. *Place the cecum in the left lower quadrant and the small bowel in the right upper quadrant.*
7. *Close ports or laparotomy.*

Note These Variations

- Open versus laparoscopic approach
- Choice of open incision: right upper quadrant transverse versus midline (midline may be preferred in older children or in those with signs of bowel necrosis)
- Management of questionable or necrotic bowel
- Resection with anastomosis versus stoma formation
- Second-look laparotomy in cases of questionable viability

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© Springer Science+Business Media, LLC 2017
J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_184

Template Operative Dictation

Preoperative Diagnosis Intestinal malrotation (with/without) volvulus

Procedure (Laparoscopic/open) Ladd's procedure

Postoperative Diagnosis Same

Indications This _____-*month-/year*-old *male/female* who presented with intestinal malrotation with/without volvulus

Findings *(Detail)*

Description of Procedure The patient was brought to the operating room and laid supine on the operating table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Appropriate cardiopulmonary monitors were placed after which general endotracheal anesthesia was induced without difficulty. An orogastric tube and Foley catheter were placed. The abdomen was then prepped and draped in standard sterile fashion.

[Choose One]:
If laparoscopic:
An infraumbilical incision was made. A *Veress needle/other method* was utilized to access the peritoneal cavity and pneumoperitoneum established. A 5-mm port was then placed. A 30° laparoscope was used to inspect the abdominal contents and revealed no entry injury.

Accessory *5-/12-mm* ports were inserted in the following locations*: one in the right iliac fossa and one in the left iliac fossa/others*. The abdominal cavity was then explored. The duodenojejunal junction was identified and noted to be on the right side. Similarly, the ileocecal junction was also identified and was abnormally placed in the (epigastrium/right hypochondrium). Upon inspection, the mesenteric base was felt to be narrow in between these two junctions confirming the diagnosis of malrotation. The bowel was inspected and there was *no volvulus/describe other findings. There was no bowel ischemia and the entire bowel looked healthy/describes other findings*.

The Ladd bands were then approached. These were grasped, elevated, and lysed using hook cautery (note variable: sharp dissection, ultrasonic shears) as they crossed between the cecum and terminal ileum to the abdominal wall, duodenum, gallbladder, and liver (not all are present). We then broadened the small bowel mesentery by scoring the anterior leaflet of the mesentery.

The appendix (if present) was then grasped with an atraumatic grasper. The base was transected with an endoGIA stapler/0 Vicryl endoloop tie, and the mesentery was transected with *LigaSure/other device.* The appendix was retrieved via an Endocatch bag and was sent for final pathological examination. The cecum was then positioned in the left lower quadrant and the small bowel in the right lower quadrant. The bowel lay comfortably with no undue tension or torsion.

All ports were removed under direct vision and the abdomen deflated. Port sites were then closed using 4-0 Monocryl for the skin. Skin glue/Steri-Strips/sterile dressings were applied.

If open:

A right upper quadrant transverse incision/vertical midline incision was made and carried down to the fascial level. The fascia was incised and the peritoneum was entered sharply.

If bowel volvulus:
The bowel was eviscerated, inspected, and detorsed by turning it counterclockwise until the mesentery was straight. (Note bowel viability. Frankly necrotic bowel after detorsion should be resected. If long segment of bowel viability is questionable, may elect for temporary abdominal closure.)
If no bowel volvulus:
The bowel was inspected and there was no volvulus.

The abdominal cavity was then explored. The duodenojejunal junction was identified and noted to be on the right side. Similarly, the ileocecal junction was also identified and was abnormally placed in the (epigastrium/right hypochondrium).

Upon inspection, the mesenteric base was felt to be narrow in between these two junctions confirming the diagnosis of malrotation.

The Ladd bands were approached. These were lysed sharply with electrocautery as they crossed between the cecum and terminal ileum to the abdominal wall, duodenum, gallbladder, and liver (not all are present). The small bowel mesentery is broadened by scoring the anterior leaflet of the mesentery.

Appendectomy was performed. The base and mesentery of the appendix were divided between clamps and tied with 3-0 Vicryl ties. The appendix was sent for final pathological examination. The cecum was then positioned in the left lower quadrant and the small bowel in the right lower quadrant. The bowel lay comfortably with no undue tension or torsion.

The fascia was then closed with ___ *PDS suture/others* (note variability in suture size depending on patient age). The subcutaneous tissue was irrigated and the skin was closed with 4-0 Monocryl suture. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was taken to the PACU in satisfactory condition.

Part XVI

Vascular Surgery: Cerebrovascular Occlusive Disease

Carotid Endarterectomy

185

Jamal J. Hoballah

Indications

- Asymptomatic stenosis >60 %
- Symptomatic stenosis >50 % in the absence of high medical risk patients or high surgical risk patients (recurrent stenosis, tracheostomy, neck radiation) where carotid stenting will be considered

Essential Steps

1. Incise the skin and platysma.
2. Retract the sternocleidomastoid laterally.
3. Identify the internal jugular and facial veins.
4. Transect and suture ligate the facial vein.
5. Expose and dissect the common, internal, and external carotid arteries.
6. Identify and preserve the vagus and hypoglossal nerve.
7. Anticoagulate with heparin.
8. Cross-clamp the internal, common, and external carotid arteries.
9. Insert shunt if needed.
10. Perform the endarterectomy.
11. Assess the endarterectomized surface and the endpoints.
12. Close the arteriotomy.
13. Backbleed the internal and external carotid arteries and forwardbleed the common carotid artery.
14. Resume flow into the external and then internal carotid arteries.
15. Assess reconstruction.
16. Secure hemostasis.
17. Close the wound.

Note These Variations

- Carotid endarterectomy is most commonly performed by opening the carotid artery longitudinally and removing the plaque. The artery is then closed primarily or with a patch as described in this chapter. The patch used can be prosthetic (polyester and PTFE), bovine pericardium, or autogenous (greater saphenous and jugular vein). Alternatively, the internal carotid artery is transected obliquely at its origin and the endarterectomy is performed using an eversion technique as described in Chap. 186.
- During carotid endarterectomy, the need for shunting can be determined by performing the procedure with the patient awake under regional/local anesthesia, by using EEG monitoring or measuring internal carotid stump pressure. Alternatively, routine shunting may be carried out.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_185

Complications

- Stroke
- Hematoma
- Thrombosis
- Cranial nerve injury
- Infection
- Recurrent stenosis

Template Operative Dictation

Preoperative Diagnosis *Right/left* carotid stenosis

Procedure *Right/left carotid endarterectomy, primary closure, patch angioplasty, and vein/ Dacron*/PTFE/*Bovine pericardium*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was *asymptomatic/had prior transient monocular blindness/transient ischemic attacks/stroke. Duplex scan/angiography/MRA/CTA* revealed stenosis of the *right/left* internal carotid artery. The risks and benefits of carotid endarterectomy were explained to the patient who elected to proceed with the Surgicel intervention.

Description of Procedure The patient was placed in the supine barber chair position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general endotracheal/regional/local anesthesia*.

The *right/left neck and right/left upper thigh* were prepped and draped in a standard fashion.

Electroencephalogram (EEG) monitoring was commenced.

A longitudinal skin incision was made overlying the anterior border of the sternocleidomastoid muscle. The incision was deepened through the platysma with electrocautery. The sternocleidomastoid muscle was retracted laterally.

The internal jugular vein was identified. Dissection along the medial border of the jugular vein revealed the facial vein. The facial vein was transected and suture ligated using a 3-0 silk suture.

The common carotid, the internal carotid, the superior thyroid, and the external carotid arteries were exposed and dissected.

The vagus and hypoglossal nerves were identified and preserved. Traction over the angle of the mandible was avoided to protect the mandibular branch of the facial nerve. The ansa cervicalis was transected to improve the exposure of the internal carotid artery.

Five thousand units of heparin were administered intravenously 75 UI/kg and an activated clotting time (ACT) was checked.

Five minutes after heparin administration, the internal carotid artery was clamped with a Yasargil clamp. The common carotid artery was clamped with a DeBakey vascular clamp. The external carotid and superior thyroid arteries were controlled with Silastic vessel loops.

No EEG changes were noted/EEG slowing was noted immediately after cross-clamping the internal carotid artery. An arteriotomy was performed on the anterolateral surface of the common carotid artery with a #11 blade scalpel and extended into the internal carotid artery using a Potts scissors.

A Javid/Sundt/Pruitt-Inahara/inlying/outlying shunt was inserted in the common and internal carotid arteries. The EEG returned to normal after shunt placement.

The endarterectomy plane was developed with a Freer elevator. The plaque was transected proximally in the common carotid artery. In the distal internal carotid artery, the plaque was feathered off, leaving a smooth endpoint. Eversion endarterectomy of the external carotid artery was performed and the carotid plaque was removed.

The endarterectomized surface was gently irrigated with heparinized saline solution. All remaining free debris was removed with a fine forceps.

The distal endarterectomy endpoint was inspected. *Tacking sutures were not deemed necessary/few interrupted 6-0 Prolene sutures were* *used to tack down the distal endpoint to secure the distal intima*.

Choose One

If primary closure: The arteriotomy was closed primarily using a continuous 6-0 Prolene suture.

If patch closure: The arteriotomy was closed using a patch angioplasty. *A Dacron/PTFE/vein/Bovine Pericardium* patch was used.

A 6-cm segment of greater saphenous vein was harvested from the right upper thigh. The vein segment was slit longitudinally. The patch was trimmed and the patch angioplasty was performed using a continuous 6-0 Prolene suture. The suture was started at the apex of the arteriotomy in the internal carotid artery and ran on each side. The patch was trimmed to the appropriate size, and another suture was started at the other end of the patch and ran on each side to meet the first suture.

Prior to tying the last sutures, the shunt was removed.

The internal carotid, external carotid, and superior thyroid arteries were backbled. The common carotid was forwardbled. The carotid lumen was again irrigated with heparinized saline.

Flow was first reestablished into the external carotid artery and then into the internal carotid artery.

No EEG changes were noted during the removal of the shunt/EEG changes were noted during the removal of the shunt; however, the EEG quickly returned to normal. The suture line was checked for hemostasis. Needle hole bleeding was controlled with the topical application of Surgicel.

Doppler/duplex evaluation revealed excellent flow signals through the common carotid, internal carotid, and external carotid arteries.

After ensuring hemostasis, the wounds were closed using 3-0 Vicryl for the platysma and soft tissues. The skin was closed with staples. Sterile dressings were applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was awakened, noted to have no gross neurological deficits, and taken to the postanesthesia care unit in stable condition.

186 Carotid Endarterectomy Using the Eversion Technique

Dale Maharaj and R. Clement Darling III

Indications

- Asymptomatic stenosis >60 %
- Symptomatic carotid stenosis >50 % (as for standard carotid endarterectomy)

Contraindications

- Previous carotid endarterectomy with patch closure (relative)
- Prior irradiation, radical neck dissection, and extensive high lesions
- Carotid bypass

Complications

- Stroke, hematoma, thrombosis, cranial nerve injury, infection
- Recurrent laryngeal nerve/hoarseness, ipsilateral tongue deviation, marginal mandibular branch – ipsilateral lip drop

Advantages of Eversion

- Less chance of closure-related stenosis. No need for patch.
- Plaque extraction is simpler and clamp time minimized.
- Better visualization and management of endpoint.
- Quick, simple reanastomosis.
- Lower incidence of recurrent carotid stenosis.
- Lower incidence of cranial nerve injury.

Essential Steps

1. Skin incision at the anterior border of the sternocleidomastoid.
2. Divide platysma and retract the sternocleidomastoid laterally.
3. Identify and then retract internal jugular laterally.
4. Transect and suture-ligate the facial vein (branch of internal jugular vein crossing over carotid bifurcation).
5. Expose the common, internal, and external carotid arteries.
6. Identify and preserve the vagus and hypoglossal nerves.
7. Anticoagulate (30 U/kg) heparin.
8. Cross-clamp the internal, external, and common carotid arteries.
9. Transect the internal carotid artery at the bulb obliquely and dissect circumferentially.
10. Insert Javid type shunt (only for neurological deterioration) before or after the endarterectomy.
11. Extend arteriotomy on the internal and common carotid cephalad and caudally, respectively, as needed.
12. Evert the internal carotid artery while holding the plaque in place with a forceps.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_186

13. Remove the common and external carotid plaque as with a standard endarterectomy (transect the plaque and deal with the common carotid and external carotid plaques individually).
14. Assess the endarterectomized surface and the endpoints and remove atherosclerotic debris.
15. Reconstruct the internal and common carotid using a continuous 6/0 polypropylene suture starting at the cephalad corner.
16. Backbleed the internal and external carotid arteries, and forward bleed the common carotid artery just before complete closure, and flush with heparinized saline.
17. Resume flow into the external, common, then internal carotid arteries.
18. Assess reconstruction – Doppler and duplex scan.
19. Ensure hemostasis.
20. Close the platysma and skin.

Operative Note

Preoperative diagnosis	Rt/Lt; carotid stenosis
Procedure	Rt/Lt; eversion carotid endarterectomy with/without shunt
	Cervical block/general anesthesia
Postoperative diagnosis	Same
Indications	___-year-old man/woman
	Asymptomatic/TIAs/stroke
	Duplex/angiography/MRA: ___% stenosis of the Rt/Lt internal carotid artery

Description of the Procedure The patient was placed in the supine position with the neck extended and lateral.

Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under cervical block/general anesthesia.

The Rt/Lt neck was prepped and draped in a standard surgical fashion.

A longitudinal incision was made overlying the anterior border of the sternocleidomastoid muscle and continued through the platysma.

The sternocleidomastoid muscle was retracted laterally.

The internal jugular vein was identified and dissection proceeded along the medial border of this vessel.

The facial vein was transected and suture ligated.

The common carotid, the internal carotid, external carotid, and the superior thyroid arteries were exposed and dissected.

The vagus and hypoglossal nerves were identified and preserved.

30 U/kg of heparin was administered intravenously.

The internal carotid and external carotid arteries were clamped with Yasargil clips, and the common carotid artery was clamped with a Cooley vascular clamp.

The internal carotid artery was transected from the carotid bulb initially using a # 11 blade and a Metzenbaum scissors, in an oblique fashion.

An arteriotomy was carried cephalad and caudally on the internal and carotid artery, respectively, for 5–10 mm.

*Shunting as needed for neurologic deterioration.

The internal carotid artery was everted using ring forceps while the plaque was held stable with a DeBakey's forceps.

The plaque was "feathered" from the endpoint, ensuring that there was no residual plaque or debris.

Attention was now shifted to the common/external carotid artery.

The endarterectomy plane was developed with a Staphylorrhaphy elevator within the carotid bulb.

The plaque was transected proximally in the common carotid artery.

In the distal internal carotid artery, the plaque was feathered leaving a very smooth endpoint. Eversion endarterectomy of the external carotid artery was performed leaving disease-free vessel just proximal to the superior thyroid artery.

The endarterectomized surface was gently irrigated with heparinized saline solution.

All remaining free debris was removed with a fine forceps and the endpoint reinspected.

Tacking sutures of 7-0 or 8-0 polypropylene were used to secure the distal endpoint (rarely needed).

The internal carotid artery and the carotid bulb were reconstructed using a continuous 6-0 polypropylene suture, commencing at the heel (cephalad apex) of the internal carotid artery.

Prior to placement of the last three sutures, the carotid vessels were “flushed” and irrigated with heparinized saline.

Flow was reestablished to the external carotid artery and then into the internal carotid artery.

The suture line was inspected for hemostasis, and gelfoam thrombin/additional sutures were placed. Doppler/duplex assessment revealed triphasic flow signals through the internal carotid, external carotid, and common carotid arteries.

The platysma was closed using 3-0 Vicryl.

The skin was closed with staples/subcuticular continuous suture.

Throughout the procedure, and at the completion of the procedure, the patient remained neurologically stable.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was transferred to the postanesthesia care unit, neurologically intact in hemodynamically stable condition.

187 Redo Carotid Endarterectomy

David C. Corry and Mark Adelman

Indications

- Asymptomatic stenosis >80 % (higher than ACAS for primary endarterectomy to balance risk of cranial nerve injury)
- Symptomatic carotid stenosis >70 % (per standard NASCET criteria)
- In the presence of contraindication of carotid stenting

Essential Steps

1. Mark the old incision prior to prepping; prep the thigh if planning to use vein reconstruction.
2. Incise the skin and platysma.
3. Retract the sternocleidomastoid laterally.
4. Identify the internal jugular vein and retract laterally.
5. Expose and control the common carotid artery.
6. Identify and preserve the vagus nerve.
7. Identify and preserve the hypoglossal nerve.
8. Expose and control the internal carotid artery as required for test clamping only.
9. Test clamp the internal carotid; evaluate for selective shunt placement.
10. Mobilize the carotid artery as necessary proximally and distally.
11. Control the external carotid artery.
12. Fully anticoagulate with heparin.
13. Test patient's tolerance of internal carotid artery cross-clamping.
14. Selective shunt placement:
    - Shunt not required:
      – Cross-clamp the internal, external, and common carotid arteries sequentially.
      – Create an arteriotomy and extend with Potts scissors.
      – Complete endarterectomy and decide on repair type.
    - Shunt required:
      – Select shunt type.
      – Further expose proximal and distal carotid as required to place shunt.
      – Cross-clamp the internal, external, and common carotid arteries sequentially.
      – Create an arteriotomy and extend with Potts scissors. Insert shunt and secure.
      – Verify flow in shunt and check for ischemic changes [electroencephalogram (EEG)/cognitive-motor exam].
      – Complete endarterectomy and decide on repair type.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_187

15. Repair type:
    - Patch angioplasty:
      - Select type of patch (vein/Dacron/PTFE/bovine); harvest saphenous from the thigh if vein is to be used.
      - Fashion patch to fit arteriotomy.
      - Complete anastomosis with running suture, removing shunt if used.
    - Interposition graft:
      - Select type of conduit (vein/Dacron/PTFE); harvest saphenous from the thigh if vein is to be used.
      - Complete distal anastomosis with running suture.
      - Measure length and complete proximal anastomosis.
      - If shunt is required, make appropriate provisions (see below in "if interposition graft" section). Suture ligate the external carotid artery.
16. Backbleed from the external, common, and internal carotid arteries.
17. If interposition graft is used, back- and forwardbleed via proximal anastomosis.
18. Flush copiously in the lumen before tying final anastomosis.
19. Release flow into the external carotid first and then common and internal carotid arteries sequentially.
20. Assess reconstruction for proper conformation and flow.
21. Secure hemostasis.
22. Close the wound and apply dressing.
23. Assess neurological status before removing the patient from the operating room.

Note These Variations

- During redo carotid endarterectomy, a patch angioplasty closure is usually possible if the original carotid endarterectomy was closed primarily. If a patch closure was performed in the original procedure, another patch angioplasty closure may not be possible, and an interposition vein graft will be needed.

Complications

- Stroke
- Hematoma
- Thrombosis
- Cranial nerve injury
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis *Right/left* recurrent carotid stenosis

Procedure *Right/left* redo carotid endarterectomy *patch angioplasty/interposition graft* (*vein/Dacron/PTFE*)

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* had a carotid endarterectomy with *primary/patch* closure in __ for an *asymptomatic/symptomatic* carotid stenosis. He/she has been *asymptomatic/has recently developed transient monocular blindness/transient ischemic attacks/stroke. Duplex scan/CT angiography/MR angiography* revealed ___% stenosis of the *right/left* internal carotid artery.

The risks and benefits of carotid endarterectomy were explained to the patient who elected to proceed with the surgical intervention. Carotid stent was not an option.

Description of Procedure The patient was placed in the supine, "beach-chair" position.

Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general endotracheal/regional/local anesthesia*.

The *right/left* neck and *right/left* upper thigh were prepped and draped in a standard surgical fashion.

EEG monitoring was initiated (if used).

A longitudinal incision was made in the previous skin incision and extended proximally in the neck (thus making the initial dissection of anatomic landmarks in virgin tissue planes). The incision was deepened through the platysma with electrocautery.

The anterior border of the sternocleidomastoid muscle was located and retracted laterally.

The medial border of the internal jugular vein was identified and retracted laterally.

The common carotid artery was located in a virgin tissue plane in the proximal neck and controlled with a Silastic vessel loop.

The vagus nerve was identified and protected while dissecting in the carotid sheath.

Before further dissection of the carotid artery was performed distally, the posterior digastric muscle tendon was located near the angle of the mandible to aid in localizing the hypoglossal nerve. Traction over the angle of the mandible was avoided to protect the marginal mandibular branch of the facial nerve. The hypoglossal nerve was identified as it crossed over the internal carotid and protected.

The internal carotid artery was exposed with minimal dissection (only as required to allow test clamping) and controlled with a vessel loop.

The remainder of the interposing carotid artery was freed from surrounding scar and lymphatic tissue.

The external carotid artery was exposed at its origin and controlled with a vessel loop.

The patient was given ____ units of heparin intravenously, and an activated clotting time (ACT) was checked to be greater than 200 s. The ACT was maintained above 200 s throughout the operation with intermittent heparin boluses as required.

The internal carotid artery was clamped, and the patient was assessed for signs of cerebral ischemia [*decreased motor and cognitive response (if awake)/EEG changes/mean internal carotid back pressure <50 mmHg* (*if under general anesthesia*)]. The patient was/was not shunt dependent.

The common and internal carotid arteries were further mobilized as needed to insert a shunt (if required).

The external and common carotid arteries were clamped sequentially after the internal carotid to prevent distal embolization.

An arteriotomy was created on the anterolateral surface of the common carotid with a #11 blade and extended into the internal carotid artery using a Potts scissors.

A *Javid/Sundt/Pruitt-Inahara inlying or outlying* shunt was inserted in the common and internal carotid arteries (if required). The patient was closely monitored for signs of cerebral ischemia, and any changes were noted to dissipate with established blood flow through the shunt.

An endarterectomy plane was developed with a Freer elevator. The plaque was transected proximally in the common carotid artery. In the distal internal carotid artery, the plaque was feathered to leave a smooth endpoint. Eversion endarterectomy of the external carotid artery was performed and the carotid plaque was removed.

The endarterectomy surface was gently irrigated with heparinized saline solution. All remaining free debris was removed with a fine forceps.

The endarterectomy was inspected and assessed to require *patch angioplasty/interposition* graft.

Choose One

If patch angioplasty: The arteriotomy was closed using a patch angioplasty of *Dacron/PTFE/vein*.

A vein patch was fashioned from a 6-cm segment of greater saphenous vein harvested from the upper thigh.

The patch angioplasty was performed using continuous 6-0 monofilament suture starting in the apex of the internal carotid, using care not to narrow the lumen.

The lumen was flushed periodically with heparinized saline to prevent buildup of stasis clot during the remainder of the repair and anastomosis.

The internal carotid and external carotid arteries were backbled and the common carotid was forwardbled.

Clamps were released to first reestablish flow from the common carotid into the external carotid artery, with flow thereafter allowed into the internal carotid artery.

The patient was examined for signs of cerebral ischemia, and none were present.

[*If the patient was shunt dependent: The shunt was removed after near completion of the anastomosis and internal carotid flow resumed thereafter in a timely fashion* (*as described above*)].

If interposition graft: An interposition graft of appropriately sized *Dacron/PTFE/vein* (*harvested from the upper thigh*) was sutured to healthy carotid artery end to end using 6-0 monofilament suture, beginning with the distal anastomosis.

Care was used not to narrow the lumen of the internal carotid artery.

Proximally, the common carotid anastomosis was completed in a similar fashion.

Prior to tying the last anastomosis, the graft was irrigated with copious amounts of heparinized saline, and bleeding was allowed into the graft (with the internal carotid artery clamp in place) to vent any remaining debris or air.

Internal carotid artery flow was then reestablished, and the patient was noted to be free of any signs of cerebral ischemia.

The external carotid artery was suture ligated.

[*If the patient was shunt dependent: A separate shunt was inserted through the interposition conduit prior to its anastomosis to the carotid artery. A shunt exchange was then performed, and the interposition conduit was sewn into place (end to end, as described above). The shunt was removed after the majority of each anastomosis was completed, and internal carotid flow resumed thereafter in a timely fashion*].

The suture lines were checked for hemostasis. Needle hole bleeding was controlled with the application of a topical thrombogenic agent *Surgicel/Gelfoam/thrombin*.

After hemostasis was assured, the wounds were closed using 3-0 Vicryl for the platysma and soft tissues. The skin was closed with staples. Sterile dressings were applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition and neurologically intact.

Carotid Artery Balloon Angioplasty and Stenting

188

Munier M.S. Nazzal

Indications

- Symptomatic carotid artery stenosis greater than 50 % in high-risk patients for carotid endarterectomy, recurrent internal carotid artery stenosis, patients with prior neck radiation, presence of a tracheostomy, and high carotid bifurcation (C2 level)
- Asymptomatic patients with carotid stenosis greater than 70 %, as part of a study or registry

Contraindications

- Absence of adequately experienced operator
- Lack of adequate imaging
- Thrombus within the internal carotid artery
- Tortuous common carotid and/or internal carotid arteries that might interfere with the procedure
- Shaggy aortic arch
- Lack of femoral access due to iliofemoral occlusive disease

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Essential Steps

1. Loading with clopidogrel prior to procedure (patient should be on clopidogrel 75 mg once per day for at least 48 h before the procedure or 300 mg at the day of the procedure).
2. Percutaneous access to the femoral artery.
3. Diagnostic angiogram of the carotid and cerebral circulations noting any intracerebral occlusive disease.
4. Calculation of the degree of stenosis; calculation of the lesion length and segment to be stented.
5. Careful manipulation of the wires and catheters within the carotid artery and ascending aorta.
6. Insertion of the 0.035 wire within the external carotid artery for a better purchase to facilitate next step.
7. Placement of shuttle sheath tip (or guiding catheter) within the common carotid artery proximal to the carotid bifurcation.
8. Crossing the stenosis with filter wire and placement of the filter within the internal carotid artery distal to the lesion.
9. Predilatation of severely stenosed internal carotid artery with a small balloon (3 mm × 2 cm balloon).
10. Stent deployment in the internal carotid artery covering the lesion into adjacent normal segments proximally and distally.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_188

11. Balloon dilatation of the stented segment. Avoid oversizing of the balloon. Accept residual stenosis up to 30 %.
12. Filter export out of the internal carotid artery.
13. Avoid crossing the carotid lesion with 0.035 wires and catheters.
14. Completion angiogram to evaluate for complications and residual stenosis.
15. Careful and continuous neurological monitoring throughout the procedure and in the postoperative period.
16. Adequate anticoagulation with ACT kept over 250 s during the procedure.
17. Be ready for immediate administration of atropine, vasopressors, and fluids when necessary.

Note These Variations

- Various protection devices are available. Filters require crossing the lesion with a 0.014 wire carrying the filter. Examples: Angioguard, Accunet, Spider, and Emboshield systems. Proximal cerebral protection devices do not require crossing the lesion. Examples: GORE Flow reversal and Mo.Ma Ultra Proximal systems. Use the system you are most familiar with.
- Avoid doing an arch aortogram if previously evaluated (MRA, CTA, or angiogram).
- Avoid predilatation of the lesion if the stenosis is not severe.

Complications

- Stroke
- Carotid dissection/thrombosis/distal embolization
- Bradycardia/hypotension/MI
- Hematoma

Template Operative Dictation

Preoperative Diagnosis *Right/left* carotid stenosis

Procedure *Right/left carotid angiogram, right/left carotid stenting with protection device*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female had prior transient monocular blindness/transient ischemic attacks/stroke. Duplex scan/angiography/MRA/CTA* revealed stenosis of the *right/left* internal carotid artery. She/he was considered to be a high-risk patient for carotid endarterectomy due to *her/his recurrent stenosis/high-level lesion/prior neck radiation/tracheostomy/significant cardiac morbidity*. The patient was offered carotid stenting. The risks and benefits of carotid stenting were explained to the patient who elected to proceed with the intervention. All complications were discussed with the patient including stroke, cardiac complications, and hematoma at the site of access.

Description of Procedure The patient was brought to the angiography suite and placed in the supine position. The right/left groins were prepped and draped in the usual fashion.

Time-out was performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure including creatinine level and INR if patient was on anticoagulation.

The right/left groin was infiltrated (1 % lidocaine/0.5 % marcaine). *Under ultrasound guidance and* using Seldinger technique, a size 5/6 French sheath was introduced percutaneously in the right/left common femoral artery.

Heparin sulfate (dose: 75–100 U/kg) was administered intravenously to the patient. The heparin dose was adjusted throughout the procedure to maintain an activated clotting time greater than 250 s.

A J wire was advanced under fluoroscopic guidance into the ascending aorta. A 5-French pigtail catheter was advanced over the wire and placed in the ascending aorta. An aortic arch angiogram was performed under 45° of left anterior oblique position. The catheter was exchanged for a 5-French *Headhunter/Vertebral/Bernstein/SIM/or other catheters*. The catheter was selectively placed in the right common carotid artery and then in the left common carotid artery. A total of (*volume/type of contrast media*) was injected in the *right/left* carotid and cerebral circulation. Images were obtained in different angles to assess both the extracranial and intracranial circulations. The degree of the stenosis was calculated in the *right/left* internal carotid artery, and a decision was made to proceed with carotid artery stenting. The diameters of the internal and common carotid arteries were calculated. The lengths of the segment with stenosis and the segment to be stented were measured.

The Headhunter/Vertebral/Bernstein/SIM2 catheter was placed in the common carotid artery on the site to be stented. A stiff Glidewire (Terumo) was navigated into the common carotid artery and then into the external carotid artery. The catheter and sheath were exchanged for a 6-French shuttle sheath. A (*Headhunter*, *JB2*) slip catheter was used within the shuttle sheath to facilitate shuttle advancement within the carotid artery. The tip of the shuttle sheath was placed in the common carotid artery proximal to the carotid bifurcation.

The location of the carotid bifurcation and area of stenosis were *marked/noted* on the screen using an erasable marker and a bony landmark. A marking ruler was used to help localize the area of stenosis and the segment to be stented.

A (size) *Angioguard/Spider/Accunet* was advanced through the sheath and placed in the internal carotid artery distal to the area of stenosis. The filter was deployed under fluoroscopy. Its location was noted on the screen. Contrast was injected to confirm placement within the *right/left* internal carotid artery.

Predilatation of the stenotic segment was done using a 3×2 Maverick balloon (or any similar type). During dilatation, blood pressure and pulse rate were noted. Then a (*type and size x length*) stent was advanced and placed in the internal/common carotid artery segment. Location was confirmed by fluoroscopy before deployment. The stent was carefully deployed within the segment of stenosis as previously marked.

The stent delivery device was removed. A 4.5/5 mm (type and length) balloon was advanced over the wire to post-dilate the stented segment carefully watching for blood pressure and pulse variations. *1 mg atropine was administered to the patient because of bradycardia* (*if occurred*). *Intravenous fluid* (*NS/Ringer's solution*) *was infused in the patient for hypotension* (*if occurred*). *Dopamine* (*5 mics/kg/min*) *started and titrated because of persistent hypotension* (*if given*). Hemodynamic parameters and neurological status were continuously monitored during the procedure.

An angiogram was done following the post-stent dilatation to evaluate both the carotid and cerebral circulations.

An export sheath was introduced over the wire. The filter was captured under fluoroscopy and carefully withdrawn through the stented segment and removed out of the sheath. The filter was inspected for any captured material (mention if any).

A final completion angiogram was done. The residual stenosis was found to be (*percentage*).

ACT was checked and found to be (……) second.

The shuttle sheath was removed and exchanged for a (French size) short sheath.

The femoral arteries were evaluated for possible closure by injecting (volume and type of contrast). The access site was successfully sealed (closed) using (type of closure device) or sheath was removed and manual compression was applied to the groin for (time in minutes) until the bleeding was controlled. A debriefing checklist was completed to share information critical to postoperative care of the patient.

Patient was taken to the recovery room. Neurological and hemodynamic parameters were continuously monitored in the recovery room. The patient was transferred to the intensive care unit for an overnight observation.

Notes

- Avoid unnecessary manipulation of the wires and catheters within the aorta and carotid arteries.
- Use proper catheters for different arch types.
- Use a slip catheter within the shuttle sheath instead of the dilator for difficult angles.
- Use long wires (260 cm) for exchange of catheters and shuttle sheath.
- Use monorail and rapid exchange catheters and balloons.

- In difficult angles, place the wire in the external carotid artery for easier control and easier advancement of the sheath or guide catheters into the common carotid artery.
- Keep the tip of the shuttle sheath within the field of imaging during the procedure.
- Use supporting wires (body wires) in difficult angles of the internal carotid artery to facilitate passage of the filter.
- Change the position of the neck with extension, flexion, and rotation to help advance wire, balloon, and stent if stuck during the procedure.
- Never force the stent into the area with stenosis. Predilate the area when necessary.
- Never inject blood-contaminated contrast in the cerebral circulation. Repeated flushing of the syringe is advisable.

Carotid Subclavian Bypass

189

Julie Freischlag and John S. Lane

Indications

- Symptomatic proximal subclavian stenosis, "subclavian steal syndrome"
- Vertebrobasilar symptoms: Visual disturbances, vertigo, ataxia, dysphagia, dysarthria, transient hemiparesis, and hemisensory disturbances
- Upper-extremity ischemic symptoms: Fatigue on exertion, rest pain, and microembolic disease
- "Coronary steal syndrome" [associated with left internal mammary artery (LIMA) coronary grafts]
- Debranching procedure prior to TEVAR

Optional Steps

1. Institute electroencephalogram (EEG) monitoring and general anesthesia.
2. Incise the skin/platysma (supraclavicular).
3. Divide the lateral head of the sternocleidomastoid (SCM).
4. Reflect the scalene fat pad superiorly.
5. Dissect and retract the phrenic nerve from the anterior surface of the anterior scalene muscle.
6. Double ligate and divide the thoracic duct.
7. Divide the anterior scalene.
8. Dissect the subclavian artery.
9. Control the subclavian arterial branches (thyrocervical/costocervical trunks, internal mammary, and vertebral).
10. Dissect the common carotid artery.
11. Heparinize.
12. Cross-clamp the subclavian artery.
13. Perform distal anastomosis between the subclavian artery and graft (PTFE/Dacron/vein).
14. Clamp graft and reestablish flow to the subclavian artery.
15. Cross-clamp the common carotid artery.
16. Insert shunt if necessary.
17. Tunnel bypass beneath the phrenic nerve and internal jugular vein.
18. Perform proximal anastomosis between the common carotid artery and graft.
19. Back- and forwardbled the carotid artery and graft.
20. Resume flow to the graft and then the common carotid artery.
21. Assess reconstruction.
22. Secure hemostasis and place drain.
23. Reapproximate scalene fat pad and SCM.
24. Close wound.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_189

Note This Variation

- Endovascular treatment (angioplasty/stenting) is becoming a popular method for subclavian revascularization. Subclavian revascularization can be achieved by transposing the subclavian artery into the common carotid artery or by creating a bypass from the common carotid artery to the subclavian artery. The procedure can be performed through a single supraclavicular incision or by adding an additional cervical incision along the anterior border of the sternocleidomastoid muscle for the carotid exposure. The conduit can be an autogenous vein (greater saphenous vein), a polyester graft (Dacron), or a ringed polytetrafluoroethylene (PTFE) graft.

Complications

- Death
- Stroke
- Bleeding
- Hematoma
- Lymphatic leak
- Nerve injury (phrenic, recurrent, laryngeal, vagus, and brachial plexus)

Template Operative Dictation

Preoperative Diagnosis *Right/left* symptomatic proximal subclavian stenosis

Procedure *Right/left* carotid subclavian bypass using *PTGE/Dacron/vein*

Postoperative Diagnosis Same

Indications This __-year-old *male/female* presented with *vertebrobasilar/upper-extremity ischemic* symptoms. Evaluation with *duplex/angiography/MRA/CTA* revealed ___ stenosis of the *right/left* subclavian artery.

Description of Procedure EEG electrodes were placed preoperatively and baseline brain wave activity was recorded.

Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure:

General anesthesia was induced.
The patient was positioned supine on the operating table with the neck extended and rotated away from the side of interest.
Skin preparation was performed in the normal sterile fashion.
Intravenous antibiotics were administered.
A supraclavicular incision was performed extending 10 cm medial to the sternocleidomastoid and 2 cm superior to the clavicle.
The subcutaneous tissue and platysma were divided with electrocautery.
The lateral head of the sternocleidomastoid was divided with electrocautery.
The scalene fat pad was separated from its attachments to the clavicle inferiorly and retracted superiorly.
The phrenic nerve was dissected and retracted medially from the anterior surface of the anterior scalene muscle.
The thoracic duct was double-ligated and divided.
The anterior scalene muscle was divided with electrocautery and retracted to gain exposure to the subclavian artery.
Dissection of the subclavian artery was performed medially until 1–2 cm of subclavian artery was accessible proximal to the vertebral artery.
The subclavian, vertebral, internal mammary, and thyrocervical arteries were controlled with vessel loops.
The carotid sheath was opened with care not to injure the vagus nerve.
The internal jugular vein was retracted superomedially, gaining exposure to the common carotid artery.
The carotid artery was dissected for a distance of 3–4 cm and was encircled with moistened umbilical tapes.
Intravenous heparin was administered (5,000 U) and the subclavian artery was clamped using vascular clamps.

A *6-/8-mm PTFE* vs. *Dacron* vs. *vein* graft was selected and spatulated appropriately.

An end-to-side anastomosis was performed between the graft and the subclavian artery with a 6-0 polypropylene suture.

The graft was clamped near the anastomosis and flow was reestablished to the upper extremity.

The graft was tunneled beneath the phrenic nerve and internal jugular vein.

The common carotid was clamped with vascular clamps.

Carotid shunting was selectively performed on the basis of changes in EEG activity.

The graft was trimmed and spatulated appropriately.

An end-to-side anastomosis was performed between the common carotid artery and graft using a 6.0 polypropylene suture.

The common carotid artery and graft were back- and forwardbled.

Flow was reestablished to the subclavian artery and then the vertebral and carotid arteries.

Hemostasis was achieved.

Drain placement and wound closure were performed.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Carotid Subclavian Transposition

190

Julie Freischlag and John S. Lane

Indications

- Symptomatic proximal subclavian stenosis, "subclavian steal syndrome"
- Vertebrobasilar symptoms: Visual disturbances, vertigo, ataxia, dysphagia, dysarthria, transient hemiparesis, and hemisensory disturbances
- Upper-extremity ischemic symptoms: Fatigue on exertion, rest pain, and microembolic disease
- "Coronary steal syndrome" [associated with left internal mammary artery (LIMA) coronary grafts]
- Debranching prior to TEVAR

Optional Steps

1. Institute electroencephalogram (EEG) monitoring and general anesthesia.
2. Incise the skin/platysma (supraclavicular).
3. Divide the lateral head of the sternocleidomastoid (SCM).
4. Reflect the scalene fat pad superiorly.
5. Dissect and retract the phrenic nerve from the anterior surface of the anterior scalene.
6. Double ligate and divide the thoracic duct.
7. Divide the anterior scalene.
8. Dissect the subclavian artery 1–2 cm proximal to the vertebral artery.
9. Control the subclavian arterial branches (thyrocervical/costocervical trunks, internal mammary, and vertebral).
10. Dissect the common carotid artery.
11. Heparinize.
12. Divide the subclavian artery proximal to the vertebral artery between vascular clamps.
13. Oversew the proximal subclavian arterial stump.
14. Cross-clamp the common carotid artery.
15. Insert shunt if necessary.
16. Transpose the subclavian artery beneath the phrenic nerve and internal jugular vein.
17. Perform anastomosis between the common carotid and subclavian arteries.
18. Resume flow to the subclavian, then the vertebral, and then the carotid.
19. Assess reconstruction.
20. Secure hemostasis and place drain.
21. Reapproximate the scalene fat pad and SCM.
22. Close the wound.

Note These Variations

- Endovascular treatment (angioplasty/stenting) is becoming a popular method for subclavian revascularization.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_190

- When angioplasty/stenting is not desired, subclavian revascularization can also be achieved by transposing the subclavian artery into the common carotid artery or by creating a bypass from the common carotid artery to the subclavian artery. The advantage of subclavian carotid transposition includes a single arterial anastomosis and the lack of graft utilization. It tends to require more proximal dissection and mobilization of the subclavian artery to allow a tension-free anastomosis.

Complications

- Death
- Stroke
- Bleeding
- Hematoma
- Lymphatic leak
- Nerve injury (phrenic, recurrent laryngeal, vagus, and brachial plexus)

Template Operative Dictation

Preoperative Diagnosis *Right/left* symptomatic proximal subclavian stenosis

Procedure *Right/left* carotid subclavian transposition

Postoperative Diagnosis Same

Indications This __-year-old *male/female* was found to have symptomatic subclavian stenosis with *vertebrobasilar/upper-extremity ischemic symptoms* upon *duplex/angio/MRA/CTA* with ___ stenosis of the *right/left* subclavian artery.

Description of Procedure EEG electrodes were placed preoperatively and baseline brain wave activity was recorded. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced:

The patient was positioned supine on the operating table with the neck extended and rotated away from the side of interest.

Skin preparation was performed in the normal sterile fashion.

Intravenous antibiotics were administered.

A supraclavicular incision was performed extending 10 cm medial to the SCM and 2 cm superior to the clavicle.

The subcutaneous tissue and platysma were divided with electrocautery.

The lateral head of the SCM was divided with electrocautery.

The scalene fat pad was separated from its attachments to the clavicle inferiorly and retracted superiorly.

The phrenic nerve was dissected and retracted medially from the anterior surface of the anterior scalene muscle.

The thoracic duct was double-ligated and divided.

The anterior scalene muscle was divided with electrocautery and retracted to gain exposure to the subclavian artery.

Dissection of the subclavian artery was performed medially until 1–2 cm of subclavian artery was accessible proximal to the vertebral artery.

The subclavian, vertebral, internal mammary, and thyrocervical arteries were controlled with vessel loops.

The carotid sheath was opened with care not to injure the vagus nerve.

The internal jugular vein was retracted superomedially, gaining exposure to the common carotid artery.

The carotid artery was dissected for a distance of 3–4 cm and was encircled with moistened umbilical tapes.

Intravenous heparin was administered (5,000 U).

The branches of the subclavian artery were controlled and the subclavian artery was doubly clamped proximal to the vertebral artery.

The subclavian artery was divided between the clamps using a surgical scalpel.

The proximal stump of the subclavian artery was oversewn using two rows of 4-0 polypropylene sutures in a horizontal mattress fashion.

The proximal clamp was carefully removed and hemostasis was assessed.

The subclavian artery was tunneled below the phrenic nerve and internal jugular vein to the common carotid artery.

The common carotid artery was controlled using two angled vascular clamps.

Carotid shunting was performed due to slowing noted on EEG monitoring.

A longitudinal arteriotomy was created using a #11 scalpel and the arteriotomy was extended using Potts scissors.

An end-to-side anastomosis was performed between the subclavian and common carotid artery using a 6-0 polypropylene suture.

The subclavian and carotid arteries were back- and forwardbled.

Flow was reestablished to the subclavian artery and then the vertebral and carotid arteries.

Assessment of flow was determined in the carotid, subclavian, and vertebral arteries using a handheld Doppler probe.

Hemostasis was achieved.

A silastic, closed suction drain was placed in the supraclavicular fossa.

The scalene fat pad was returned to its anatomic location and secured to the clavicle using interrupted 3.0 absorbable sutures.

The lateral head of the SCM was reapproximated using absorbable sutures.

The platysma was closed using running a 3-0 absorbable suture and the skin was closed using a 5-0 subcuticular suture.

Sterile dressings were applied.

The patient awoke from anesthesia without neurological deficits.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Vertebral Artery Reconstruction

191

David C. Corry and Mark Adelman

Indications

- Vertebrobasilar insufficiency with bilateral vertebral stenosis/occlusion
- Symptomatic subclavian steal syndrome

Essential Steps

1. Incise the skin and platysma.
2. Incise the scalene fat pad and retract superiorly.
3. Identify the phrenic nerve.
4. Divide the scalenus anticus muscle (in some cases, this may be preserved).
5. Identify and divide the vertebral veins.
6. Identify the stellate ganglion (preserve).
7. Control the subclavian artery proximal and distal to the vertebral artery.
8. Control the internal mammary artery.
9. Decide on the type of repair.
10. Anticoagulate with heparin.
11. Clamp the vertebral artery.
12. Clamp the proximal and distal subclavian artery.
13. Repair type:
    - For angioplasty:
      – Make arteriotomy in the subclavian artery extending up onto the vertebral artery.
      – Perform plication of the vertebral artery.
      – Harvest 3 cm of greater saphenous vein from the thigh, or use bovine patch.
      – Prepare a vein patch angioplasty.
      – Sew patch angioplasty over the vertebral arterial plication and arteriotomy.
      – Backbleed the vertebral artery.
      – Backbleed the subclavian artery.
      – Forwardbleed the subclavian artery.
      – Complete the anastomosis.
      – Unclamp the distal subclavian artery.
      – Unclamp the proximal subclavian artery.
      – Unclamp the vertebral artery.
      – Place small closed suction drain.
      – Wound closure.
    - For vertebral transposition:
      – Retract the sternocleidomastoid (this may need to be divided).
      – Control the common carotid artery proximally and distally.
      – Systemically anticoagulate.
      – Clamp the vertebral artery.
      – Clamp the distal subclavian artery.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_191

  - Clamp the proximal subclavian artery.
  - Divide the vertebral artery just distal to origin.
  - Oversew the proximal vertebral artery stump.
  - Mobilize the vertebral artery and prepare for transposition.
  - Plan the arteriotomy.
  - Clamp the common carotid artery distally.
  - Clamp the common carotid artery proximally.
  - Make small common carotid artery arteriotomy.
  - End-to-side vertebral to common carotid anastomosis using 7-0 Prolene.
  - Backbleed the vertebral artery.
  - Backbleed the common carotid artery.
  - Forwardbleed the common carotid artery.
  - Tie suture line with vertebral artery backbleeding.
  - Unclamp the proximal common carotid artery.
  - Unclamp the distal common carotid artery.
14. Check for hemostasis.
15. Place closed suction drainage catheter.
16. Wound closure.

Note These Variations

- Vertebral revascularization can be achieved by performing a vein/Dacron/bovine patch angioplasty of the origin of the vertebral artery or by vertebral-carotid transposition. If the atherosclerotic pathology is limited to the origin of the vertebral artery and in the presence of vertebral artery redundancy, plication and patch angioplasty can be the preferred procedure. If the atherosclerotic disease is also affecting the origin of the subclavian artery, a vertebral-carotid transposition is performed especially if the carotid artery is disease-free.

Complications

- Stroke
- Hematoma
- Thrombosis
- Phrenic nerve injury
- Thoracic duct injury (left side)
- Recurrent laryngeal nerve injury (right side)
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Vertebrobasilar insufficiency, subclavian steal syndrome, and *right/left* vertebral artery stenosis

Procedure *Right/left vertebral plication and vein patch angioplasty/right/left vertebral-carotid transposition*

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* presented with *vertebrobasilar/subclavian steal* symptoms. Evaluation with *duplex/angiography/magnetic resonance angiography* revealed ___ stenosis of the *right/left* vertebral artery.

Description of Procedure The patient was placed in the supine position.

Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under general endotracheal anesthesia.

The *right/left* neck and *right/left* upper thigh were prepped and draped in the usual sterile fashion.

A transverse curvilinear skin incision was made from the lateral edge of the medial head of the sternocleidomastoid muscle for a distance of 5–6 cm. The platysma muscle was divided with electrocautery.

The scalene fat pad was identified. The scalene fat pad was divided inferiorly and retracted superiorly.

The phrenic nerve was identified and gently mobilized medially.

The scalenus anticus muscle was divided and the *right/left* vertebral artery was identified. Prior to identifying this vessel, the vertebral veins were divided between ligatures. (On the left side, the thoracic duct was identified and *preserved/ligated*. On the right side, the recurrent laryngeal nerve was identified and preserved.) Care was taken to identify the stellate ganglion and preserve it.

The vertebral artery was assessed to require plication and patch angioplasty or transposition repair.

Choose One

If vertebral artery plication and patch angioplasty: The vertebral artery was mobilized and found to be redundant.

The proximal and distal subclavian arteries were identified and controlled.

The internal mammary was identified and controlled.

The patient was systemically heparinized, and the vertebral artery and distal subclavian artery were clamped sequentially, followed by the proximal subclavian artery.

A keyhole-shaped arteriotomy was placed in the subclavian artery and extended up onto the vertebral artery.

Using 6-0 monofilament suture in a running fashion, the vertebral artery was plicated to reduce its redundancy. After completion of the plication, saphenous vein was harvested from the thigh, and a saphenous vein patch was fashioned. The saphenous vein patch angioplasty was performed using 6-0 monofilament suture in a running fashion.

After forward- and backbleeding, the anastomosis was completed, and flow was initiated first down the subclavian artery and then up the vertebral artery.

If vertebral artery to common carotid artery transposition: The sternocleidomastoid was retracted medially.

The common carotid artery was identified and controlled proximally and distally.

The vertebral artery was clamped, followed sequentially by the distal subclavian and proximal subclavian arteries.

The vertebral artery was divided just distal to its origin, and the vertebral artery stump was oversewn with 6-0 monofilament suture.

The remaining end of the vertebral artery was extensively mobilized up to its bony insertion.

The distal common carotid artery was cross-clamped, followed by the proximal common carotid artery.

After careful planning, an arteriotomy along the posterolateral border of the carotid artery was performed. The arteriotomy was extended up the vertebral artery along its anteromedial border. This was extended for a distance of approximately 5–6 mm.

Using 6-0/7-0 monofilament suture, an end-to-side running anastomosis was performed between the vertebral artery and common carotid artery.

Prior to tying the anastomosis, the vertebral artery was backbled and the common carotid artery was backbled. The proximal common carotid artery was then forwardbled and the suture line was tied with the vertebral artery backbleeding.

The proximal common carotid artery was unclamped, followed by the distal common carotid artery.

Hemostasis was achieved.

A 7-mm closed suction drain was placed deep in the wound.

The scalene fat pad was placed gently over the phrenic nerve.

The platysma muscle was closed with 3-0 absorbable sutures in a running fashion.

The skin was closed with 4-0 subcuticular absorbable sutures (*for vein patch angioplasty, the thigh incisions were closed in layers*).

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition and neurologically intact.

Subclavian Artery Angioplasty Stenting

192

Rabih A. Houbballah and Jamal J. Hoballah

Indications

- Subclavian artery steal syndrome manifested by dizziness and arm pain on exercise
- Angina pectoris in the presence of an LIMA graft

Essential Steps

1. Ipsilateral brachial artery access using a micropuncture sheath
2. Replacement of the micropuncture sheath with a size 5-French sheath
3. Placement of a diagnostic catheter in the axillary artery
4. Heparinization: 50–75 UI/kg
5. Performance of angiogram to delineate the location of the stenosis and relationship to the origins of subclavian, vertebral, and internal mammary arteries
6. Replacement of the 5-French sheath with a 6-F guiding catheter or long (55-cm) sheath
7. Performance of another angiogram under magnification
8. Crossing the lesion under road map and identification of the location of the stenosis and the size of the stent to be used
9. Angioplasty/stenting using size 8 mm × 3 mm self-expending stent
10. Poststent in dilatation of the stenotic segment
11. Angiogram documenting patency and absence of dissection
12. Reversal of the heparin and removal of the sheath

Note These Variations

- The procedure can also be performed through a femoral approach. A long sheath/guiding catheter (90 cm) will be placed in the proximity of the stenosis.

Complications

- Injury to the subclavian artery (dissection, pseudoaneurysm, and perforation)
- Occlusion of the internal mammary or vertebral artery
- Access artery thrombosis (brachial)
- Bleeding/false aneurysm of the brachial artery

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_192

Template Dictation

Preoperative Diagnosis Right/left subclavian artery stenosis with subclavian artery steal syndrome

Procedure Aortogram, left/right subclavian angiogram, subclavian artery angioplasty, and subclavian artery stent placement

Postoperative Diagnosis Right/left subclavian artery stenosis

Indications This is a ___-year-old *male/female* patient presented with *arm numbness and pain/angina following coronary artery bypass grafting*. Evaluation revealed the presence of a *right/left* significative subclavian artery stenosis.

Details of the Operation The patient was brought to the operating room and placed on the angiography table in the supine position. The right antecubital/femoral area was prepped and draped in a standard session. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The area over the brachial/femoral artery was anesthetized with 1 % Xylocaine. Percutaneous cannulation of the right brachial artery was achieved using an 18-gauge vascular access needle. A 0.035" Standard Hydrophilic Guidewire soft angled, 180 cm was advanced through the needle and under fluoroscopy up the brachial and axillary arteries, into the subclavian artery. The needle was removed and a 5-French short Pinnacle sheath was first placed over the glide wire. The patient was given 5,000 U of heparin intravenously (75–100 U/kg). A *multipurpose MP 4F*, *Angled Glide Catheter* was introduced over the wire into the proximal axillary artery and an angiogram was performed. The angiogram revealed the presence of a *very tight stenosis/occlusion ___cm* distal to the origin of the subclavian artery. On evaluation of this stenosis, decision was made to treat this interventionally. The MP catheter was advanced to the area of pathology, and after gentle manipulation, the Glidewire successfully crossed the lesion. The MP catheter was advanced over the Glide wire. The Glidewire was exchanged for a 0.035" Stiff angled wire, 260-cm wire. The sheath was then removed and replaced by a 6-French or 7-French 45-cm long valved anti-kinking sheath, which was parked just few centimeters from the location of the subclavian artery stenosis. Predilation with a size 3 mm × 4 cm noncompliant balloon was performed. A self-expanding/balloon-mounted stent measuring 8 mm × 4 cm was then introduced and used to cross the lesion under road map imaging. The stent was then deployed in the desired location.

Variation For balloon-mounted stent, the balloon was inflated using an Endoflator device, thus expanding the stent. There was noted to be a tight calcific lesion with a waist created in the balloon. Based on the waist size in the balloon, the stenosis was felt to be about 80 % of luminal diameter. The balloon and stent expanded to profile, up to 10 atm on the Endoflator device.

Poststenting dilatation was performed using a size of 8 mm × 4 cm balloon. Completion arteriogram demonstrates a stent in good position. It was fully deployed. There was good flow across the stented lesion. Both vertebral and internal mammary arteries were patent. There was/wasn't a mild poststenotic dilatation in the subclavian artery. There was no evidence of dissection. There was no evidence of extravasation. Heparin was then reversed (optional), and the catheter, wire, and sheath were removed when the ACT was below 150 s. Gentle pressure was applied on the brachial artery, while monitoring of distal flow into the radial artery until hemostasis was achieved. A debriefing checklist was completed to share information critical to postoperative care of the patient.

If a femoral artery approach was preferred, closure of the arteriotomy could be performed using a percutaneous closure device such as a 6-F Angioseal (St Jude Medical) or a Starclose (Abbott Vascular).

193 Aorto-Innominate Artery Bypass

Christian Bianchi and Jeffrey L. Ballard

Indications

- Symptomatic innominate artery stenosis >50 %
- Asymptomatic stenosis >70 % or deep ulcerated plaque lesion associated with >50 % stenosis
- Debranching procedure prior to TEVAR

Essential Steps

1. Limited skin incision from the sternal notch to the third intercostal space.
2. Divide the sternum to the third intercostal space, creating an upside-down T-shaped incision.
3. Push aside or transect the thymus in midline plane.
4. Open the pericardium and place pericardial stay sutures.
5. Expose and dissect the ascending aorta.
6. Divide venous tributaries to fully mobilize the left brachiocephalic vein.
7. Expose and thoroughly dissect the innominate artery and the proximal aspects of right subclavian and common carotid arteries.
8. Construct end-to-side proximal aortic anastomosis (reinforce suture line with Teflon felt).
9. Construct end-to-end distal innominate artery anastomosis.
10. Backbleed subclavian and common carotid arteries and forward flush bypass graft.
11. Resume prograde blood flow in this order: The subclavian first, followed by the common carotid artery.
12. Place #19F Blake drain deep in the pericardial space and bring out the second intercostal space lateral to the internal mammary artery.
13. Wire close sternal incision after adequate wound hemostasis.
14. Close the fascia, subcutaneous tissue, and skin in separate layers.

Note These Variations

- The sternotomy may be extended beyond the third intercostal space to include the entire sternum.
- Additional graft may be added to bypass the left common carotid artery in the presence of significant disease.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_193

- Endovascular treatment (angioplasty/stenting) is gaining popularity as another revascularization option.

Complications

- Stroke
- Transient ischemia attacks (TIAs)
- Upper-extremity embolism
- Recurrent laryngeal nerve injury
- Pneumothorax
- Aortic arch dissection
- Internal mammary artery injury
- Mediastinitis
- Mediastinal bleeding

Template Operative Dictation

Preoperative Diagnosis Symptomatic innominate artery stenosis

Procedure Ascending aorta-to-innominate artery bypass with 10-/12-mm Dacron tube graft

Postoperative Diagnosis Same

Indications This ___-year-old *male/female was asymptomatic/presented with TIA*, *stroke*, *or upper-extremity embolism*. Preoperative arch aortogram demonstrated severe stenosis of the proximal innominate artery. Endovascular treatment was not an option.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under general anesthesia with the patient in supine position.

The neck and anterior chest were prepped and draped in a standard fashion.

A midline incision was made from the sternal notch to the third intercostal space and deepened to the sternum with electrocautery. An oscillating blade mounted on a redo sternotomy saw was used to make a sternal incision from the notch to the third intercostal space. The sternal incision was “Td” at the third intercostal space to facilitate exposure of the upper mediastinum. Hemostasis was obtained at the periosteal edges, followed by placement of a pediatric sternal retractor. The thymus was divided in the midline with cautery and the pericardium was opened longitudinally to expose the ascending aorta. Silk stay sutures were placed in the pericardial edges and secured to the skin.

The left brachiocephalic vein was dissected circumferentially and isolated with a silastic vessel loop. The ascending aorta was gently dissected free from surrounding tissue with care not to injure pulmonary or neurolymphatic structures. The innominate artery was identified and circumferentially dissected to its bifurcation into the subclavian and common carotid arteries. The origin of each of these arteries was exposed and then controlled with a silastic vessel loop. Systemic anticoagulation was then achieved using an intravenous bolus of heparin (100 U/kg). Approximately 3 min later, a partially occluding clamp was placed on the anterolateral aspect of the ascending aorta. An aortotomy was created with a #11 blade and lengthened appropriately with angled Potts scissors. A 10-/12-mm Dacron tube graft was anastomosed in an end-to-side fashion to the ascending aorta using 4-0 Prolene sutures in a running fashion. The suture line was reinforced with a strip of Teflon felt. An atraumatic clamp was then placed on the graft near the proximal anastomosis, and the side-biting clamp on the ascending aorta was released.

Next, vascular occluding clamps were applied to the proximal innominate, right subclavian, and common carotid arteries. The innominate artery was transected distally and the proximal innominate artery was oversewn in two separate layers using 4-0 Prolene sutures. The Dacron graft was *passed over/tunneled under* the left brachiocephalic vein to facilitate an end-to-end anastomosis at the level of the distal innominate artery. The anastomosis was created using 4-0 Prolene sutures in a continuous running fashion. Just prior to completion of the anastomosis, the subclavian and common arteries were backbled and the bypass graft was flushed to clear all potential air and debris from the lumens. Prograde blood flow was first established to the subclavian artery, followed by the right common carotid. Immediate intraoperative duplex ultrasound was used to confirm a widely patent innominate artery reconstruction with no compromise in the graft lumen diameter.

Heparin was reversed with protamine sulfate, and hemostasis was obtained throughout the upper mediastinum using cautery and thrombin-soaked Gelfoam. A #19F drain was placed within the pericardium and brought out through a separate stab incision made in the second intercostal space. The drain was secured at the skin exit site using a 3-0 nylon suture. The wound was then closed after verification of hemostasis, using sternal wires followed by reapproximation of the pectoral fascia using 3-0 Vicryl in a continuous running fashion. The subcutaneous tissue was closed using 3-0 Vicryl, followed by subcuticular skin closure with a 3-0 monocryl suture. Sterile dressing was applied and the drain was placed to bulb suction. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, was awakened in the operating room, and noted to have no gross neurological deficits and was taken to the postanesthesia care unit in stable condition.

194 Innominate/Common Carotid Artery Angioplasty Stenting Using Hybrid Open Technique

Jamal J. Hoballah

Indications

- Symptomatic innominate/right/left common carotid artery stenosis (transient ischemic attacks, stroke, finger/hand ischemia) in the presence of arch/iliac anatomy that precludes percutaneous femoral approach.

Essential Steps

1. Five-centimeter neck incision along the sternocleidomastoid muscle border under local anesthesia
2. Exposure of the common carotid artery
3. Placement of a size 6-French sheath with marked tip using Seldinger technique
4. Heparinization: 50–75 UI/kg
5. Performance of angiogram to delineate the location of the stenosis and relationship to the aortic arch and origins of the right subclavian (in the case of innominate stenosis)
6. Crossing the lesion using a multipurpose catheter and glide wire in the common carotid artery
7. Performance of another angiogram under magnification
8. Identification of the location of the stenosis and the size of the stent to be used
9. Applying a vascular clamp on the common carotid artery distal to the insertion of the 6-French sheath to protect from embolization
10. Angioplasty/stenting using balloon expandable stent/self-expending under road map
11. Post-stent dilatation of the stenotic segment
12. Angiogram documenting patency and absence of dissection
13. Removal of the balloon and flushing any debris through the size 6-French sheath
14. Reversal of the heparin and removal of the sheath

Note These Variations

- For innominate pathology, the procedure can also be performed through a brachial approach; however, this does not provide any cerebral protection.
- A balloon expandable stent can provide very precise deployment location and may also be used. Predilation with a small 3 mm X 3 cm balloon is recommended with vey tight preocclusive stenosis.
- The common carotid exposure can be performed under cervical block or local anesthesia.

Complications

- Common carotid/innominate (dissection, pseudoaneurysm, perforation, and rupture)
- Distal embolization (brain or hand)

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_194

Template Dictation

Preoperative Diagnosis Symptomatic innominate; *right/left* common carotid artery

Procedure Aortogram; innominate; *right/left* common carotid artery angioplasty and stent placement

Postoperative Diagnosis Symptomatic innominate; *right/left* common carotid artery stenosis

Indications This is a …-year-old *male/female* patient presenting with *right/left TIA*, *stroke*, *transient monocular blindness arm numbness*, *and pain/angina following coronary artery bypass grafting*. Evaluation revealed the presence of a significant *right/left* common carotid artery/ innominate stenosis. The anatomy of the aortic arch/iliac arteries was felt inappropriate for percutaneous approach through the femoral or brachial approach. The decision was to perform a carotid/innominate stenting through an open neck approach.

Details of the Operation The patient was brought to the operating room and placed on the angiography table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

With the patient in the supine position, and after administration of *cervical block a*nesthesia, the neck was prepped and draped in the usual sterile fashion. A 5-cm skin incision was then performed along the medial edge of the sternocleidomastoid. The platysma was incised and the sternocleidomastoid was mobilized laterally exposing the internal jugular vein. The internal jugular vein was then mobilized laterally exposing the common carotid artery. This was freely dissected for a 5-cm segment. The patient was then given 5,000 U of intravenous Heparin, and using the Seldinger technique, the common carotid artery was punctured and a size 6-French sheath was introduced. A retrograde angiogram of the *carotid/innominate* artery was performed through the sheath and revealed the area of the stenosis. Using an MP catheter and a glide wire, the stenosis was negotiated, allowing the wire to traverse the stenosis into the aortic arch. This was followed by the advancement of the catheter over the wire into the aortic arch. The glide wire was then exchanged to a stiff wire. A repeat angiogram was then performed under magnification. The size of the vessel and the size of the stent to be used were then selected. The common carotid artery was then cross-clamped, and the stent was introduced over the wire into the desired location. A *self-expanding stent/balloon expandable stent* was inserted into the desired location and the stent was deployed. Post-deployment angioplasty was performed (for self-expanding stent). An angiogram revealed excellent placement without any extravasation. The catheter and wire were then removed. Aspiration through the sheath was performed to flush out any debris from the angioplasty site. The sheath was then removed allowing the artery to flush out any debris. A vascular clamp was then reapplied proximal to the sheath insertion site, and the hole in the common carotid artery was oversewn with a 5-0 Prolene suture. The clamps were then removed and flow was resumed into the internal and external carotid arteries.

Hemostasis was secured and the wound was then irrigated. The wound was closed with 3-0 Vicryl for the platysma and 4-0 Monocryl for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the recovery room in good condition.

Part XVII

Vascular Surgery: Mesenteric and Renal Artery Occlusive Disease

195 Antegrade Aortoceliac/Mesenteric Bypass for Chronic Mesenteric Ischemia

Roderick T.A. Chalmers

Indications

- Patient with classic symptoms (abdominal pain, weight loss, postprandial pain, diarrhea, and fear of food) with two of three visceral vessel occlusions.
- Angiograms reveal extent of and length of occlusion(s).

Essential Steps

1. Midline abdominal incision.
2. General laparotomy to exclude other relevant pathologies.
3. Incise the left triangular ligament and retract the left lobe of the liver to the right.
4. Enter the lesser omentum and retract the stomach inferiorly and to the left.
5. Identify the esophagus (nasogastric tube helpful) and gently mobilize to the left.
6. Divide the median arcuate ligament and crural fibers in the midline to gain access to the anterior surface of the supraceliac aorta.
7. Expose several centimeters of the supraceliac aorta.
8. Trace the anterior aorta inferiorly until the origin of the celiac axis is encountered.
9. Dissect out the celiac axis and its three main branches.
10. Expose and dissect the superior mesenteric artery (SMA).
11. Administer systemic heparin 50–75 U/kg.
12. Apply side-biting Satinsky clamp to the supraceliac aorta.
13. Create the proximal anastomosis with an 8-mm knitted Dacron/PTFE graft.
14. Create the distal anastomosis to the celiac artery or hepatic artery.
15. Create a side limb.
16. Create the distal anastomosis to the SMA.
17. Check for celiac and SMA flow and for bowel viability.
18. Confirm viability of the gut and distal extremities.
19. Ensure hemostasis.
20. Close the abdominal wall with mass closure.
21. Recheck distal pulses and urine output.

Note These Variations

- Endovascular treatment (angioplasty/stenting) is an acceptable option when possible though associated with a higher recurrence rate.
- A bifurcated graft with a limb to the celiac and another to the SMA is often used. Alternatively,

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_195

an aortoceliac bypass is constructed, and the bypass to the SMA is constructed as a side arm of the aortoceliac graft.
- Aortic control is typically achieved with a side-biting clamp. On occasion, aortic disease may dictate using proximal and distal clamps.
- The site for the celiac anastomosis can be either the distal celiac or one of its proximal branch arteries, usually the common hepatic artery.
- The site for anastomosis on the SMA is dictated by the distal extent of disease. For the origin and most proximal segment of the SMA, exposure is achieved by gently retracting the upper border of the pancreas inferiorly. For the mid-segment and distal segments of the SMA in the root of the small bowel mesentery, exposure is achieved by first reflecting the transverse colon superiorly (much easier). Bypass to the SMA at this level needs to be tunneled with care, usually behind the pancreas and in front of the left renal vein. The graft may be also tunneled anterior to the pancreas, especially if a vein graft is used.

Complications

- Bleeding
- Graft thrombosis with recurrent ischemia
- Renal failure
- Lower limb embolism
- Spinal cord ischemia
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Chronic mesenteric ischemia secondary to celiac and mesenteric occlusive disease

Procedure Antegrade aortoceliac and/or aorto-mesenteric bypass with 8-mm Dacron

Postoperative Diagnosis Same

Indication This is a ___-year-old *male/female* with a history of *weight loss*, *postprandial abdominal pain and diarrhea*, *and a fear of food*. Angiography showed occlusion of the proximal celiac artery, tight stenosis of the origin of the SMA, and occlusion of the inferior mesenteric artery. The patient consented to surgical *celiac/mesenteric revascularization* having been fully informed of the risks and benefits of the procedure.

Description of Procedure The patient was placed supine on the operating table with arms *tucked in/at 80°*. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Large-bore intravenous and central venous lines were placed by anesthesia and general anesthesia achieved with endotracheal intubation. A Foley urethral catheter was placed under sterile conditions. The entire anterior chest, abdomen, and both legs to knee level were prepared and draped. Routine antibiotic prophylaxis was administered prior to the skin incision.

A skin incision was fashioned from the xiphisternum to symphysis pubis. The subcutaneous tissues were divided in the midline with electrocautery. The peritoneum was entered sharply and the abdominal wall incision completed.

There were no *adhesions/moderate adhesions* that were lysed.

General laparotomy revealed *no/the following abnormalities* (*detail*).

The left triangular ligament of the liver was incised and the left hepatic lobe retracted to the right. The lesser omentum was incised and the stomach gently retracted inferiorly. Using a combination of blunt and sharp dissection, the esophagus was identified and protected. The esophagus was mobilized to the left and the median arcuate ligament and fibers of the right crus incised, allowing exposure of the supraceliac aorta. Several small bleeding vessels were controlled with *electrocautery/ligatures*. The anterior and lateral surfaces of the aorta were cleared of surrounding tissues for several centimeters proximally. Next, the dissection was continued distally and the origin of the celiac artery dissected clear of surrounding tissues. The left gastric, splenic, and common hepatic arteries were individually dissected and slung with vessel slings. The distal celiac artery was soft and suitable for the location of the distal anastomosis.

The proximal superior mesenteric artery was exposed and slung via an incision in the peritoneum at the root of the small bowel mesentery. A tunnel was created behind the pancreas with care being taken to protect the left renal vein and its tributaries. The SMA was a pulseless vessel of good caliber.

The patient received 5,000 U of heparin intravenously.

A Satinsky clamp was applied to the supraceliac aorta and the aorta opened with a #15 blade. An 8-mm *knitted Dacron PTFE* graft was anastomosed end to side with 3-0 polypropylene sutures. One extra suture was required to ensure hemostasis. The graft was clamped and the Satinsky removed. Aortic clamp time was ___ min. The vessel slings around the celiac branch arteries were tensed and the celiac artery was opened longitudinally. Backbleeding from distally was brisk. The graft was cut to length and anastomosed end to side with 5-0 polypropylene sutures. The graft was flushed and vessels backbled before completing the suture line and releasing clamps. There was an excellent pulse in the common hepatic and splenic arteries.

A second length of 8-mm *knitted Dacron/PTFE/vein* graft was then placed in the retro-pancreatic tunnel. The aortoceliac graft was reclamped and opened longitudinally. The second graft was anastomosed end to side to with 5-0 polypropylene. This second graft was clamped proximally and the clamp removed from the first graft. Using slings to control the SMA, an arteriotomy was made on this vessel. Heparinized saline was injected distally with ease. The graft was cut to length and sutured end to side to the SMA again with 5-0 polypropylene. There was good flow with clamps removed. Hemostasis was carefully assessed and found to be satisfactory. The small and large bowels were carefully inspected and found to be well vascularized and exhibiting active peristalsis. There was a palpable pulse in the ileocolic vessels and also in the marginal artery. Using a handheld Doppler, there was a biphasic signal throughout the small and large bowel vessels.

A final check of hemostasis was made. The divided crural fibers were reconstituted with interrupted 2-0 Vicryl sutures. The abdominal content was returned to the peritoneal cavity. Abdominal closure was with mass 0 polypropylene sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Mesenteric Artery Stenting

196

Neelima Katragunta

Indications

- Chronic mesenteric ischemia
- Early acute mesenteric ischemia in a patient with no clinical suspicion of intestinal infarction

Preoperative Imaging

- Preferably CT angiogram or MR angiogram
- Duplex ultrasound (plan for a diagnostic angiogram with possible intervention)

Anatomic Requirements

- Adequate access vessels (brachial or iliofemoral)

Contraindications

- Not to be used as a first-line therapy in a patient with acute mesenteric ischemia with rapid clinical deterioration or suspicion for intestinal infarction

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Essential Steps

- Obtain brachial or femoral access.
- Systemically heparinize the patient (80 U/kg IV heparin bolus).
- Angiogram with steep oblique/lateral angle.
- Place a long sheath (6 Fr) near the vessel.
- Select the vessel using the appropriate wire and catheter, depending on the angle (if both celiac and SMA are involved, treat SMA first).
- Traverse the lesion with the catheter and confirm true lumen entry with an angiogram.
- Perform predilation with a smaller angioplasty balloon.
- Perform an angiogram and obtain a reference overlay (or mark the monitor if that is not available).
- Pass the sheath beyond the lesion.
- Introduce a stent through the sheath.
- Withdraw the sheath and deploy the stent to cover the entire lesion, flaring the proximal portion into the aorta.
- Post-dilatation with an appropriately sized balloon if needed.
- Completion angiogram.

Note This Variation

- Brachial or femoral access can be used depending on the vessel orientation. Brachial

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_196

approach often offers a more direct and stable platform.
- Retrograde SMA stenting is a useful option in a patient that undergoes open abdominal exploration for acute mesenteric ischemia with suspected intestinal infarction (hybrid technique). This can be done by exposing the SMA at the root of mesentery and using it to access the vessel. The lesion is crossed in a retrograde fashion and stented using the same technique as described below.
- If a chronic total occlusion is encountered, it can be treated but tends to be more challenging to cross and more prone to complications such as arterial dissection.
- Passing the sheath beyond the stenotic lesion may not always be possible, and the stent may have to be advanced through the lesion without the sheath protection. Predilation is essential in such situation to avoid dislodgement of the stent from the balloon while passing through the lesion.

Potential Complications

- Arterial dissection
- Arterial occlusion
- Arterial perforation
- Distal embolization
- Stent migration
- Stent thrombosis
- Access site hematoma or pseudoaneurysm
- Brachial sheath hematoma resulting in median nerve compromise
- Contrast nephropathy

Template Operative Dictation

Preoperative Diagnosis Chronic mesenteric ischemia

Procedure Mesenteric angiogram with angioplasty and stenting

Postoperative Diagnosis Chronic mesenteric ischemia

Findings
1. Severe SMA stenosis beyond the origin
2. Chronic occlusion of the celiac artery

Estimated Blood Loss ___ cc

Indications This ___-year-old *man/woman* presented with postprandial abdominal pain, nausea, and ..... lb weight loss over the last 3 months. Further evaluation with a duplex ultrasound and a CT angiogram revealed critical stenosis of the SMA and a chronic occlusion of the celiac artery. Mesenteric angioplasty and stenting was recommended, and an informed consent was obtained after discussing the risks, benefits, and alternative options.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under monitored care anesthesia with local anesthetic agent. The patient was taken to the hybrid suite, and his/her bilateral groins as well as the left arm were prepared and draped in an appropriate sterile fashion.

Using ultrasound guidance, the left brachial artery was identified and the area infiltrated with 1 % lidocaine. A micropuncture needle and wire were used to access the artery and exchanged for a glide wire and a 6 Fr sheath. The patient was systemically heparinized at this point. The glide wire was then directed into the abdominal aorta using an angled glide catheter. A flush catheter was placed in the visceral aorta and connected to a power injector. An aortogram was obtained with anteroposterior and steep oblique (or lateral) views. This showed a flush occlusion of the celiac artery that filled retrograde from the SMA. The SMA itself had a critical stenosis just beyond the origin. The flush catheter was removed and a long 6 Fr sheath was placed with its tip in the visceral aorta. Using a ___ (Glide/MPA) catheter, the artery was cannulated and the wire and catheter were advanced past the lesion. An angiogram was performed through the catheter to confirm entry into the true lumen. A 4×40 mm balloon was placed across the lesion and an angioplasty was performed. It resulted in some improvement with a residual stenosis of about 50 %. We, therefore, decided to stent the lesion. A 6×40 mm iCast balloon expandable covered stent was chosen. The dilator of the sheath was reintroduced and the tip of the sheath advanced beyond the lesion. The stent was positioned across the lesion and, using a reference overlay on the monitor, the sheath withdrawn and the stent deployed. The shaft of the stent was removed and an angiogram performed revealing complete resolution of the stenosis with brisk flow into the SMA and retrograde flow into the celiac artery.

With this we decided to conclude the procedure. All wires and catheters were removed and pressure held over the brachial access site until hemostasis was achieved. A dressing was placed and palpable left radial and ulnar pulses were confirmed. The patient tolerated the procedure well and there were no intra-procedural complications. A debriefing checklist was completed to share information critical to postoperative care of the patient.

He/she was taken to the recovery area in a stable condition.

197 Celiac and SMA Stenting

Raphael C. Sun

Indications

- Acute mesenteric ischemia
- Chronic mesenteric ischemia

Essential Steps

1. Femoral or brachial access.
2. Anticoagulate with IV heparin sulfate (3,000–7,000 U).
3. Control access with 6-French sheath.
4. Aortogram for SMA/CA anatomy evaluation.
5. Cannulation of the SMA/CA.
6. Exchange of guide wire.
7. Pre-dilate the stenotic lesion.
8. Advance introducer sheath or guiding sheath up to or across the lesion.
9. Position stent across lesion.
10. Retract sheath and recheck position with angiogram.
11. Deploy stent across lesion.
12. Post-stent placement angiogram.
13. Check ACT.
14. Remove all sheaths, wires, and catheters.
15. Apply pressure.
16. Secure hemostasis.

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Note These Variations

- Femoral approach most commonly used.
- Brachial approach is especially useful for the SMA.
- Size of wires, sheaths, catheters, and stents will vary depending on access and degree of stenosis and patient's anatomy.

Complications

- Nephrotoxicity
- Artery dissection
- Thrombosis
- Artery perforation and hemorrhage
- Embolization
- Pseudoaneurysm

Template Operative Dictation

Preoperative Diagnosis Mesenteric ischemia

Procedure Mesenteric angiogram, SMA/celiac balloon angioplasty, and SMA/celiac stent placement

Postoperative Diagnosis Mesenteric ischemia

Indications This ___-year-old male/female was found to have a history of nausea, vomiting, and

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_197

pain after eating with significant weight loss. Angioplasty and stenting was indicated.

Description of Procedure The patient was brought to the operative suite and placed on the operating table in the supine position.

Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The right/left groin/arm was shaved, prepped, and draped in the usual sterile fashion. Monitored anesthesia was provided. Prophylactic antibiotics were given by the anesthesiologist. The area over the common femoral artery/brachial artery was anesthetized with 1 % lidocaine solution. Heparin 3,000–7,000 IU was given intraoperatively.

A micropuncture needle was used to access the femoral/brachial artery and exchanged for a micropuncture sheath. This was exchanged for a 5–7-French sheath using the Seldinger technique. An angled Glidewire/Bentson wire and angled catheter were used to advance into the descending aorta down into the abdominal aorta. The angled Glidewire was then exchanged for an Omni Flush catheter. Using the catheter, an aortogram was obtained that demonstrated ____(findings)____. The SMA/CA was cannulated. This was done with an MPA catheter and an angled Glidewire to cross the occlusion. The MPA catheter was removed and occlusion was crossed with a Glide catheter. A 0.014 Mailman wire/TAD wire was exchanged and placed into the SMA/CA, and the lesion was dilated with a 2.5-mm VascuTrak cutting balloon and dilated with an ____mm × ____ mm angioplasty balloon under fluoroscopy. A self-expandable/balloon-expandable stent with a 0.014 wire was used and deployed without difficulty at the origin of the stenosis.

Completion angiogram revealed a widely patent SMA/CA that demonstrated brisk flow across the previous stenotic segment and showed filling of the branches of the SMA/CA. Both AP and lateral views were obtained. There was no residual stenosis, dissection, or thrombosis noted. All balloons, wires, sheaths, and catheters were after the ACT was less than 150–180. Direct manual pressure was held for 10 min over the access site to achieve hemostasis. There were no complications. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was brought back to the postanesthesia care unit in stable condition.

198 Superior Mesenteric Artery Embolectomy with Primary/Patch Closure for Acute Embolic Mesenteric Ischemia

Roderick T.A. Chalmers

Indication

- Acute abdominal pain and atrial fibrillation/other arrhythmias, with no other obvious causes.

Essential Steps

1. Midline abdominal incision.
2. Thorough exploration of the peritoneal cavity.
3. Careful inspection of the small and large bowel to determine extent of ischemia and investigation of the pulse in the superior mesenteric artery (SMA) from its origin to the distal vasculature.
4. Expose the proximal SMA by incising the peritoneum at the root of the small bowel mesentery.
5. Control the vessel and its branches with slings.
6. Perform a transverse/longitudinal arteriotomy.
7. Remove embolic material with forceps.
8. Pass a #4 (red) Fogarty embolectomy catheter proximally to establish good inflow.
9. Pass a smaller #3 (green) Fogarty embolectomy catheter distally, and retrieve all *emboli/thrombi*.
10. Allow for one pass of the catheter with no clot retrieved.
11. Inject heparinized saline distally.
12. Close arteriotomy primarily/patch.
13. With flow restored to the SMA, allow for 10 or 15 min with the intestine returned to the abdominal cavity.
14. Assess pulsation in the distal small bowel mesentery and color and contractility of the bowel.
15. If all the bowel looks viable, return it to the abdomen.
16. Close the abdomen in usual fashion.
17. Monitor the patient carefully in intensive care unit (serial blood gas analysis, lactate levels, etc.).
18. Perform relook laparotomy 12–24 h later no matter what the clinical scenario is.

Note This Variation

- If the SMA is of reasonable caliber and an embolic etiology is suspected, perform a transverse arteriotomy; otherwise, perform a longitudinal arteriotomy.
- The transverse arteriotomy is typically closed with interrupted 6-0 or 5-0 polypropylene sutures. The longitudinal arteriotomy is closed

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_198

with a patch (a segment of the saphenous vein should be harvested simultaneously from one of the groins to minimize the duration of bowel ischemia).

Complications

- High-associated mortality
- Bowel infarction
- Multiorgan failure

Template Operative Dictation

Preoperative Diagnosis Embolic occlusion of the SMA with acute bowel ischemia.

Procedure Fogarty catheter embolectomy of the SMA with saphenous vein patch closure.

Postoperative Diagnosis Same.

Indications This is a ___-year-old *male/female* who presented with acute onset of abdominal pain. *Clinically*, *the patient was in fast atrial fibrillation. Biochemistry revealed a low-grade metabolic acidosis*. A clinical diagnosis of acute embolic mesenteric occlusion was made. A CTA confirmed the diagnosis. *The patient* was taken to the operating room with a view to performing an SMA *embolectomy/revascularization* procedure. *The patient* was apprised of the risks of the condition and of the surgical procedure.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°* at the sides. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Anesthesia was placed in peripheral and central venous lines, a Swan-Ganz catheter, and arterial lines, and the patient was intubated. A Foley urinary catheter was inserted under sterile conditions. The anterior abdominal wall and right thigh were draped and prepped in the usual manner. The patient received intravenous cefuroxime and metronidazole prior to skin incision.

A midline abdominal skin incision was made. The subcutaneous tissues were divided with electrocautery. The linea alba was opened with electrocautery. The peritoneum was opened along the length of the wound.

Abdominal exploration revealed the small intestine from the proximal jejunum to terminal ileum and the right colon to the mid-transverse level to be ischemic looking, flaccid with no evidence of peristalsis. There was no palpable pulsation within the vessels in the small bowel mesenteric arcades and *a monophasic/no Doppler* signal. The remainder of the colon and the other abdominal viscera appeared normal. The SMA was exposed and slung by opening the peritoneum at the root of the small bowel mesentery. The SMA was pulseless at this level but was a soft, disease-free artery with a diameter of 5 mm. A transverse arteriotomy was fashioned with a #15 blade. Fresh embolus was retrieved with forceps, giving rise to a little inflow. A #4 Fogarty catheter was passed proximally and further thrombus/embolus was obtained and the inflow was excellent. The proximal SMA was double slung to control bleeding. A #3 Fogarty catheter was passed distally and further thrombus was retrieved and there was some backbleeding. Heparinized saline was injected with ease. The SMA was closed with interrupted 6-0 polypropylene sutures.

(**If longitudinal SMA**: *A portion of greater saphenous vein was harvested from the right groin. At the same time*, *a #4 Fogarty catheter was passed proximally and further thrombus/embolus was obtained and the inflow was excellent. The proximal SMA was double slung to control bleeding. A #3 Fogarty catheter was passed distally and further thrombus was retrieved and there was some backbleeding. Heparinized saline was injected with ease. The harvested vein was opened and cut to size and shape. It was sutured to the SMA with 6-0 polypropylene*.)

Flow was restored to the SMA and, after ensuring that the anastomosis was hemostatic, the intestines were returned to the abdominal cavity, taking all stretch off the small bowel mesentery. After a 15-min interval, there was an easily palpable pulse in the SMA and ileocolic vessels. Also, there appeared to be a palpable pulse in the marginal artery. The Doppler signal was biphasic in the distal SMA and marginal artery. The previously ischemic small bowel had become pink and there were areas of active peristalsis. The entire colon also appeared satisfactorily vascularized.

After a final check for hemostasis, the intestines were returned to the peritoneal cavity. The abdominal wall was closed with a mass closure of 0 polypropylene sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the intensive care unit in stable condition. Serial arterial blood gas analysis and serum lactate levels will be measured. A relook laparotomy will be performed in 24 h.

199 Superior Mesenteric Artery Thrombectomy with Retrograde Aortomesenteric Bypass for Acute Thrombotic Mesenteric Ischemia

Roderick T.A. Chalmers

Indication

- Acute abdominal pain, evidence of bowel ischemia (acidosis, elevated lactate, clinical evidence of occlusive arterial disease), with other causes of pain excluded.

Essential Steps

1. Midline abdominal incision.
2. Abdominal exploration reveals ischemia of the small bowel beyond the proximal jejunum.
3. Pulseless superior mesenteric artery (SMA) with evidence of occlusive disease (palpable calcification, calcification of aorta, and iliac arteries).
4. Expose the SMA in the root of the small bowel mesentery as before.
5. Confirm its patency distally and proximal occlusion.
6. Expose the infrarenal aorta by incising the posterior peritoneum to the left of the duodenojejunal (DJ) flexure, distal to the inferior mesenteric vein.
7. Find a soft portion of the aorta that can be clamped safely and used as the site for a graft anastomosis.
8. Be prepared to harvest a length of saphenous vein for use as a graft (preferable to prosthetic graft where ischemic bowel is present).
9. Administer systemic heparin intravenously (75–100 U/kg) and wait a few minutes.
10. Control the SMA with slings.
11. Perform longitudinal arteriotomy distal to the middle colic artery takeoff.
12. Attempt to pass # Fogarty embolectomy catheter proximally (confirms proximal occlusion/tight stensosis with supervening thrombosis).
13. Pass #3 Fogarty embolectomy catheter distally, removing all clot.
14. Side-bite clamp on the infrarenal aorta.
15. Longitudinal aortotomy to the right of the midline of 2-cm length.
16. Reverse harvested long saphenous vein and suture end-to-side to the aorta with 4-0 polypropylene sutures.
17. Lay graft in "cleft" between the aorta and vena cava.
18. Cut vein graft to length and anastomose so that heel of graft lies distally and toe proximally on the SMA. This avoids the kinking associated with other techniques.
19. Anastomose the vein graft to the SMA with 6-0 polypropylene sutures.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_199

20. Check that anastomoses are hemostatic.
21. Return the intestines to the peritoneal cavity for 15 min.
22. Reinspect the entire small and large intestine for viability.
23. Palpate for pulses in the SMA, distal ileocolic arteries, and marginal artery.
24. Resect the obviously infarcted bowel.
25. Do not anastomose the bowel, bring out end stoma(s).
26. Close the abdomen as usual.
27. Plan for a relook laparotomy in 12–24 h.
28. Monitor patient in intensive care unit with blood gases, electrolytes, and serum lactate levels.

Note This Variation

- If the aorta is extremely calcified, the iliac arteries can serve as an inflow source.

Complications

- Bowel infarction.
- Myocardial infarction.
- Multiorgan failure.
- Lower limb ischemia.
- Pneumonia.

Template Operative Dictation

Preoperative Diagnosis Acute mesenteric ischemia.

Procedure Thrombectomy of the SMA with retrograde aortomesenteric reversed saphenous vein bypass.

Postoperative Diagnosis Same.

Indications This is a ___-year-old *male/female* who presented with a short history of acute abdominal pain. There was a history of recent weight loss and epigastric pain after eating. Peptic ulcer and other upper gastrointestinal pathologies had been ruled out previously. *The patient* was thought to have acute mesenteric ischemia and consented to laparotomy with a view to mesenteric revascularization if possible. *The patient* was aware of the risks of the procedure, including the possible need for *colostomy/ileostomy*.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°* at the sides. Timeouts were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Anesthesia placed peripheral and central venous lines, a Swan-Gantz catheter, and arterial lines and the patient was intubated. A Foley urinary catheter was inserted under sterile conditions. The anterior abdominal wall and right thigh were draped and prepped in the usual manner. The patient received intravenous cefuroxime and metronidazole prior to skin incision.

A midline abdominal skin incision was made. The subcutaneous tissues were divided with electrocautery. The linea alba was opened with electrocautery. The peritoneum was opened along the length of the wound.

Abdominal exploration revealed the small intestine from the proximal jejunum to terminal ileum and the right colon to the mid-transverse level to be pale and flaccid with no evidence of peristalsis. There was no palpable pulsation within the vessels in the small bowel mesenteric arcades. The SMA was exposed in the root of the small bowel mesentery. It was pulseless and more proximally was obviously calcified and occluded. It was deduced that the acute bowel ischemia was due to acute thrombosis of a heavily diseased proximal SMA. As there was bowel salvageable, it was decided to attempt SMA thrombectomy and aortomesenteric bypass.

The SMA was dissected just distal to the middle colic artery takeoff and slings were passed around the vessel and its branches for control.

The infrarenal aorta was exposed by incising the posterior peritoneum overlying it. The aorta had obvious areas of calcification but there was a length of soft aorta found at the level of the inferior mesenteric artery.

While these arteries were being dissected, a 30-cm length of greater saphenous vein was harvested from the right thigh.

The patient was given 5,000 U of intravenous heparin.

A 1.5-cm longitudinal arteriotomy was fashioned on the proximal SMA with a #15 blade. There was fresh thrombus within the vessel lumen and this was removed with forceps. There was no inflow and the vessel was clearly occluded proximally. A #3 Fogarty embolectomy catheter was passed distally and a small amount of fresh thrombus was retrieved. *A #2 Fogarty embolectomy catheter was also passed in the larger SMA branches and a small amount of fresh thrombus was also retrieved*. There was some backbleeding. Heparinized saline was injected distally.

The soft portion of the infrarenal aorta was isolated using two clamps and a 2-cm aortotomy performed. It was clear that the inferior mesenteric artery was chronically occluded over several centimeters from its origin. The harvested saphenous vein was placed in reversed orientation and anastomosed end-to-side to the aorta with a continuous 4-0 polypropylene suture. This anastomosis was hemostatic when the clamps were removed from the aorta. With a ligaclip placed on the distal end of the graft, it was placed in the gutter between the aorta and the vena cava so that it lay without kinks, in retrograde orientation. Attention was turned to the SMA. The vein graft was cut to length so that the toe of the planned anastomosis to the SMA was at the proximal end of the SMA arteriotomy and the heel at the distal end. The graft was anastomosed to the SMA with continuous 6-0 polypropylene. When flow was restored to the graft, there was a palpable pulse in the distal SMA and, within 1 or 2 min, the color of the small bowel began to improve. The intestines were replaced carefully in the peritoneal cavity and packs soaked in warm saline placed over them. After a 15-min interval, the intestines were reinspected. The entire small and large bowels appeared viable. There were palpable pulsations in the distal SMA and ileocolic and ascending colic arteries and evidence of peristalsis.

After a final check for hemostasis, the intestines were returned to the peritoneal cavity. The abdominal wall was closed with 0 polypropylene and staples to skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the intensive care unit in stable condition. Serial arterial blood gas analysis and serum lactate levels will be measured. A relook laparotomy will be performed in 24 h.

200 Bilateral Aortorenal Bypass

Jamal J. Hoballah

Indications

- Renal artery occlusive disease: Asymptomatic, renovascular hypertension, and renal insufficiency
- Recurrent renal artery stenosis following angioplasty/stenting

Essential Steps

1. Midline xiphoid to pubis incision; transverse/bilateral subcostal incision.
2. Abdominal exploration for unexpected findings.
3. Retract the transverse colon anteriorly and to the right.
4. Retract the splenic flexure posteriorly and laterally.
5. Divide the peritoneal periaortic attachment of the duodenum.
6. Wrap the small bowel in a wet towel and retract to the right.
7. Incise the retroperitoneum overlying the aorta and continue proximally.
8. Identify the left renal vein.
9. Dissect and mobilize the left renal vein and divide its branches.
10. Expose and dissect the left renal artery.
11. Expose and dissect the right renal artery.
12. Anticoagulate with heparin 75–100 U/kg and wait for 5 min.
13. Cross-clamp the aorta, and perform the proximal anastomosis of the left aortorenal bypass.
14. Perform the proximal anastomosis of the right aortorenal bypass.
15. Give 12.5 g mannitol intravenously.
16. Construct the distal anastomosis to the left renal artery.
17. Evaluate the reconstruction with Doppler/duplex.
18. Construct the distal anastomosis to the right renal artery.
19. Evaluate the reconstruction with Doppler/duplex.
20. Reevaluate hemostasis.
21. Close the abdomen.
22. Recheck distal pulses.

Note These Variations

- Renal artery angioplasty/stenting has gained popularity as the first line of intervention.
- The right renal artery may be accessed by exposing the pararenal aorta and the origin of the right renal artery and tracing it distally

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_200

posterior to the vena cava. Alternatively, the right renal artery is approached by performing a Kocher maneuver and exposing it lateral to the vena cava.
- Vein or prosthetic grafts may be used to construct the bypass.
- The renal artery anastomosis can be constructed using end-to-end or end-to-side configuration.

Complications

- Bleeding
- Myocardial infarction
- Pneumonia
- Renal failure
- No postoperative improvement in renal function or blood pressure control
- Leg ischemia

Template Operative Dictation

Preoperative Diagnosis Bilateral renovascular occlusive disease.

Procedure Bilateral aortorenal bypasses.

Postoperative Diagnosis Same.

Indications This ___-year-old *male/female* was found to have poorly controlled hypertension despite maximal medical therapy. *The patient* has *no/mild/moderate/severe* renal dysfunction with blood urea nitrogen ___ and creatinine ___.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Anesthesia was placed in appropriate lines and induced and intubated the patient without complications. A Foley catheter was then placed under sterile technique. The patient's anterior abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

The skin incision was then made from the subxiphoid to the suprapubic region. The subcutaneous tissue was divided with electrocautery. The linea alba was exposed and incised. The peritoneum was elevated and entered sharply. The abdominal wall incision was then extended to the full length of the skin incision.

There were *no/moderate number* of adhesions requiring lysis.

Abdominal exploration revealed no/the following incidental findings (detail).

The transverse colon was then elevated superiorly out of the wound, wrapped in a moist towel. A moist rolled laparatomy pad was placed in the bed of the splenic flexure of the colon, which was retracted laterally and posteriorly. The remainder of the small bowel was then deflected to the right, exposing the aorta. Sharp dissection of the ligament of Treitz and the distal fourth portion of the duodenum allowed further exposure of the aorta and retraction of the small bowel to the right. The small bowel was then wrapped in a moistened towel and held in place using the Omni retractor.

The retroperitoneum overlying the aorta was incised and continued proximally to the level of the left renal vein and distally toward the aortic bifurcation. The inferior mesenteric vein was encountered, ligated, and divided. The lymphatics overlying the infrarenal aortic neck were ligated and divided.

The abdominal aorta was then sharply dissected.

The infrarenal aorta appeared to be adequate for clamping and constructing the proximal anastomoses.

Further mobilization of the left renal vein was performed. The left *gonadal*, *lumbar*, *and adrenal veins* were ligated and divided. The left renal vein was circumferentially mobilized and retracted proximally, exposing the renal arteries.

The left renal artery was dissected distally toward its segmental branches.

The right renal artery was dissected distally posterior to the inferior vena cava for a 3-cm segment. This necessitated division of few venous branches draining into the medial aspect of the vena cava.

(**Alternatively**: *The peritoneum lateral to the second part of the duodenum was incised, and the duodenum and the head of the pancreas were reflected medially and anteriorly performing a Kocher maneuver. The right renal vein draining into the inferior vena cava was exposed posterior to the duodenum. The right renal vein was mobilized cephalad, exposing the right renal artery. The right renal artery was then exposed and encircled with a vessel loop. The right renal artery was dissected proximally and distally until it divided into its segmental branches*.)

The greater saphenous vein was exposed and two 15-cm segments were harvested.

The patient was given 5,000 U or 75 UI/kg of heparin intravenously along with 12.5 g of mannitol. The aorta was clamped proximally and distally and a soft part of the aorta was identified. A 1-cm incision was performed on the left anterolateral aspect of the aorta. The vein was used in a *reversed/nonreversed* manner. One end was spatulated. An anastomosis was then performed between the spatulated end of the vein and the aortotomy using a 5-0 Prolene running suture. At the completion of the anastomosis, the aorta was backbled and forwardbled and irrigated with heparinized saline. The suture line was then completed.

A 1-cm incision was performed on the right anterolateral aspect of the aorta and a similar procedure was performed on that side.

The left renal artery was then *ligated/suture ligated* as proximal as possible toward its origin from the aorta. The distal part of the artery was controlled with a Yasargil clip. The renal artery was then transected and its distal end spatulated. The end of the vein was spatulated to match the arteriotomy. An end-to-end anastomosis was then performed using a 5-0 Prolene running suture. At the completion of the anastomosis, the renal artery was allowed to backbleed and the graft was forward flushed. The anastomosis was irrigated with heparinized saline. The sutures were tied and the anastomotic suture line was checked for hemostasis, which was adequate. There were excellent Doppler signals in the kidney.

The same was then performed on the other side.

The renal artery cross-clamp time was ___ min.

The proximal and distal anastomoses were reinspected for hemostasis.

The renal artery was evaluated using intraoperative *duplex/Doppler ultrasound*. The reconstruction appeared to be patent without any defects, and there were excellent Doppler signals in the kidney.

The abdominal wall was then closed using #1 Prolene *interrupted/continuous* sutures. The skin was closed with staples. The feet were inspected and there was evidence of strong Doppler signals. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition, making good urine output.

201 Hepatorenal Artery Bypass

Jamal J. Hoballah

Indications

- Renal artery occlusive disease: Asymptomatic, renovascular hypertension, renal insufficiency, recurrent renal artery stenosis following angioplasty/stenting
- Aortic disease precluding the use of the aorta as an inflow as part of aortic debranching procedure

Essential Steps

1. Rule out via a lateral aortogram the presence of any stenosis at the origin of the celiac artery.
2. Right subcostal incision/midline xiphoid to pubis incision.
3. Abdominal exploration for unexpected findings.
4. Stomach retracted to the left, and the lesser omentum entered.
5. The common hepatic, proper hepatic, and gastroduodenal arteries dissected and encircled with Silastic vessel loops.
6. Kocher maneuver performed.
7. The right renal vein exposed.
8. The right renal artery exposed and encircled with a vessel loop.
9. Greater saphenous vein segment harvested.
10. Anticoagulation with intravenous heparin.
11. Proximal end-to-side anastomosis constructed to the common hepatic artery.
12. 12.5 g of mannitol given intravenously.
13. Distal anastomosis performed (end to end or end to side) to the renal artery.
14. Hemostasis established.
15. Revascularization checked with *Doppler/duplex*.
16. Incisions closed.

Note These Variations

- The vein can be used in a reversed or nonreversed fashion.
- The renal artery anastomosis can be done in an end-to-end or end-to-side manner.

Complications

- Bleeding
- Myocardial infarction
- Pneumonia
- Renal failure
- No postoperative improvement in renal function or blood pressure control

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_201

Template Operative Dictation

Preoperative Diagnosis Renovascular occlusive disease

Procedure Right hepatorenal bypass

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* was found to have poorly controlled hypertension despite maximal medical therapy. The patient has *no/mild/moderate/severe* renal dysfunction with blood urea nitrogen ___ and creatinine ___.

Angiogram revealed ___% right renal artery stenosis and a severely calcified and diseased infrarenal aorta. The risks and benefits of surgical intervention were discussed with the patient, and *he/she* elected to undergo surgical intervention. The patient has prior angioplasty/stenting with recurrent stenosis.

Description of Procedure The patient was placed supine. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under general anesthesia. The abdomen and upper thighs were prepped and draped in the standard fashion.

A right subcostal incision was then performed. The incision was deepened through the subcutaneous tissue and fat. The anterior rectus sheath was identified and divided. The rectus muscle was divided with electrocautery. The posterior rectus sheath and the peritoneum were then lifted and the abdominal cavity entered. The muscle incision was then extended for the full length of the skin incision.

Exploration revealed no evidence of any unexpected findings. The stomach was retracted to the left and the lesser omentum entered. Palpation along the upper border of the pancreas revealed the location of the hepatic artery. The common hepatic artery was dissected and encircled with a Silastic vessel loop. The common hepatic artery was traced distally toward its bifurcation into the proper hepatic and the gastroduodenal arteries, which were also dissected and encircled with Silastic vessel loops.

Attention was then directed to expose the right renal artery. The peritoneum lateral to the second part of the duodenum was incised and the duodenum and the head of pancreas were reflected medially and anteriorly performing a Kocher maneuver. The right renal vein draining into the inferior vena cava was exposed posterior to the duodenum. The right renal vein was mobilized cephalad, exposing the right renal artery. The right renal artery was then exposed and encircled with a vessel loop. The right renal artery was dissected proximally and distally until it divided into its segmental branches.

Attention was then directed to harvesting of the greater saphenous vein in the thigh. An upper thigh incision was performed over the greater saphenous vein, which had been evaluated and marked preoperatively by duplex ultrasonography. The vein was mobilized toward the saphenofemoral junction, and its branches were ligated and divided. A segment measuring 15 cm was harvested. The patient was given 5,000 U of heparin intravenously.

Atraumatic vascular clamps were applied on the common hepatic, proper hepatic, and gastroduodenal arteries. A 1.0-cm incision was then performed in the common hepatic artery. The vein was used in a reversed manner. The end of the vein was spatulated to match the hepatic arteriotomy. The proximal anastomosis was then constructed using a running 5-0 Prolene suture. At the completion of the anastomosis, forward- and back-bleeding from the hepatic arteries were performed, and the anastomosis was irrigated with heparinized saline. The sutures were tied and the anastomosis was checked for hemostasis, which was adequate.

The patient was then given 12.5 g of mannitol intravenously.

Choose One

If end-to-end anastomosis: *The right renal artery was then ligated as proximally as possible to its origin. The distal end was controlled with a Yasargil clip. The renal artery was transected* *and the distal end was spatulated. The bypass was measured to the appropriate length and transected. The distal end of the bypass was spatulated to match the size of the renal artery. An end-to-end anastomosis was then constructed using a running 5-0 Prolene*.

If end-to-side anastomosis: *The right renal artery was then controlled distally and proximally as close as possible to its origin using Yasargil clips/vascular clamps/vascular Bulldog clamps/Silastic loops. A 1-cm arteriotomy was then performed in the renal artery. The bypass was measured to the appropriate length and transected. The distal end of the bypass was spatulated to match the size of the renal arteriotomy. An end-to-side anastomosis was then constructed using a running 5-0 Prolene suture*.

At the completion of the anastomosis, backbleeding from the renal artery was obtained and the graft was forward flushed. The anastomosis was irrigated with heparinized saline, and the sutures were tied. The suture line was checked for hemostasis and was adequate. The renal artery cross-clamp time was ___ min.

The proximal and distal anastomoses were reinspected for hemostasis.

The renal artery was evaluated using intraoperative *duplex/Doppler ultrasound*. The reconstruction appeared to be patent without any defects, and there were excellent Doppler signals in the kidney.

The wound was then closed in layers using no. 1 Vicryl sutures. The skin was closed with staples. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in good condition, making good urine output.

202 Transaortic Celiac and Superior Mesenteric Artery Endarterectomy

Christian Bianchi and Jeffrey L. Ballard

Indication

- Chronic mesenteric ischemia due to atherosclerotic occlusive disease of the celiac and superior mesenteric arteries (usually ostial lesions)

Essential Steps

1. Retroperitoneal aortic exposure via left flank incision.
2. Identify and expose the left renal artery to use as a landmark for further dissection.
3. Divide the median arcuate ligament and left crus of the diaphragm to expose the supraceliac aorta.
4. Ligate the iliolumbar venous tributary immediately inferior to the left renal artery.
5. Divide the neurovascular tissue around and superior to the left renal artery to facilitate exposure of origins of the superior mesenteric and celiac arteries.
6. Dissect out each mesenteric artery in a similar fashion.
7. Administer intravenous bolus of mannitol (12.5 g) and heparin (100 U/kg) prior to application of supraceliac cross-clamp.
8. Create a curvilinear aortotomy in the paravisceral aorta.
9. Create an appropriate endarterectomy plane just superior to the celiac artery, and use curved scissors to transect the paravisceral aortic plaque around the origins of the mesenteric arteries.
10. Complete meticulous plaque extraction at the level of the celiac and superior mesenteric arteries using eversion endarterectomy technique.
11. Sharply transect distal paravisceral plaque without creating a flap.
12. Back-bleed the mesenteric arteries into the aorta, and flush the proximal and distal abdominal aorta.
13. Close aortotomy using 4-0 prolene bolstered with Teflon felt strips.
14. Perform immediate intraoperative duplex ultrasound examination of the celiac and superior mesenteric arteries.
15. Achieve meticulous hemostasis.
16. Close the surgical wound in layers.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_202

Note These Variations

- Endovascular treatment (angioplasty/stenting) is an option especially in high-risk patient even though it is associated with higher recurrence rate.
- Revascularization of the mesenteric vessels can be achieved using aortoceliac-mesenteric bypasses or transaortic celiac and superior mesenteric artery endarterectomy.
- Transaortic endarterectomy can be performed using a retroperitoneal approach as described in this chapter or through a transperitoneal approach with medial visceral notation.
- If the plaque in the superior mesenteric artery (SMA) extends distally and does not lend itself to a smooth endpoint, an additional longitudinal arteriotomy is carried in the SMA to complete the endarterectomy. The arteriotomy is then closed using a vein patch angioplasty.

Complications

- Acute mesenteric artery occlusion, dissection, or thrombosis
- Hepatobiliary or small bowel ischemia
- Distal aortic, renal, or lower-extremity embolization
- Acute tubular necrosis or renal failure

Template Operative Dictation

Preoperative Diagnosis Chronic mesenteric ischemia

Procedure Transaortic celiac and superior mesenteric artery endarterectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* has a ___-month history of postprandial abdominal pain associated with significant and unintended weight loss. Duplex ultrasound suggested severe atherosclerotic disease at the origins of the celiac and superior mesenteric arteries, and arteriography confirmed this finding.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under general anesthesia with the patient placed in a modified right lateral decubitus position. The chest, abdomen, and groin were prepped and draped in a standard fashion. An incision was made across the left flank extending from just lateral to the umbilicus toward the tip of the 12th rib posteriorly. The incision was deepened through abdominal fascia and musculature to the peritoneum. The 12th rib was partially resected to improve this extraperitoneal exposure of the left retroperitoneal space. The peritoneal contents and left kidney including Gerota's fascia were rotated medially off the psoas muscle and diaphragm to expose the abdominal aorta. The left renal artery was identified, and neurovascular tissue surrounding this vessel was divided between silk ligatures. Division of median arcuate ligament and the left diaphragmatic crus facilitated exposure and dissection of the distal descending thoracic and supraceliac aorta. Inferior to the left renal artery, iliolumbar venous tributaries to the left renal vein were divided to allow superomedial retraction of the renal vein off the infrarenal aorta. This maneuver facilitated exposure of the aorta below the level of the renal arteries.

Attention was then turned to the paravisceral aorta, where the celiac and superior mesenteric arteries were individually dissected free of surrounding tissue for approximately 1 cm beyond grossly palpable atherosclerotic disease. The left and right renal arteries were also dissected free of surrounding tissue at their origins. All these vessels were encircled with a Silastic loop for vascular control. Mannitol (12.5 g) and heparin (100 U/kg) were administered intravenously, and after 3 min, the vessel loops were gently snugged around the uninvolved aspects of each mesenteric vessel and the origins of the renal arteries. Supraceliac and infrarenal vascular occluding clamps were then placed to facilitate a bloodless operative field.

A curvilinear aortotomy was then created that began just below the level of the left renal artery and coursed posterolaterally around the origins of the mesenteric arteries to end just superior to the origin of the celiac artery. An endarterectomy plane was developed just superior to the celiac artery, and curved scissors were used to transect the paravisceral aortic plaque around to origins of the mesenteric arteries. Meticulous plaque extraction then took place at the level of the celiac and superior mesenteric arteries using a Freer elevator and eversion endarterectomy technique. Neat endpoints were visualized prior to release of the everted vessel. Distally, the paravisceral plaque was sharply transected superior to the left renal artery without creating a flap. The aortotomy was then closed using a running 4-0 prolene suture. This suture line was reinforced using longitudinal strips of Teflon felt. The mesenteric and renal arteries, infrarenal aorta, and supraceliac aorta were all back-bled/flushed just prior to completion of the suture line. Supraceliac clamp time was ____ min.

Immediate intraoperative duplex ultrasound interrogation of the celiac and superior mesenteric arteries was then performed. This demonstrated widely patent mesenteric vessels with normal flow velocities. After meticulous hemostasis, wound closure was accomplished in layers using #1 Vicryl suture for the posterior rectus sheath, transversalis fascia, transversus abdominis, and internal oblique muscle layers. The anterior rectus sheath and external oblique aponeurosis were closed with #1 PDS suture. Subcuticular skin closure was accomplished with 3-0 Monocryl.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

203 Transaortic Renal Artery Endarterectomy

Christian Bianchi and Jeffrey L. Ballard

Indications

- Primary: Renovascular hypertension due to unilateral or bilateral ostial renal artery stenosis >60 %
- Secondary: Preservation of kidney parenchyma in cases of severe unilateral or bilateral renal artery stenosis in conjunction with infrarenal aortic aneurysm or aortoiliac occlusive disease

Essential Steps

1. Retroperitoneal aortic exposure via left flank incision.
2. Identify and expose the left renal artery.
3. Divide the median arcuate ligament and left crus of the diaphragm.
4. Ligate the iliolumbar venous tributary.
5. Expose the proximal aspect of the right renal artery.
6. Grossly palpate the pararenal aorta to determine level of clamp (supraceliac/suprarenal).
7. Administer intravenous bolus of mannitol (12.5 g) and heparin (100 U/kg) prior to application of aortic cross-clamp.
8. Create curvilinear aortotomy that courses posterolaterally around the left renal artery ending at or below the level of the superior mesenteric artery (SMA).
9. Create appropriate endarterectomy plane beginning in the pararenal aorta and complete plaque extraction using eversion endarterectomy technique for both renal arteries.
10. Back-bleed the renal arteries into the aorta, and flush the proximal and distal abdominal aorta.
11. Close aortotomy using 4-0 prolene bolstered with Teflon felt strips.
12. Perform immediate intraoperative duplex ultrasound examination of the renal arteries.
13. Achieve meticulous hemostasis.
14. Close the surgical wound in layers.

Note These Variations

- Endovascular treatment (angioplasty/stenting) is often performed as first line of interventional therapy.
- Renal vascularization can be achieved using bypasses to the renal arteries or transaortic renal endarterectomy.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_203

- Transaortic renal endarterectomy can be performed using a retroperitoneal approach as described in this chapter or through a transperitoneal approach.
- In the transabdominal approach, the aorta is ideally clamped above the SMA. The renal endarterectomy can be performed through a longitudinal aortotomy in the pararenal aorta or through a transverse aortotomy that extends from the proximal anterior wall of the right renal artery to the proximal anterior wall of the left renal artery. The longitudinal aortotomy is closed primarily, while the transverse is closed with a patch.
- When renal endarterectomy is performed in conjunction with the placement of an aortic graft, the aorta is transected 1 cm below the origin of the renal arteries, and the endarterectomy is performed through the transected aorta.

Complications

- Acute renal artery occlusion, dissection, or thrombosis
- Acute tubular necrosis and transient or permanent renal failure
- Distal aortic, mesenteric, or lower-extremity embolization

Template Operative Dictation

Preoperative Diagnosis Renovascular hypertension with severe bilateral renal artery stenosis

Procedure Bilateral transaortic renal artery endarterectomy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* has uncontrolled hypertension and new onset of renal insufficiency. Preoperative imaging demonstrates severe bilateral renal artery stenosis without associated aortoiliac occlusive disease.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under general anesthesia with the patient placed in a modified right lateral decubitus position. The chest, abdomen, and groin were prepped and draped in a standard fashion. An incision was made across the left flank extending from just lateral to the umbilicus toward the tip of the 12th rib posteriorly. The incision was deepened through the abdominal fascia and musculature to the peritoneum. The 12th rib was partially resected to improve this extraperitoneal exposure of the left retroperitoneal space. The peritoneal contents and left kidney including Gerota's fascia were rotated medially off the psoas muscle and diaphragm to expose the abdominal aorta. The left renal artery was identified, and neurovascular tissue surrounding this vessel was divided between silk ligatures. The median arcuate ligament and a portion of the left diaphragmatic crus were divided to facilitate exposure of the suprarenal and supraceliac aorta. Inferior to the left renal artery, iliolumbar venous tributaries to the left renal vein were divided to allow superomedial retraction of the renal vein off the infrarenal aorta. This maneuver facilitated identification and exposure of the proximal right renal artery and facilitated exposure of the abdominal aorta from the diaphragmatic crura through the aortic bifurcation.

Gross palpation of the extent of atherosclerotic disease at the juxtarenal aorta demonstrated significant plaque through the level of the proximal SMA. Therefore, the supraceliac aorta was dissected free of surrounding tissue. In addition, the left and right renal arteries were exposed for at least 1 cm beyond the gross extent of palpable disease. Silastic vessel loops were then passed around each renal artery in a Potts loop fashion for vascular control. Mannitol (12.5 g) and heparin (100 U/kg) were administered intravenously, and after 3 min, the vessel loops were gently snugged around the distal aspect of each renal artery. The infrarenal aorta was then cross-clamped, followed by supraceliac clamp application.

Longitudinal aortotomy was initiated below the level of the left renal artery and gently curved posterolaterally around the left renal artery origin to end directly opposite the SMA. Entry into the appropriate endarterectomy plane was made just inferior to the SMA, and curved scissors were used to transect the pararenal aortic plaque circumferentially. With meticulous control of the mobilized plaque and gentle manipulation of the renal artery away from the plaque using a Freer elevator, vessel loops about each renal artery were loosened temporarily so that a clean endarterectomy breakpoint could be individually accomplished without creating a flap within the renal artery. The aortotomy was then closed using a running 4-0 prolene suture. This suture line was reinforced using longitudinal strips of Teflon felt. The renal arteries, infrarenal aorta, and suprarenal aorta were flushed just prior to completion of the suture line. Supraceliac clamp time was ____ min.

Immediate intraoperative duplex ultrasound interrogation of each renal artery was then performed. This demonstrated widely patent renal arteries with normal flow velocities.

After meticulous hemostasis, wound closure was accomplished in layers using #1 Vicryl sutures for the posterior rectus sheath, transversalis fascia, transversus abdominis, and internal oblique muscle layers. The anterior rectus sheath and external oblique aponeurosis were closed with #1 PDS suture. Subcuticular skin closure was accomplished with 3-0 Monocryl.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Renal Artery Angioplasty and Stenting

204

F. Ezequiel Parodi and Murray L. Shames

Indications

- Cure or improve renovascular hypertension that has failed to respond to a combination of medications
- To improve or stabilize renal function
- Focal renal artery stenosis

Essential Steps

1. Femoral access. Brachial access may also be performed if the anatomy is suboptimal for femoral access or if cannulation via the femoral access was not successful.
2. Aortogram for renal artery anatomy evaluation and artery sizing.
3. Cannulation of the renal artery (SOS, Simmons catheter).
4. Exchange of guidewire to floppy-tip wire (0.035 in. or 0.018 in. depending on stent to be used).
5. Predilate the stenotic lesion.
6. Advance introducer sheath or guiding sheath *up to or across* the lesion over a guidewire.
7. Position stent across the lesion.
8. Retract sheath and check position with angiogram.
9. Deploy stent.
10. Completion angiogram.

Note This Variation

- After predilating the renal artery stenosis, the guiding sheath may be introduced across the stenosis or kept in the aorta just below the renal artery. In the latter situation, the balloon-mounted stent will be advanced across the renal artery stenosis without the protection of the guiding sheath.

Complications

- Vascular injury (dissection, thrombosis, perforation, embolization)
- Renal parenchymal injury (embolization, perforation)
- Contrast nephropathy

Template Operative Dictation

Preoperative Diagnosis *Right/left* renal artery stenosis with *hypertension/renal insufficiency*

Procedure Aortogram, renal angiogram, renal angioplasty, and renal stent placement

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_204

Postoperative Diagnosis *Right*/*left* renal artery stenosis with *hypertension*/*renal insufficiency*

Indications This ___-year-old *male*/*female* patient was found to have symptomatic *right*/*left* renal artery stenosis.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. The *right*/*left* groin was shaved, prepped with povidone–iodine solution, and draped in the standard fashion. Timeouts were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The area over the common femoral artery was anesthetized with *1% lidocaine*/*0.25% bupivacaine* solution. A Seldinger needle was used to access the common femoral artery. A Bentson wire was advanced into the needle and tracked with fluoroscopy into the descending thoracic aorta. The needle was removed and a 6–8-French arterial sheath advanced into the external iliac artery. A pigtail catheter was positioned at the level of the renal arteries, and an arteriogram was performed to evaluate the vessels and their diameters. The pigtail was then exchanged for a *Simmons*/*SOS*/*Cobra* catheter. A guidewire (*Glide*/Terumo hydrophilic/*V18*[*0.018*]) was used to cannulate the affected renal artery. A selective renal angiogram confirmed the focal high-grade stenosis with a normal renal artery distally. The wire was advanced across the lesion and the patient was anticoagulated with heparin (1,000–3,000 U). The wire was exchanged for a *TAD wire*/*Rosen wire* (or the 0.018 in., wire left in position), making sure to keep the tip in view and in a renal branch vessel. The lesion was predilated with a __-mm angioplasty balloon. A __-mm guiding catheter was then advanced to or across the stenotic lesion. A __-mm stent was introduced through the guiding sheath. The guiding *catheter*/*sheath* was then retracted. The position of the lesion was then confirmed with an angiogram, and the ____ stent was placed across the stenosis and deployed by balloon inflation. The postdeployment angiogram demonstrated brisk flow across the previously stenotic segment, without any intrastent stenosis or arterial dissection. The sheaths and wires were sequentially removed. Pressure was applied for hemostasis for 15 min.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Radiology Supervision and Interpretation

1. ***Aortogram***: High-grade focal, *nonostial*/*ostial* stenosis of the *right*/*left* renal artery.
2. ***Postdeployment angiogram***: A stent has been placed across renal artery stenosis, brisk flow, and no residual stenosis.

Notes

Anatomic Requirements

Focal renal artery stenosis

Necessary Equipment

X-ray compatible operating table
Angled C-arm
Seldinger needle
Selection of 0.035″ and 0.018″ guidewires (Bentson, Amplatz, Glide)
Selection of catheters (Simmons, SOS, Cobra)
Guiding sheaths (6 F–8 F)
Sheaths (6 F–8 F)
Angioplasty balloons (4–8 mm)
Selection of short balloon-expandable stems (4–8 mm)

Part XVIII

Vascular Surgery: Aortoiliac Occlusive Disease

Thoracofemoral Bypass

205

Kelly S.A. Blair and Hisham Bassiouny

Indications

- Presence of an abdominal stoma
- Radiation therapy
- Aortic occlusion
- Symptomatic (disabling claudication, rest pain, ulceration, gangrene, or limb salvage) lower-extremity occlusive disease
- Revascularize lower extremities where standard aortofemoral bypass grafts cannot be used due to severe patient comorbidities chronic obstructive pulmonary disease, stomas, or hostile abdomen.
- Revascularize lower extremities before or after removal of infected aortic grafts.
- Revascularize lower extremities after exclusion of infrarenal aortic aneurysm.

Essential Steps

1. Place a double-lumen endotracheal tube.
2. Position the patient on a beanbag with shoulders at a 45° angle and the pelvis as flat as possible.
3. Perform an incision at the level of the sixth intercostal space.
4. Deepen the incision, switch to single-lung ventilation, and enter the pleural cavity.
5. Transect the pulmonary ligament, and free the lung.
6. The descending aorta below the level of the pulmonary vein was selected for an inflow. Dissect a segment of the descending aorta below the pulmonary vein, and encircle it with umbilical tape.
7. Perform bilateral vertical groin incisions overlying each common femoral artery.
8. Dissect the common femoral, and if necessary superficial femoral, and profunda femoris arteries on both sides.
9. Create a small left flank retroperitoneal incision lateral to the rectus. A lateral retroperitoneal tunnel is created with a tunneler from the chest to the left groin through the diaphragm.
10. Create a retroperitoneal tunnel to the left groin. A tunnel is created to the right groin from the left retroperitoneal space traversing the abdominal musculature to the subcutaneous plane. Tunnels are marked with umbilical tape.
11. Anticoagulate with 75–100 U/kg of intravenous heparin.
12. Clamp the thoracic aorta using a side-biting or proximal and distal clamps.
13. Create an incision in the aorta, and construct the proximal anastomosis using an appropriately sized bifurcated PTFE or Dacron graft.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_205

14. Place a Fogarty graft clamp on the distal graft, and slowly remove the aortic clamps.
15. Pass the graft through the retroperitoneal tunnel, avoiding any twists.
16. Construct the left femoral anastomosis.
17. Construct the right femoral anastomosis.
18. Reevaluate hemostasis in all anastomoses.
19. Assess the distal vessels by both palpation and Doppler exam.
20. Place a left chest tube and close left thoracotomy.
21. Close groin incisions.

Note These Variations

- *A unilateral aorto-left femoral bypass with a femorofemoral crossover bypass can be used as described in the template dictation. Alternatively, a bifurcated graft may be used as described in the essential steps. The latter will require an additional small left retroperitoneal exposure to ensure adequate retropubic tunneling, to the right groin. It will also require one less anastomosis.*
- When constructing the proximal anastomosis, a side-biting clamp is often used to control the descending thoracic aorta yet maintain distal flow into the visceral vessels. On occasion, proximal and distal control with separate clamps may be necessary.

Complications

- Graft infection
- Ureter injury
- Bleeding
- Distal embolization
- Renal failure
- Mesenteric infarction
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Bilateral lower-limb ischemia

Procedure Thoracofemoral bypass

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with bilateral symptomatic lower-extremity occlusive disease (disabling claudication, rest pain, ulceration, gangrene, or limb salvage). *The patient has had multiple failed previous aortic revascularization/hostile abdomen abdominal stoma/radiation therapy/aortic occlusion/infected aortic grafts*.

Description of Procedure The patient was placed in the supine position on a beanbag. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was connected to general anesthesia-monitoring equipment and induced with general endotracheal anesthesia. An arterial line and pulmonary artery catheter were placed. A Foley catheter was placed. A double-lumen endotracheal tube was placed.

After intubation, the patient was positioned on a beanbag with shoulders at a 45° angle toward the patient's right side. The left arm was supported on a sling anteriorly and superiorly. The pelvis was as flat as possible.

An incision was performed with a scalpel in the left chest at the level of the sixth intercostal space. The incision was taken down through the subcutaneous tissue as well as the intercostal muscles with electrocautery. Single-lung ventilation was introduced with deflation of the left lung. The pleural cavity was incised, with care taken to avoid injury to the underlying lung. A rib retractor was utilized for exposure. The lung was freed at the inferior aspect by transecting the pulmonary ligament with electrocautery.

The left lung was retracted cephalad.

The descending aorta below the level of the pulmonary vein was selected for an inflow site. The aorta was dissected from surrounding tissue and encircled with umbilical tape for proximal and distal control.

A linear vertical groin skin incision was performed overlying each common femoral artery with a scalpel. This incision was taken down through the subcutaneous tissue and the femoral sheath with electrocautery. The common femoral, superficial femoral, and profunda femoris arteries were identified and dissected from surrounding tissue. Proximal distal control was obtained with vessel loops.

A retroperitoneal tunnel was created through the diaphragm and retroperitoneum extending into the groin incision with a tunneler. In addition, a subcutaneous tunnel was performed between each groin incision with the tunneler. Appropriately sized PTFE was selected and passed through the retroperitoneal tunnel. A second PTFE graft was placed through the subcutaneous tunnel between the groin incisions. Care was taken to ensure that no twisting of the grafts occurred. The patient was heparinized with 100 U/kg of intravenous heparin.

An aortic clamp was placed on the encircled thoracic aorta proximally. A second aortic clamp was placed on the thoracic aorta distally. A linear aortotomy was performed with a scalpel between the clamps. The arteriotomy was enlarged with Potts scissors or curved Metzenbaum scissors.

The proximal PTFE graft was beveled, and an end-to-side anastomosis was performed with a *running/continuous* 3-0 monofilament nonabsorbable suture, beginning at the inferior heel of the graft. The running suture was carried up each side of the arteriotomy and completed in the middle of the arteriotomy on the operator's side. Prior to completion of the anastomosis, the aorta was back-bled proximally and distally. The aorta was then flushed with heparinized saline. The anastomosis was completed.

A Fogarty graft clamp was placed on the distal graft after it was flushed with heparinized saline. Aortic clamps were slowly removed in the usual sequence to prevent hypotension and distal embolization. All excess graft was pulled through the retroperitoneal tunnel.

Attention was now focused on the distal anastomosis. Vascular clamps were placed on the ipsilateral common femoral, superficial femoral, and profunda femoral vessels. A longitudinal arteriotomy was performed in the common femoral with a scalpel. The arteriotomy was extended with Potts scissors. The graft was cut to appropriate length and beveled in the usual manner. The graft was anastomosed to the arteriotomy in a *running/continuous* fashion with a 5-0 monofilament nonabsorbable suture.

After completion of the femoral anastomosis, a window of graft was removed from the hood of the anastomosis. The end of the femorofemoral bypass graft was beveled and anastomosed to the PTFE hood in an end-to-side manner with a *continuous/running* 5-0 monofilament nonabsorbable suture. This anastomosis was performed as distally as possible to maximize the volume flow through the long proximal limb of the bypass graft. Prior to completion of the anastomosis, all vessels were back-bled and flushed with heparinized saline. The anesthesiologist was informed of impending revascularization of each limb so that bicarbonate and extra intravenous fluids could be administered for acid washout and to prevent hypotension. Clamps were removed from the graft and the vessels in the usual sequence to prevent distal embolization. Hemostasis was assured. A Fogarty graft clamp was placed on the femorofemoral bypass PTFE graft.

Attention was now focused on the contralateral groin anastomosis. Vascular clamps were placed on the common femoral, superficial femoral, and profunda femoral vessels. A longitudinal arteriotomy was performed in the common femoral with a scalpel. The arteriotomy was extended with Potts scissors. The graft was cut to appropriate length and beveled in the usual manner. The graft was anastomosed to the arteriotomy in a *running/continuous* fashion with a 5-0 monofilament nonabsorbable suture. Prior to completion of the anastomosis, all vessels and grafts were back-bled and flushed with heparinized saline. The anastomosis was completed. The Fogarty graft clamp was removed from the PTFE graft, and vascular clamps were removed in the usual sequence.

Hemostasis of all anastomoses was assured. Distal vessels were examined by both palpation and Doppler exam and then documented. Capillary refill of each foot was examined and assured. Evaluation of distal embolization was noted.

Incisions were copiously irrigated. All instruments, lap pads, and retractors were removed. A #32 French chest tube was placed in the left chest through a stab incision in the usual manner and secured with 1-0 nylon. The chest tube was connected to a pleurovac and the lung reinflated. The chest incision was closed in layers with interrupted 1-0 Maxon to reapproximate the ribs after a rib approximator was placed. The muscle and fascia were closed in layers with *continuous/running* 2-0 Vicryl. The skin was reapproximated with a continuous 4-0 Vicryl subcuticular closure. Each groin wound was closed in two layers with *running/continuous* 2-0 Vicryl. The skin was reapproximated with a continuous 4-0 Vicryl subcuticular closure. Steristrips and sterile dressing were placed.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient awoke in the operating room, was extubated, and was taken to the *postanesthesia care unit/intensive care unit* in hemodynamically stable condition. A chest X-ray was obtained.

Aortobifemoral Bypass

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Rabih A. Houbballah and Jamal J. Hoballah

Indications

- Disabling claudication
- Ischemic rest pain
- Nonhealing ulcers
- Foot gangrene

Essential Steps

1. Bilateral groin incisions.
2. Expose the right common femoral, superficial femoral, and profunda femoris arteries and prepare them for clamping.
3. Expose the left common femoral, superficial femoral, and profunda femoris arteries, and prepare them for clamping.
4. Midline subxiphoid to suprapubic incision.
5. Abdominal exploration for unexpected findings.
6. Retract the transverse colon anteriorly and to the right.
7. Retract the splenic flexure posteriorly and laterally.
8. Divide the peritoneal periaortic attachment of the duodenum.
9. Wrap the small bowel in a wet towel and retract to the right.
10. Incise the retroperitoneum overlying the aorta and continue proximally.
11. Identify the left renal vein.
12. Dissect the aorta at the level of the left renal vein and prepare it for clamping.
13. Incise the retroperitoneum overlying the aorta, and continue distally to the level of the aortic bifurcation.
14. Create a tunnel from each common femoral artery to the aortic bifurcation, staying posterior to the ureters.
15. Anticoagulate with heparin 75–100 U/kg and wait for 5 min.
16. Apply the proximal clamp on the aorta below the renal arteries.
17. Apply the distal clamp on the aorta at the level of the inferior mesenteric artery.
18. Create a longitudinal arteriotomy measuring 2.5–3 cm.
    - *Alternative*: *Transect the aorta 2–3 cm below the infrarenal clamp*.
    - *Oversew the distal aortic end using a 3-0 Prolene running suture*.
19. Construct the proximal anastomosis and check for hemostasis.
20. Pass the right limb into the right tunnel.
21. Cross-clamp the common femoral, superficial femoral, and profunda femoris arteries.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_206

22. Create a longitudinal arteriotomy in the common femoral artery.
    - *Alternative*: *Extend the arteriotomy into the profunda femoris with possible endarterectomy*.
23. Construct the right distal anastomosis and check for hemostasis.
24. Back-bleed the femoral bifurcation and forward-flush the graft.
25. Perfuse into the lower extremity.
26. Repeat the same on the left.
27. Check sigmoid viability.
28. Reevaluate hemostasis.
29. Close the periaortic tissues.
    - *Alternative*: *Create omental flap for graft coverage*.
30. Close the abdomen.
31. Recheck distal pulses.

Note These Variations

- The femoral arteries may be exposed first, followed by the aorta, or vice versa.
- The proximal control is typically carried at the infrarenal level. If the aortic disease precludes infrarenal clamping, the aorta can be controlled at the suprarenal or supraceliac level.
- The proximal anastomosis can be performed in an end-to-end or end-to-side fashion depending on the best means to preserve pelvic perfusion and the quality of the aorta at the infrarenal level.
- In severely calcified vessels, limited endarterectomy may be necessary to conduct the proximal or distal anastomoses.
- The periaortic tissue may not be adequate to cover the graft, necessitating coverage with an omental flap.

  Inferior mesenteric artery reimplantation may be necessary if coexisting superior mesenteric artery stenosis or occlusion is present.

Complications

- Bleeding
- Myocardial infarction
- Pneumonia
- Renal failure
- Wound infection
- Wound dehiscence
- Limb ischemia
- Trash foot
- Bowel ischemia
- Buttock ischemia
- Spinal cord ischemia
- Ureteral injury
- Graft occlusion
- Anastomotic false aneurism
- Impotence
- Aortoenteric fistula
- Graft infection

Template Operative Dictation

Preoperative Diagnosis Aortoiliac occlusive disease.

Procedure (1) Aortobifemoral bypass with *20×10/18×9/16×8 PTFE/Dacron* graft and (2) endarterectomy of the right common femoral and profunda femoris arteries.

Postoperative Diagnosis Same.

Indications This is a ___-year-old *male/female* with *disabling claudication/ischemic rest pain/nonhealing ulcers/foot gangrene*. Evaluation revealed aortoiliac occlusive disease. The risks and benefits of the surgical options were discussed with the patient, and *he/she* elected to proceed with surgical intervention.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Anesthesia was placed in appropriate lines and induced and intubated the patient without complications. A Foley catheter was then placed under sterile technique. A nasogastric tube was inserted in the stomach and placed under aspiration. The patient's anterior abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

1. **Bilateral exposure of the femoral arteries**
   A vertical skin incision was started in the right groin midway between the pubic tubercle and the anterior superior iliac spine and extended for approximately 10–12 cm. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared. The same was performed on the left side. The groin wounds were then packed bilaterally with antibiotic-soaked sponges.
2. **Infrarenal aortic exposure**
   Attention was then focused on the abdominal part of the operation. A skin incision was made from the subxiphoid to the suprapubic region. The subcutaneous tissue was then divided with electrocautery. The linea alba was exposed and incised. The peritoneum was elevated and entered sharply. The abdominal wall incision was then extended to the full length of the skin incision.

   There was *no/moderate amount* of adhesions requiring lysis.

   Abdominal exploration revealed *no/the following incidental findings* (*detail*).

   The transverse colon was then elevated superiorly out of the wound, wrapped in a moist towel. A moist rolled lap pad was placed in the bed of the splenic flexure of the colon, which was retracted laterally and posteriorly. The remainder of the small bowel was then reflected to the right, exposing the infrarenal aorta. Sharp dissection of the ligament of Treitz and the distal fourth portion of the duodenum allowed further exposure of the aorta and retraction of the small bowel to the right. The small bowel was then wrapped in a moistened towel and held in place using the Omni retractor.

   The retroperitoneum overlying the aorta was incised. The incision continued proximally to the level of the left renal vein. The inferior mesenteric vein was encountered, ligated, and divided. The lymphatics overlying the aortic neck were ligated and divided.

   The infrarenal aorta was then sharply dissected for a 6-cm segment and appeared adequate for clamping.

Choose One

If infrarenal aorta is inadequate: *The infrarenal aorta appeared to be inadequate for clamping and constructing the proximal anastomosis* (*in cases of complete infrarenal aortic occlusion or if the aorta was extremely calcified*, *not allowing an area of safe clamping*). *Thus*, *further mobilization of the left renal vein was performed. The left gonadal*, *lumbar*, *and adrenal veins were ligated and divided. The left renal vein was circumferentially mobilized and retracted proximally*, *exposing the renal arteries. The left and right renal arteries were identified at their origin from the aorta and encircled with Silastic vessel loops. The suprarenal aorta was sharply dissected and appeared adequate for clamping*.

If para-/suprarenal aorta is inadequate: *The para-/suprarenal aorta was felt to be inadequate for clamping*; *the supraceliac aorta was exposed and dissected. This was performed by incising the lesser omentum, mobilizing the esophagogastric junction to the left*, *and dividing the right crus of the diaphragm*.

The dissection was then carried distally toward the aortic bifurcation. A tunnel from each common femoral artery to the aortic bifurcation was then created bluntly with the index fingers staying posterior to the ureters.

3. **Heparinization**
   The patient was given heparin 75–100 U/kg and mannitol 12.5 g intravenously. After

5 min from the heparin administration, the proximal vascular clamp was applied on the *aorta below the renal arteries/suprarenal aorta* after controlling the renal arteries with *Yasargil clamp/bulldog clamp/supraceliac aorta*. The distal vascular clamp was applied on the aorta at the level of the inferior mesenteric artery.

4. **Proximal anastomosis**

   A longitudinal arteriotomy in the anterior wall of the aorta was created measuring 2.5–3 cm.

   Alternative: *The aorta was transected 2–3 cm below the level of the renal arteries. The distal aortic end was oversewn with 3-0 Prolene sutures*; *a localized endarterectomy of the proximal stump was performed*.

   The aortic lumen was irrigated with heparinized saline solution and all debris was removed.

   A *20×10/18×9/16×8 Dacron/PTFE* graft was then soaked in antibiotic solution. The body of the graft was trimmed and tailored for the proximal anastomosis. The anastomosis was constructed in a running fashion using 3-0 Prolene sutures. At the completion of the suture line, the sutures were tied and the anastomosis checked for hemostasis. Hemostasis was *adequate/except for a suture line bleeding controlled with an interrupted mattress suture/needle-hole bleeding controlled with the topical application of Gelfoam soaked with thrombin*.

5. **Distal anastomosis**

   Attention was focused on the femoral anastomoses. The right limb of the graft was then passed in the preformed tunnel posterior to the ureter, maintaining alignment and avoiding any kinks. The common femoral, superficial femoral, and profunda femoris arteries were cross-clamped.

   A longitudinal arteriotomy in the anterior wall of the common femoral artery was created.

   (*Alternative*: *Extend arteriotomy into the profunda femoris with possible endarterectomy*.)

   The right limb of the graft was then sized and cut. The anastomosis was then performed with 5-0 Prolene running sutures. Prior to completing the anastomosis, the distal clamps were released, allowing for back-bleeding of the superficial and profunda femoris arteries. The aortic clamp was released for forward-flushing of the graft. The anastomosis was copiously irrigated with heparinized saline solution. The clamps were then released, allowing flow into the profunda femoris artery first, followed by the superficial femoral artery. There were strong Doppler signals in the right superficial femoral and profunda femoris arteries.

   Attention was then focused on the left femoral anastomosis. The left limb of the graft was passed in the preformed tunnel anterior to the left common iliac artery and posterior to the ureter. The left common femoral, superficial femoral, and profunda femoris arteries were cross-clamped. A longitudinal arteriotomy in the anterior wall of the left common femoral artery was created and extended into the profunda femoris artery. *The atherosclerotic plaque was extensive and an endarterectomy was deemed necessary. Using a Freer elevator*, *the plaque in the common femoral artery was elevated and circumferentially dissected. The plaque was transected proximally and elevated. The plaque was feathered at the distal end in the profunda femoris artery*.

   The left graft limb was then sized and cut. The left femoral anastomosis was then constructed into the profunda femoris artery with 5-0 Prolene running sutures. Prior to completing the anastomosis, the graft limb was forward-flushed, the femoral bifurcation back-bled, and the anastomosis copiously irrigated with heparin saline solution. The anastomosis was then completed and blood flow resumed into the left profunda femoris artery. The left profunda femoris artery had a strong pulse distal to the anastomosis with a strong Doppler signal.

   Reinspection of all the suture lines was performed and revealed adequate hemostasis.

   The field was then irrigated with antibiotic solution.

   The periaortic soft tissues were then sutured over the aortic graft using 3-0 Vicryl sutures.

   The periaortic tissue was inadequate to cover the aortic graft and an omental flap was deemed necessary. A tongue of omentum *based on the left omental artery was created. The flap was allowed to gently fold over the transverse colon mesentery and was placed over the aortic prosthesis. The flap was then secured in place with a running 3-0 silk suture*.

The bowel was then placed back in the anatomic position.

Abdominal wall closure was then performed with *running/interrupted* 0 Prolene sutures.

The groin wounds were then reevaluated, ensuring adequate hemostasis. The soft tissues in the groin were then closed over the graft limbs in two layers of 3-0 Vicryl. A Redon drain was left in each groin wounds. The skin edges were opposed with skin staples.

The peri-incisional prep and drape were cleaned and dried, followed by 4×4 gauze, silk tape.

The feet were inspected and appeared well perfused. There were good Doppler signals in the pedal vessels bilaterally.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

207 Endovascular Reconstruction for Aortoiliac Occlusive Disease

Susan M. Shafii and Elizabeth Hartmann

Indications

- Symptomatic aortoiliac occlusive disease
- Isolated infrarenal aortic stenosis/occlusion
- Ostial common iliac artery occlusions
- TASC C and TASC D lesions

Preoperative Imaging

- Noninvasive vascular laboratory imaging
  - Pulse volume recording
  - Ankle-brachial index
- CT angiogram of the abdomen and pelvis with bilateral lower extremity runoff. Fine cuts (1–3 mm) preferable

Anatomic Requirements

- Patent left subclavian artery
- Patent common femoral arteries or plan to perform endarterectomy

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Contraindications

- Any condition of the patient that threatens to infect the graft (active UTI, sepsis, wound infection, etc.)
- Allergy to graft materials

Essential Steps

1. Decide preoperatively if common femoral artery endarterectomy is indicated. If so, proceed with the following.
2. Prep the abdomen to bilateral knees and the left antecubital area into the surgical field.
3. Bilateral longitudinal incisions. Perform standard common femoral artery endarterectomy with patch angioplasty.
4. Restore flow into the patch.
5. Access the patch with direct-puncture starter needle and place a Benson, starter wire or stiff-angled glidewire. Then place a 5 Fr sheath. Attempt to cross the iliac lesion in a retrograde fashion in the true lumen. Dissection flap and reentry are not preferred. If unable to cross retrograde, move to the left arm.
6. Under ultrasound guidance, access the left brachial artery and place a 4 Fr sheath.
7. Cannulate the descending thoracic aorta and place your 0.035″ wire and catheter into the infrarenal aorta. Then exchange for a 4 Fr 90 cm Ansel-0 sheath.
8. Utilize the 4 Fr sheath and 4 Fr catheter of choice to cross the iliac or aortoiliac lesion in antegrade fashion.
9. Once across the lesion, confirm angiographically that in fact you are in true lumen dis-

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_207

tally. At this point, establish a thru-and-thru wire access.

10. Once thru-and-thru access is obtained, place a catheter from the groin over the wire into the normal aorta and then exchange for a Rosen wire from the groin. Withdraw the 4 Fr sheath back into the left subclavian beyond the vertebral artery origin.
11. Balloon angioplasty the occluded iliac segment with a small-diameter balloon to create a flow channel if necessary.
12. Repeat the steps for the opposite iliac as well.
13. Once both iliac artery occlusions have been crossed and true lumen is confirmed proximally and distally along the wire and predilation is complete, proceed with simultaneous common iliac stenting. The goal of stenting in endovascular aortoiliac reconstruction is to avoid raising the aortic bifurcation, and thus thought should be applied for proper choice of stents. In cases that the lesions to be treated do not extend to the ostium or into the aorta, covered balloon-expandable stents or uncovered balloon-expandable stents may be used. The size of stents is at the operators' discretion.
14. Deploy bilateral common iliac stents simultaneously, and then extend distally with self-expanding stents to healthy iliac artery. If endarterectomy was performed, extend the iliac stents to the distal external iliac artery if needed to ensure proper patency for TASC D lesions.
15. Post-dilate the overlap regions and throughout the iliac regions to ensure the stents are properly expanded.
16. Completion angiogram of the entire aortoiliac segment that was reconstructed should be performed, and ensure the femoral reconstructions are also included.
17. Remove catheters and wires and close the groin wounds after confirming hemostasis throughout the surgical beds.
18. Assess for distal pulses prior to closure.

Note This Variation

- In the presence of distal infrarenal aortic disease, large-diameter covered balloon-expandable stents may be placed in the distal aorta. Another option is to utilize the Endologix graft for the distal aortic disease and extend distally into the iliac arteries as described above.

Potential Complications

- Graft limb thrombosis
- Arterial injury (dissection, embolization, rupture)
- Renal failure
- Conversion to open procedure
- Limb ischemia
- MI

Template Operative Dictation

Preoperative Diagnoses *Left*/*Right* lower extremity critical limb ischemia and tissue loss

Postoperative Diagnoses *Left*/*Right* lower extremity critical limb ischemia and tissue loss

Procedures

1. Bilateral common femoral artery endarterectomies with bovine patch angioplasty
2. Left brachial artery ultrasound-guided access
3. Recanalization of the right common iliac artery with placement of a right common iliac artery *iCAST stent 8×59 mm and an 8×40 mm* and right external iliac artery *Epic stent 8×80 mm*
4. Recanalization of the left common iliac artery and left external iliac artery with placement of a left common iliac artery *iCAST stent 8×38 mm* and an *Epic 8×80 mm and Epic 8×60 mm* in the external iliac artery
5. Angiography and interpretation

Attending surgeon:
Assistant surgeon:

Indications This is a ___-year-old *male*/*female* who presents with a *right*/*left* ____th toe tissue loss as well as a *left*/*right* lower extremity lifestyle-limiting claudication. *He*/*She* was worked up preoperatively and found to have bilateral occlusive iliac lesions and aortoiliac lesion, and we felt that *he/she* would be a good candidate for endovascular recanalization.

Procedure The patient was consented and taken to the operating room. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was performed. The patient's abdomen, groins to knees, and left arm were prepped and draped in sterile fashion. A longitudinal incision was made in the right groin, and the inguinal ligament was mobilized medially and laterally in the usual fashion. The common femoral artery was exposed proximally and distally and the SFA as well as the profunda is encircled using a Potts loops fashion. We then turned our attention to the left groin where we also made a longitudinal incision, and again the inguinal ligament was identified and mobilized medially and laterally in the usual fashion. In addition, the common femoral artery was exposed proximally and distally and vascular control was obtained. We then heparinized the patient and performed bilateral common femoral artery endarterectomies on to the bilateral profunda. We then restored flow to the leg after the bovine pericardial patches were sewn in and hemostatic. We then used a starter needle and placed a 5 Fr sheath up the right groin. We also accessed the left groin as well; however, it appeared we were in a subintimal plane on the left side. We were in the true lumen on the right side and into the aorta. Then after an attempt at recanalizing via the retrograde approach and being subintimal on the left side, we elected to use ultrasound guidance and accessed the left brachial artery. We placed a 4 Fr sheath and cannulated the distal thoracic aorta. We passed a Rosen wire and exchanged for a long 4×90 Ansel-0 sheath into the distal abdominal aorta, cannulated the left common iliac artery, and traversed the occlusion via an antegrade approach. We confirmed we were in true lumen distally and were able to gain access into the left short 5 Fr sheath. We established a thru-and-thru wire and placed a catheter up the left femoral wire into the aorta. We removed the wire and pulled back our 4 Fr sheath and confirmed we were in the true lumen in the aorta. We then placed bilateral common iliac artery stents; on the right, we used an 8×59 mm iCAST and on the left an 8×38 mm iCAST. We took these up simultaneously taking care not to raise the aortic bifurcation. With successful placement of bilateral common iliac stents, we proceed to complete the iliac stenting distally. We placed a self-expanding Epic 8×40 mm in the right distal common iliac artery, taking care not to cover the internal iliac artery. We extended this distally into the right external iliac artery with an 8×80 mm self-expanding Epic stent. We post-dilated with a Mustang balloon. We then turned our attention to the left side where again we completed our distal iliac stenting with an 8×80 mm self-expanding Epic stent with proper overlap into the iCAST and another 8×60 mm distally through the entire external iliac artery. We performed completion imaging. We closed each puncture site using interrupted 6-0 Prolene suture after removing the sheath and wires. We then ensured hemostasis throughout both groins. The patient had palpable pulses in the feet bilaterally at completion. We closed each groin using interrupted 2-0 Vicryl, 3-0 Vicryl, and 4-0 Monocryl. Dermabond was then placed. The left brachial sheath was removed and pressure was held for 20 min. The arm was then placed in an arm board to immobilize the arm. A debriefing checklist was completed to share information critical to postoperative care of the patient. *He/She* tolerated the procedure well, was extubated, and transferred to recovery room in stable condition.

Radiographic and Interpretation Complete occlusion of the left common iliac artery and left external iliac artery with reconstitution of the left common femoral artery. The left internal iliac artery was also occluded. A short-segment occlusion of the right iliac artery with successful recanalization of bilateral iliac arteries and successful placement of iliac stenting bilaterally with brisk flow into both common femoral artery and profunda arteries as well as the SFAs. There was no extravasation noted at the completion of the case.

Retroperitoneal Aortofemoral Bypass

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Kelly S.A. Blair and Hisham Bassiouny

Indications

- Symptomatic (disabling claudication, rest pain, ulceration, gangrene, or limb salvage) aortic/aortoiliac occlusive disease
- "Shaggy" aorta with recurrent distal embolization

Essential Steps

1. The patient is positioned with the shoulders at a 45° angle toward the patient's right side and the pelvis as flat as possible.
2. Perform a left flank incision extending from two fingerbreadths above the umbilicus and starting at the lateral rectus border to the tip of the twelfth rib.
3. Divide the external and internal oblique and transverse abdominus muscles.
4. Separate and mobilize the peritoneum to the costal cartilage and to the anterior iliac spine.
5. Retract the peritoneum to the right.
6. Identify the iliopsoas muscle and ureter. Avoid stripping the transversalis fascia overlying the iliopsoas.
7. Develop a plane between the colon anteriorly and the ureter posteriorly.
8. Mobilize the colon to the right, keeping the left kidney and ureter posteriorly.
9. Identify the left renal vein and the level of the infrarenal aorta.
10. Dissect the infrarenal aorta from the renal arteries to the inferior mesenteric artery.
11. Encircle the proximal aorta with an umbilical tape.
12. Perform linear vertical groin incision overlying each common femoral artery.
13. Dissect the common femoral, superficial femoral, and profunda femoris arteries.
14. Create a retroperitoneal tunnel from the aortic bifurcation, over the iliac artery, and beneath each ureter, extending into the groin incision. Ligation and division of the inferior mesenteric artery facilitate in creating the retroperitoneal tunnel from the aorta to the right femoral arteries.
15. Pass an umbilical tape through each retroperitoneal tunnel.
16. Administer 100 U/kg of intravenous heparin.
17. Create the proximal anastomosis (end to side vs. end to end).
18. Pass each graft limb through the retroperitoneal tunnel.
19. Clamp the femoral arteries on one side and create the femoral anastomosis.
20. Repeat the same on the opposite side.
21. Reassess all anastomoses for hemostasis.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_208

22. Close abdominal and groin incisions with surgical staples. Each groin wound was closed in two layers with running/continuous 2-0 Vicryl. The skin was reapproximated.

Note These Variations

- The plane of the retroperitoneal dissection may be anterior to the kidney as described above or posterior to the kidney. In the latter situation, the kidney is mobilized and retracted anteriorly. The lumbar vein will serve to identify the level of the left renal vein and is divided to better expose the infrarenal aortic neck.
- The proximal (aortic) anastomosis may be performed using an end-to-end or end-to-side configuration.

Complications

- Graft infection
- Ureter injury
- Graft-enteric fistula
- Bleeding
- Distal embolization
- Renal failure
- Mesenteric ischemia
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Aortoiliac occlusive disease

Procedure Retroperitoneal aortofemoral bypass

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with *disabling claudication/ischemic rest pain/nonhealing ulcers/foot gangrene*. Evaluation revealed aortoiliac occlusive disease. The risks and benefits of the surgical options were discussed with the patient, and *he/she* elected to proceed with surgical intervention.

Description of Procedure The patient was placed in the supine position on a beanbag. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The patient was connected to general anesthesia monitoring equipment and induced with general endotracheal anesthesia. An arterial line and pulmonary artery catheter were placed. A Foley catheter was placed.

The patient was then repositioned with the shoulders at a 45° angle toward *his/her* right side. The left arm was supported on a sling anteriorly and superiorly. The pelvis was as flat as possible.

A left flank incision extending from two fingerbreadths above the umbilicus and starting at the lateral rectus border to the tip of the twelfth rib was performed. The external and internal oblique muscles were divided with electrocautery. The left rectus muscle was divided with electrocautery. The transversus abdominis muscle fibers were split. The peritoneum, which lies directly below the transversus abdominis muscle, was separated from the muscle laterally and from the posterior rectus sheath medially with a moist gauze. The peritoneum was mobilized superiorly to the costal cartilage and inferiorly to the anterior iliac spine.

The peritoneum was retracted to the right until the iliopsoas muscle and ureter were visualized. The plane between the colon anteriorly and the ureter posteriorly was developed. The colon was mobilized to the right. The left kidney and ureter remained posteriorly. The left renal vein was visualized as it crosses the aorta, thus identifying the level of the infrarenal aorta. An Omni retractor was utilized for exposure.

The infrarenal aorta was dissected from surrounding tissue, with Metzenbaum scissors, down to the level of the aortic bifurcation. The proximal aorta was encircled with umbilical tape for proximal control.

A linear vertical groin was performed overlying each common femoral artery with a scalpel. This incision was taken down through the subcutaneous tissue and the femoral sheath with electrocautery. The common femoral, superficial femoral, and profunda femoris arteries were identified and dissected from surrounding tissue. Proximal distal control was obtained with vessel loops.

A retroperitoneal tunnel was created by blunt finger dissection from the aortic bifurcation, over the iliac artery, extending into the groin incision. Care was taken to create the tunnel beneath each ureter. An umbilical tape was passed through each retroperitoneal tunnel.

The patient was heparinized with 100 U/kg of intravenous heparin. After the appropriately sized bifurcated graft was obtained, it was pulled through the retroperitoneal tunnels to the groin incisions. Care was taken to ensure that no twisting of the grafts occurred.

An aortic clamp was placed on the encircled infrarenal aorta proximally. A second aortic clamp *or bilateral proximal common iliac artery clamps were placed distally*. A small Bulldog clamp was placed on the inferior mesenteric artery (IMA), which was removed after the anastomosis was completed.

A linear aortotomy was performed with a scalpel above the level of the IMA and below the level of the renal arteries. The arteriotomy was enlarged with Pott's scissors or curved Metzenbaum scissors. Any loose debris or thrombus was removed from the aorta.

Posterior bleeding lumbar arteries were clipped retroperitoneally with stainless steel surgical clip (or excluded by oversewing from within the aorta with a simple interrupted suture).

A 20×*10/18×9/16×8/14×7 polyester/PTFE* graft was used. The proximal bifurcated graft was beveled, and an end-to-side anastomosis was performed with a *running/continuous* 3-0 monofilament nonabsorbable suture, beginning at the inferior heel of the graft. The running suture was carried up each side of the arteriotomy and completed in the middle of the arteriotomy on the operator's side. Prior to completion of the anastomosis, the aorta was forward- and back-bled. The aorta was then flushed with heparinized saline. The anastomosis was completed and checked for hemostasis.

Fogarty graft clamps were placed on each limb of the bifurcated graft. Aortic clamps were slowly removed in the usual sequence to prevent hypotension and distal embolization. The IMA clamp was removed. Blood was flushed through one limb of the graft and then each limb was flushed with heparinized saline and reclamped. All excess graft was pulled through the retroperitoneal tunnels.

In each groin, vascular clamps were placed on the common femoral, superficial femoral, and profunda femoris arteries. A linear arteriotomy was performed with a scalpel and enlarged with Pott's scissors. Each limb of the graft was cut to the appropriate length and then beveled in the usual manner. Each limb of the graft was anastomosed to the femoral artery with a 5-0 monofilament nonabsorbable in a *continuous/running* manner as previously described. Prior to completion of the anastomosis, all vessels were backbled and flushed with heparinized saline. The anastomosis was completed. The anesthesiologist was informed of impending revascularization of each limb *so that bicarbonate and extra intravenous fluids could be administered for acid washout and to prevent hypotension*. Clamps were removed from the graft limbs and the vessels in the usual sequence to prevent distal embolization.

Hemostasis of all anastomoses was assured. Distal vessels were examined by both palpation and Doppler exam and then documented. Capillary refill of each foot was examined and assured. Evaluation of distal embolization was noted if present.

Incisions were copiously irrigated. All instruments, lap pads, and retractors were removed. The abdominal incision was closed in layers with *running/continuous* 1-0 maxon. The skin was reapproximated with surgical staples. Each groin wound was closed in two layers with *running/continuous* 2-0 Vicryl. The skin was reapproximated with surgical staples. Sterile dressings were placed.

There were no complications.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient awoke in the operating room, was extubated, and was taken to the *postanesthesia care unit/intensive care unit* in hemodynamically stable condition with excellent *pedal signals/pulses*.

Axillobifemoral Bypass

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Kelly S.A. Blair and Hisham Bassiouny

Indications

- Disabling claudication
- Ischemic rest pain
- Nonhealing ulcers
- Foot gangrene
- Aortic graft infection
- Temporary retrograde aortic perfusion during repair of thoracoabdominal aortic aneurysms beyond the left subclavian artery

Essential Steps

1. Infraclavicular incision.
2. Incise the pectoralis muscle fascia and spread the muscle along its fibers.
3. *May retract or divide partially or completely the pectoralis minor close to its insertion*.
4. Identify the axillary vessels.
5. Mobilize the axillary vein and identify the axillary artery.
6. Circumferentially dissect the first portion of the axillary artery.
7. Bilateral groin incisions.
8. Expose the right common femoral, superficial femoral, and profunda femoris arteries and prepare them for clamping.
9. Expose the left common femoral, superficial femoral, and profunda femoris arteries and prepare them for clamping.
10. Create a tunnel from the right common femoral artery to the axillary artery along the midaxillary line starting subcutaneously in the groin and continuing on the chest wall posterior to the pectoralis major.
11. Create a subcutaneous tunnel between both groins.
12. Anticoagulate with heparin 75–100 U/kg and wait 5 min.
13. Proximal and distal control of the axillary artery.
14. Select an * mm ringed PTFE or Dacron graft or a pre-reconstructed graft with a side limb.
15. Create a 1.5–2-cm arteriotomy in the axillary artery.
16. Construct the proximal anastomosis in an end-to-side fashion at 70–90° and check for hemostasis. The arm should be in the abducted position while constructing the proximal anastomosis to avoid any tension at the anastomosis and kinking of the artery with shoulder movement.
17. Pass the graft in the axillary tunnel.
18. Cross-clamp the common femoral, superficial femoral, and profunda femoris arteries.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_209

19. Create a longitudinal arteriotomy in the common femoral artery.
    - *Alternative*: *Extend the arteriotomy into the profunda femoris with possible endarterectomy*.
20. Construct the right distal anastomosis and check for hemostasis.
21. Create a 1- to 1.2-cm incision in the hood of the *femoral anastomosis*/(*or a more proximal area in the axillofemoral graft*).
22. Construct an end-to-side anastomosis with the femorofemoral bypass.
23. Back-bleed femoral bifurcation and forward-flush the graft.
24. Perfuse into the lower extremity.
25. Pass the femorofemoral graft in its tunnel.
26. Repeat the same on the left.
27. Reevaluate hemostasis.
28. Close the incision.

Note These Variations

- The femoral arteries may be exposed first, followed by the axillary artery, or vice versa, or simultaneously using a double-team approach. In the presence of groin infection, the femoral artery is exposed through an incision lateral to the sartorius muscle.
- Numerous variations are possible for the femoral anastomoses of the axillofemoral and femorofemoral graft. The proximal anastomosis of the femorofemoral bypass can be performed in the hood of the femoral anastomosis of the axillofemoral bypass or in a more proximal segment of the axillofemoral bypass. Another alternative is to connect the femorofemoral graft directly to the femoral artery and then connect the axillofemoral artery to the hood of the femoral anastomosis of the femorofemoral graft.

Complications

- Bleeding
- Wound infection
- Wound dehiscence
- Limb ischemia
- Graft thrombosis

Template Operative Dictation

Preoperative Diagnosis Bilateral aortoiliac occlusive disease

Procedure Axillobifemoral bypass: Right axillobifemoral artery bypass with distal anastomoses to the profunda femoris bilaterally, using 8-mm ringed PTFE graft.

Postoperative Diagnosis Same.

Indications This is a ___-year-old *male/female* with *disabling claudication/ischemic rest pain/nonhealing ulcers/foot gangrene*. Evaluation revealed aortoiliac occlusive disease. The patient had significant medical comorbidities. The risks and benefits of the surgical options were discussed with the patient and *he/she* elected to proceed with surgical intervention.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under general anesthesia. The patient's right shoulder, chest, groin, and lower extremities were prepped and draped in the usual sterile fashion. A 10- to 12-cm transverse incision a finger breadth inferior and parallel to the right clavicle was performed and deepened through the subcutaneous tissues. The pectoralis major fascia was identified and incised. The incision was deepened through the pectoralis major bluntly by separating the muscle along its fibers. The underlying pectoral fat was incised, exposing the axillary vessels. A short segment of the axillary vein was mobilized and its tributaries were ligated and divided to expose the axillary artery. The first portion of the axillary artery just medial to the pectoralis minor was identified and encircled with a silastic vessel loop. A 3- to 4-cm segment of the axillary artery was circumferentially dissected. *The pectoralis minor muscle was partially/completely divided close to its insertion to facilitate the exposure*.

A vertical skin incision was then performed overlying the right common femoral artery. The incision was deepened through the subcutaneous tissue. Encountered venous and lymphatic tributaries were ligated and divided. The common femoral, superficial femoral, and profunda femoris arteries were dissected. The same was performed on the opposite side. A tunnel from the right groin to the infraclavicular incision along the anterior axillary line was made. This tunnel was subcutaneous except for its upper part, where it coursed posterior to the pectoralis major and anterior to the chest wall. A subcutaneous tunnel was then performed between the two groin incisions. Intravenous heparin at 75 U/kg was then administered. An 8-mm ringed PTFE graft was then passed through the axillary tunnel. Vascular clamps were applied on the axillary artery and a 1-cm arteriotomy was created. The end of the PTFE graft was spatulated to match the arteriotomy. An end-to-side anastomosis was then constructed with a 5-0 Prolene suture. At the completion of the anastomosis, forward-flushing and back-bleeding of the axillary artery were performed. The anastomosis was checked for hemostasis, which was adequate.

Attention was then directed to the right groin. The common femoral, superficial femoral, and profunda femoral arteries were controlled. A 1- to 1.5-cm arteriotomy was started in the common femoral and extended into the *profunda femoris/superficial femoral artery*. The distal end of the graft was measured to appropriate length and transected obliquely to match the arteriotomy. An end-to-side anastomosis was then performed between the PTFE graft and the arteriotomy using 5-0 Prolene sutures. A 1-cm arteriotomy was then performed in the hood of the femoral anastomosis. Another 8-mm ringed PTFE graft was then used to construct the femorofemoral bypass. The end of the graft was spatulated and then sutured with *5-0/6-0* Prolene to the incision in the axillofemoral graft. At the completion of the anastomosis, the graft was forward-flushed and the femoral vessels were allowed to back-bleed. The anastomosis was irrigated with heparinized saline and the sutures were tied. The suture lines were then inspected for hemostasis, which was adequate except for needle hole bleeding controlled by Gelfoam soaked with thrombin. The femorofemoral graft was then passed in its tunnel. The left common femoral, superficial femoral, and profunda femoral arteries were controlled. A 1- to 1.5-cm arteriotomy was started in the common femoral and extended into the *profunda femoris/superficial femoral artery*. The distal end of the graft was measured to appropriate length and transected obliquely to match the arteriotomy. An end-to-side anastomosis was then performed between the PTFE graft and the arteriotomy using 5-0 Prolene sutures. At the completion of the anastomosis, the graft was forward-flushed and the femoral vessels were allowed to back-bleed. The anastomosis was irrigated with heparinized saline and the sutures were tied. The suture lines were then inspected for hemostasis, which was adequate.

The patient had good continuous Doppler signals in both profunda femoris arteries as well as the pedal vessels. All the wounds were irrigated with antibiotic solution. Hemostasis was secured. In the right subclavicular incision, the subcutaneous layers were reapproximated with a running 3-0 Vicryl suture and the skin was closed with staples. The investing femoral fascia and the subcutaneous layers were closed with running 3-0 Vicryl sutures and the skin was closed with staples. Dressings were applied. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was awakened in the operating room and taken to the postanesthesia care unit in stable condition.

Iliofemoral Bypass

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Munier M.S. Nazzal

Indications

- Disabling claudication
- Ischemic rest pain
- Nonhealing ulcers
- Foot gangrene with unilateral iliac occlusive disease, in the presence of normal or near-normal aorta and proximal common iliac artery

Essential Steps

1. Incise the skin and subcutaneous tissue to expose the common femoral, superficial femoral, and profunda femoris arteries.
2. Incise the skin and external oblique muscle over the lower quadrant of the abdomen.
3. Divide the internal oblique and transverse muscles.
4. Develop retroperitoneal space and expose the iliac vessels to the bifurcation.
5. Develop a tunnel between the common iliac artery and common femoral artery.
6. Anticoagulate with heparin.
7. Pass synthetic graft, 8 mm.
8. Perform proximal anastomosis.
9. Perform distal anastomosis.
10. Assess the retroperitoneum and groin for bleeding.
11. Close both wounds.

Note These Variations

- May start with the iliac exposure, followed by the femoral exposure, or vice versa.
- The proximal iliac anastomosis may be performed using an end-to-side or end-to-end configuration depending on the status of the artery and the need to maintain hypogastric flow.

Complications

- Retroperitoneal hematoma
- Distal embolization
- Thrombosis
- Wound infection

Template Operative Dictation

Preoperative Diagnosis *Right/left* leg claudication with iliac artery occlusion

Procedure *Right/left* iliofemoral bypass with PTFE/Dacron 8-mm graft.

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_210

Indications This is a ___-year-old *male/female* presenting with claudication. Evaluation (*angiography/MRA/*___) revealed occlusion of the *right/left* iliac arteries with reconstitution of the *common femoral/profunda/superficial femoral artery*.

Description of Procedure The patient was placed in a supine position. Time-out was performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general/epidural/spinal* anesthesia. The abdomen, both groins, and lower extremities were prepped and draped.

A vertical skin incision was made over the *right/left* groin. The subcutaneous tissues were incised and encountered lymphatics were ligated and divided. The common femoral, superficial femoral, and profunda femoral arteries were dissected and isolated with Silastic vessel loops.

A curvilinear incision was made in the *right/left* lower quadrant of the abdomen. The external oblique aponeurosis was incised in the direction of its fibers. The tendinous part of the internal oblique muscle and transversus abdominis muscle was incised.

The retroperitoneum was exposed and retracted with the assistance of a self-retaining retractor.

The proximal common iliac artery was dissected and encircled with Silastic tapes. A 1-in. segment of the artery was cleared of the surrounding tissue.

A tunnel was constructed deep to the inguinal ligament between the retroperitoneal space and the groin incision.

An 8-mm *PTFE/Dacron* graft was tunneled between the incisions.

Intravenous heparin 70–100 U/kg was administered to the patient, and after 3–5 min, a vascular clamp was applied to each end of the dissected segment of the common iliac artery.

A 1.0–1.5-cm arteriotomy was created in the common iliac artery. An anastomosis was constructed between the end of the graft and the side of the common iliac artery using *4-0/5-0* Prolene.

A clamp was applied to the graft, followed by removal of the common iliac artery clamps.

Clamps were applied to the common femoral, profunda femoris, and superficial femoral arteries.

A longitudinal arteriotomy was made in the common femoral artery and *extended into the profunda femoris/superficial femoral artery*.

An anastomosis was constructed between the end of the graft and the side of the common femoral artery using 5-0 Prolene.

Before completing the anastomosis, the lumen was flushed with heparinized saline, and forward bleeding and back bleeding were allowed from all arteries.

The anastomosis was completed and blood was allowed to flow in the graft and the distal vessels.

Blood flow in the superficial femoral and profunda femoris arteries was checked by both palpation and Doppler probe.

Hemostasis was secured in both wounds.

The retroperitoneal wound was closed in layers, with the first layer using Vicryl 0 to close the transverse and internal oblique muscles in *interrupted/continuous* fashion. The second layer used Vicryl 0 to close the *external oblique muscle/aponeurosis* in *interrupted/continuous* fashion.

The skin was closed with staples. The groin was closed in three layers: the first layer with 3-0 Vicryl for the fascia, the second layer with 3-0 Vicryl for the subcutaneous tissue, and the skin with staples. Dressings were applied.

Pulse and Doppler flow were checked in the arteries distally. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was awakened and taken to the postanesthesia care unit in stable condition.

211 Femorofemoral Bypass

Munier M.S. Nazzal

Indications

- Ischemia of the lower extremity
- Disabling claudication
- Ischemic rest pain
- Nonhealing ulcers
- Foot gangrene with unilateral stenotic/obstructive lesion of the iliac artery not amenable to endovascular procedures
- Occlusion of a limb of an aortobifemoral bypass that could not be opened by thrombectomy or thrombolysis

Essential Steps

1. Incision of the skin over both groins.
2. Dissection of the common femoral, superficial femoral, and profunda femoris arteries bilaterally.
3. Creation of a tunnel between both groin incisions.
4. Passing a PTFE graft (preferably reinforced with rings) in the tunnel.
5. Anticoagulate with heparin.
6. Clamping of the common, profunda, and superficial femoral arteries.
7. Arteriotomy in the donor common femoral artery made obliquely toward the profunda femoris artery.
8. Performance of the anastomosis in the donor femoral artery.
9. Back bleeding of the profunda and superficial femoral arteries bilaterally.
10. Repeat the same on the opposite limb.
11. Femoral endarterectomy and profundoplasty may be necessary.
12. Resume flow to the lower extremity.
13. Secure hemostasis.
14. Close the wound.

Note These Variations

- The femorofemoral bypass is usually constructed using a C configuration. In the presence of severe calcifications in the donor femoral artery, a lazy S configuration may be used. In this configuration, the proximal anastomosis is performed as proximal as possible after starting at the junction with the external iliac artery. Alternatively, a localized endarterectomy of the femoral artery may be necessary.
- In the presence of occlusive disease in the donor iliac vessel, an intraoperative angioplasty/stenting of the stenotic pathology can be combined with the femorofemoral bypass.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_211

Complications

- Infections
- Bleeding
- Hematoma
- Steal syndrome of the donor leg

Template Operative Dictation

Preoperative Diagnosis Ischemia of the *right/left* lower extremity

Procedure Femorofemoral bypass with reinforced PTFE graft

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who presents with ischemia of the *right/left* lower extremity. The patient was found to have occlusion of the *right/left* common iliac artery. The contralateral iliac artery and common femoral artery were normal without any evidence of stenosis.

Description of Procedure The patient was placed in a supine position. Time-out was performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *general endotracheal/spinal/epidural/local* anesthesia. Both lower extremities were prepped and draped in a standard surgical fashion.

A vertical incision was made over the *right/left* femoral artery. Fascia and lymphatic tissue were bisected. The *common femoral/superficial femoral/profunda femoris* arteries were dissected and isolated with Silastic vessel loops.

A tunnel was created subcutaneously between both groin incisions. The *PTFE/ring-enforced PTFE/Dacron* graft was passed in the tunnel.

The patient was given 5,000 U of heparin intravenously. Five minutes after heparin administration, the common femoral, profunda femoris, and superficial femoral arteries were clamped on the donor side using vascular clamps.

An arteriotomy was performed in the common femoral artery obliquely toward the profunda femoris artery using a #11 blade scalpel and extended using Potts scissors. The end of the graft was fashioned to fit the arteriotomy. An anastomosis was constructed between the end of the graft and the side of the femoral artery using 5-0 prolene in a continuous fashion. Before completing the anastomosis, the lumen was irrigated. An atraumatic vascular clamp was applied to the graft, and the profunda femoris and superficial femoral arteries were allowed to back-bleed. The common femoral artery was allowed to forward-bleed. The anastomosis was completed and blood was allowed to flow into the donor leg.

The recipient femoral artery was prepped in the same fashion as the donor side. An arteriotomy was made in the common femoral artery *and extended toward the profunda femoris artery.* Anastomosis was constructed between the end of the graft and the side of the common femoral artery in a similar fashion. Blood was allowed to back-bleed from the profunda femoris and superficial femoral arteries, and the graft was allowed to forward-bleed. The lumen was irrigated and the anastomosis was completed.

Blood flow in the superficial femoral and profunda femoris arteries was checked by both palpation and Doppler probe.

Hemostasis was secured in both groins.

Both groins were closed in three layers: the first layer with 3-0 Vicryl for closing the fascia, the second layer with 3-0 Vicryl for closing the subcutaneous tissue, and the skin with staples.

Pulse was checked in both donor and recipient legs postoperatively.

Dressing was applied to both groins. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was awakened, the lower extremities were noted for the presence of pulsations by Doppler/palpation, and the patient was taken to the postanesthesia care unit in stable condition.

212 Iliac Artery Angioplasty and Stenting

F. Ezequiel Parodi and Murray L. Shames

Indication

- Short (<5 cm) stenosis or occlusion of the iliac artery with symptoms (claudication, rest pain, nonhealing ulcer, and gangrene)

Note These Variations

- The sheath size will vary depending on the stent and balloon used.
- Predilation of the lesion may be performed.

Essential Steps

1. Percutaneous or open access of the common femoral artery on the affected side.
2. Control access with 5-French sheath.
3. Anticoagulate with IV heparin sulfate (5,000 U).
4. Place guide wires through the lesion into the abdominal aorta under fluoroscopic guidance.
5. Perform diagnostic aortogram with femoral runoff.
6. Measure gradient across the lesion (optional).
7. Measure length and degree of the stenotic lesion using DSA.
8. Dilate with appropriately sized balloon.
9. Deploy stent across the lesion.
10. Remeasure gradient and completion angiogram to evaluate for residual stenosis and potential complications.

Complications

- Artery dissection
- Artery rupture with hemorrhage
- Embolization
- Thrombosis

Template Operative Dictation

Preoperative Diagnosis Claudication (or other symptoms) secondary to iliac artery stenosis

Procedure Iliac angioplasty and stent placement

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with lifestyle-limiting claudication (or other symptoms of peripheral arterial occlusive disease (PUD)) with diminished *right/left* femoral pulse. Preoperative duplex evaluation is consistent with *right/left* iliac stenosis. The patient has been informed of the risks and benefits of angiography and balloon angioplasty

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_212

and stenting of the iliac vessels and has agreed to the procedure.

Description of Procedure The patient was brought to the operating room and positioned on the operating table in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Prophylactic antibiotics were administered by the anesthesiologist if required. The *right/left* groin was shaved, prepped with povidone-iodine solution, and draped in the usual fashion. *Local/regional* anesthetic (*1% lidocaine/0.25% bupivacaine*) was infiltrated in the region of the common femoral artery. A small cut was made in the skin overlying the common femoral artery. The Seldinger needle was inserted into the common femoral artery and a guide wire advanced into the iliac artery under fluoroscopic guidance. A short 5- to 7-French sheath was then placed over the wire. An angiogram was performed through the sheath and the stenosis identified. The stenosis was then crossed with a *Glide/Bentson* guide wire and guiding catheters. An aortogram with runoff was performed. Using the images from the angiogram, the length and diameter of the stenotic iliac artery were measured. Intravenous heparin sulfate (5,000 U) was administered by the anesthesiologist. A ___-mm angioplasty balloon was then passed over the wire and centered across the lesion. The lesion was dilated while observing the vessel with fluoroscopy. An angiogram was performed through the femoral sheath; there was no evidence of dissection or vessel rupture. A ___-mm *self-expandable/balloon-expandable* stent was then placed over the wire and advanced across the lesion. The stent was deployed without difficulty. Angiography was performed with contrast, and no residual stenosis, dissection, or thrombus was noted. All balloons, catheters, sheaths, and wires were then removed. Manual compression of the common femoral artery was performed for 10–15 min for hemostasis. A strong ipsilateral femoral pulse was noted at the completion of the procedure. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Radiology Supervision and Interpretation

1. ***Aortogram with runoff***: *Patent distal aorta with high-grade stenosis of the common/external iliac artery on the right/left*.
2. ***Angiogram postangioplasty and stent***: *Stent placed in right/left common/external iliac artery*, *brisk flow*, *no residual stenosis*.

Part XIX

Vascular Surgery: Infrainguinal Occlusive Disease

Femoropopliteal Bypass with PTFE Graft

213

Jamal J. Hoballah

Indications

- Tissue loss
- Gangrene
- Rest pain
- Disabling claudication

Essential Steps

1. Expose the popliteal artery.
2. Expose the inflow femoral vessels.
3. Create graft tunnel.
4. Construct the proximal anastomosis.
5. Check for hemostasis.
6. Pass graft through tunnel.
7. Construct the distal anastomosis.
8. Completion angiogram.
9. Wound closure.
10. Pulse reevaluation.

Note These Variations

- Endovascular treatment (angioplasty/stenting/recanalization) is often attempted as a first revascularization option.
- The graft can be tunneled in various ways, most commonly in a subsartorial tunnel to the above-knee popliteal level and then anatomic between the heads of the gastrocnemius muscle for the below-knee popliteal level.

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Complications

- Bleeding
- Gangrene
- Thrombosis of graft
- Infection
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left* leg *disabling claudication*, *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Procedure *Right/left* common femoral artery to above-knee popliteal artery PTFE bypass; completion intraoperative arteriogram.

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female* with *right/left* leg disabling

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_213

claudication, *right/left* foot rest pain, *right/left foot/toe ulcerations/gangrene*.

Preoperative evaluation revealed infrainguinal occlusive disease with reconstitution of the *suprageniculate/infrageniculate* popliteal artery with good tibial runoff. Endovascular revascularization was not deemed appropriate.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines, and *regional/general* anesthesia was induced. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

Choose One

If above-knee popliteal artery: A 10- to 12-cm longitudinal skin incision was performed on the medial aspect of the thigh along the anticipated anterior border of the sartorius muscle. The skin incision was deepened through the subcutaneous tissue, exposing the adductor tendon anteriorly and the sartorius muscle posteriorly. The fascia between these two muscles was incised and the popliteal fossa entered. A self-retaining retractor was placed deeper in the wound and the popliteal artery was palpated and exposed. A 2-cm segment of the popliteal artery was sharply dissected. Attention was then directed to the groin.

If below-knee popliteal artery: A 10- to 12-cm longitudinal skin incision was performed 1–2 cm posteromedial and parallel to the tibia. The incision was deepened through the subcutaneous tissue, exposing the fascia. Attention was made to avoid injuring the great saphenous vein. The fascia was incised and the popliteal space was entered. A self-retaining retractor was applied, retracting the gastrocnemius muscle posteriorly and laterally. The tendons of the semimembranosus and semitendinosus muscles were divided to further facilitate the exposure. The popliteal vessels were identified. A 2-cm segment of the popliteal artery was sharply dissected. Attention was then directed to the groin.

A vertical curvilinear skin incision overlying the right common femoral artery pulse was made. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared.

If above-knee popliteal bypass: A *subfascial/subsartorial* tunnel was then created using a *Zepplin/Kelly weck/Gortex tunneler*.

If below-knee popliteal bypass: A 5-cm longitudinal skin incision was performed on the medial aspect of the thigh along the anticipated anterior border of the sartorius muscle. The skin incision was deepened through the subcutaneous tissue, exposing the adductor tendon anteriorly and the sartorius muscle posteriorly. The fascia between these two muscles was incised and the above-knee popliteal fossa entered. The tunnel was created bluntly between the heads of the gastrocnemius muscle connecting the infrageniculate popliteal space with the suprageniculate popliteal space. *A subsartorial/subfascial tunnel* was then created between the suprageniculate popliteal space and the inguinal incision using a *Zepplin/Kelly weck/Gortex tunneler*.

The patient was given 5,000 U of heparin intravenously, and after 5 min elapsed, the common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. A PTFE graft 6/8 mm with rings was used and its end was fashioned to match the femoral arteriotomy. The proximal anastomosis was constructed between the PTFE graft and the femoral arteriotomy with a running *5-0/6-0 prolene/Gortex* suture. Prior to completing the suture line, back bleeding of the popliteal artery, forward flushing of the graft, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was *adequate/revealed needle hole bleeding. This was controlled with the application of Gelfoam soaked with thrombin*. The PTFE graft was then passed distended through the tunnel, avoiding any twists.

Atraumatic *vascular clamps/Bulldog clamps/Yasargil clips* were placed proximally and distally on the dissected popliteal artery. A 1-cm arteriotomy was then created in the anterior wall of the popliteal artery.

The PTFE graft was transected at the appropriate length. The transected end was incised along its posterior aspect, spatulating the vein. The distal anastomosis to the popliteal artery was constructed with a running *5-0/6-0* prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. A 20-gauge angiocatheter was then introduced into the PTFE graft near the proximal anastomosis, and an intraoperative arteriogram was performed. This revealed a widely patent anastomosis and no evidence of filling defects or kinks. The angiocatheter was removed and its puncture site repaired with a 6-0 prolene suture. The suture lines and the wounds were then rechecked for hemostasis. There was good *Doppler signal/palpable pulses* in the foot and a good augmentation of the signal with compressing and releasing the PTFE graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the sartorius muscle was approximated with 3-0 Vicryl sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

214 Femoral Posterior Tibial Bypass with PTFE Graft and Adjunctive AV Fistula

Mohammad Rachad Wehbe and Jamal J. Hoballah

Indications

Tissue loss
Gangrene

Essential Steps

1. Expose the target tibial artery.
2. Mobilize 4–5 cm of the larger accompanying tibial vein extending 1 cm distal to the targeted anastomotic site.
3. Expose the inflow femoral vessels.
4. Create a tunnel between the proximal and distal vessels.
5. Pass graft through the tunnel.
6. Anticoagulate.
7. Construct the proximal anastomosis.
8. Transect the accompanying tibial vein 1 cm distal to the proposed anastomotic site.
9. Construct an end-of-vein to side-of-artery anastomosis.
10. Construct an anastomosis between the prosthetic graft and the hood of the vein.
11. Completion angiogram.
12. Wound closure.
13. Pulse reevaluation.

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Note These Variations

Endovascular recannalization is often attempted before offering a prosthetic bypass to the tibial vessels.

Grafts to the posterior tibial artery may be tunneled in various ways, including subcutaneous (rarely used with prosthetic grafts), subfascial, or anatomic tunnels.

Control of the target vessels can be achieved in various ways, such as tourniquet, internal occluders, Silastic vessel loops, vascular clamps, or Yasargil clips.

Complications

Bleeding
Gangrene
Infection
Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Procedure *Right/left* common femoral artery to posterior tibial artery bypass with PTFE using adjunctive AV fistula.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_214

Postoperative Diagnosis Same

Indications The patient is a _-year-old *male/female* with *right/left foot/toe ulcerations/gangrene*.

Preoperative evaluation revealed infrainguinal occlusive disease with reconstitution of the posterior tibial artery in the *proximal mid-/distal leg*.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Procedure: The patient was placed supine on the operating table with the arms tucked in. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines and *regional/general* anesthesia was induced. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision. A 10- to 12-cm vertical skin incision was performed on the medial aspect of the leg, 2 cm posteromedial and parallel to the tibia. The skin incision was deepened through the subcutaneous tissue until the fascia was identified. The fascia was incised, exposing the soleus muscle. The soleus muscle was incised along its attachment down to its posterior deep fascia. This fascia was incised, exposing the posterior tibial and flexor muscles. Gentle dissection between these two muscles was performed, and a self-retaining retractor was placed deeper in the wound, exposing the posterior tibial artery and veins. A 2-cm segment of the posterior tibial artery was sharply dissected. A 5-cm segment of the larger accompanying tibial vein was dissected. Crossing venae comitantes were ligated and divided. Attention was then directed to the groin. A vertical curvilinear skin incision overlying the right common femoral artery was made extending down the upper medial thigh. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared.

A tunnel was then created using a *Zepplin/Kelly weck/Gortex tunneler*.

The tunnel was subfascial along the medial aspect of the thigh and knee. The tunnel was subfascial/subsartorial along the medial aspect of the thigh and then anatomic at the knee level passing between both heads of the gastrocnemius muscle. Below the knee the tunnel was posterior to the soleus muscle.

The patient was given 5,000 U of heparin intravenously. The common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. A PTFE graft was beveled to match the size of the arteriotomy. The proximal anastomosis was constructed between the PTFE and the femoral arteriotomy with a running 5-0/6-0 Prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. The flow through the PTFE graft was checked and was pulsatile. The graft was clamped proximally and then passed through the tunnel avoiding any twists.

Choose One

If tourniquet control: *A tourniquet was placed above the knee, and an Esmarch rubber bandage was applied to the foot and wrapped proximally to exsanguinate the leg. The tourniquet was then inflated to 250–350 mmHg*.

If internal occluder: *A 1-cm arteriotomy was then created in the anterior wall of the posterior tibial artery. A 2.0-/2.25-/2.50-mm internal occluder (flowrestor) was introduced into the lumen to achieve proximal and distal control*.

If loops or clamps: *Proximal and distal control of the posterior tibial artery was then performed using vessel loops/vascular clamps/Bulldog clamp. A 1-cm arteriotomy was then created in the anterior wall of the posterior tibial artery*.

Adjunctive AV fistula: *The larger accompanying tibial vein that was dissected at the level of the posterior tibial artery was ligated and transected as distally as possible. Then the posterior wall of the transected vein was incised to match the size of the arteriotomy. The arteriovenous anastomosis was done using the parachute technique. Prior to completing the suture line*, *back bleeding*, *forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis which was adequate*.

This was followed by a 1–1.5-cm venotomy. The distal part of the PTFE graft was transected in a beveled fashion to match the size of the venotomy. An end-to-side anastomosis with 7-0 Prolene was performed between the PTFE graft and the arteriovenous fistula.

Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed.

The anastomosis was then completed and checked for hemostasis, which was adequate. The suture lines and wounds were then rechecked for hemostasis. There was a good Doppler signal in the foot at the posterior tibial artery level and a good augmentation of the signal with compressing and releasing the PTFE graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the distal part of the soleus muscle was approximated with 3-0 Vicryl sutures. The skin was closed with staples. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Femoroposterior Tibial Bypass with Reversed Greater Saphenous Vein

215

Rabih A. Houbballah and Jamal J. Hoballah

Indications

- Tissue loss
- Gangrene
- Rest pain
- Disabling claudication

Essential Steps

1. Expose the target tibial vessel.
2. Expose the inflow femoral vessels.
3. Harvest the greater saphenous vein.
4. Create graft tunnel.
5. Heparinize the patient with one bolus of 50 units/kg.
6. Reverse the vein.
7. Construct the proximal anastomosis.
8. Check for hemostasis.
9. Mark the vein with methylene blue to avoid twist.
10. Pass graft through the tunnel.
11. Check for twist and kink.
12. Construct the distal anastomosis.
13. Completion angiogram.
14. Wound closure.
15. Pulse reevaluation.

Note These Variations

- Endovascular recannalization is often attempted prior to offering a tibial bypass.
  Grafts to the posterior tibial artery may be tunneled in various ways, including subcutaneous, subfascial, or anatomic tunnels.
- Control of the target vessels can be achieved in various ways, such as tourniquet, internal occluders, Silastic vessel loops, vascular clamps, or Yasargil clips.

Complications

- Bleeding
- Gangrene
- Thrombosis of graft
- Infection
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left foot rest pain, right/left foot/toe ulcerations/gangrene*.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_215

Procedure *Right/left* common femoral artery to posterior tibial artery vein bypass with reversed right greater saphenous vein; completion intraoperative arteriogram.

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female* with *right/left foot rest pain, right/left foot/toe ulcerations/gangrene*.

Preoperative evaluation revealed infrainguinal occlusive disease with reconstitution of the posterior tibial artery in the *proximal/mid/distal* leg. Duplex mapping of the right leg revealed a good saphenous vein which was marked.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines and *regional/general* anesthesia was induced. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

1. **Exposure of the posterior tibial artery**
   A 10- to 12-cm vertical skin incision was performed on the medial aspect of the leg, 2 cm posteromedial and parallel to the tibia. The incision was located directly over the saphenous vein. The skin incision was deepened through the subcutaneous tissue, and the saphenous vein was carefully reflected posteriorly. The deep muscular fascia was incised, exposing the medial head of gastrocnemius muscle which is reclined posteriorly. The soleus muscle is then exposed and incised along its attachment down to its posterior deep fascia. This fascia was incised, exposing the posterior tibial and flexor muscles. Gentle dissection between these two muscles was performed, and a self-retaining retractor was placed deeper in the wound, exposing the posterior tibial artery and veins. The artery is palpated to assess the feasibility of the distal anastomosis. A 2-cm segment of the posterior tibial artery was sharply dissected. Crossing venae comitantes were ligated and divided.

2. **Exposure of the common femoral artery**
   A vertical curvilinear skin incision overlying the right common femoral artery was made extending down the upper medial thigh along the preoperatively mapped greater saphenous vein. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared. The greater saphenous vein was then identified. The vein was exposed from the saphenofemoral junction to the *mid/lower* leg through one *continuous incision/multiple incisions separated by skin bridges*. Dextran–heparin–papaverine solution was infused into the saphenous vein through a blunt needle that was placed in a side branch in the most distal aspect of the vein. The saphenous vein was harvested and its tributaries ligated with *3-0/4-0* silk ties.

3. **Creation of the tunnel**
   A tunnel was then created using a *Zepplin/Kelly weck/Gortex tunneler*.

   The tunnel was subcutaneous parallel to the course of the saphenous vein to the level of the exposed posterior tibial artery.

   The tunnel was subfascial along the medial aspect of the thigh and knee.

   The tunnel was subfascial/subsartorial along the medial aspect of the thigh and then *anatomic at the knee level passing between both heads of the gastrocnemius muscle. Below the knee the tunnel was posterior to the soleus muscle.*

4. **Anticoagulation**
   The patient was given 50 UI/Kg of heparin intravenously. The saphenous vein was transected at the saphenofemoral junction and its stump suture ligated with 2-0 silk sutures. The distal end was double ligated and transected.

5. **Proximal anastomosis**
   The common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. The vein was then reversed, and its distal end was incised along its posterior wall/*incorporating a side branch, creating a T-junction shape*. The proximal anastomosis was constructed between the spatulated vein and the femoral arteriotomy with a running *5-0/6-0* prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. The flow through the vein was checked and was pulsatile. The end of the vein was ligated with a 2-0 silk tie. The vein was rechecked for hemostasis. The vein was marked with methylene blue and then passed distended through the tunnel, avoiding any twists.

6. **Distal anastomosis**
   A tourniquet was placed above the knee, and an Esmarch rubber bandage was applied to the foot and wrapped proximally to exsanguinate the leg. The tourniquet was then inflated to 350 mmHg.

Choose One

If internal occluder**:** *A 1-cm arteriotomy was then created in the anterior wall of the posterior tibial artery. A 2.0-/2.25-/2.50-mm internal occluder (flowrestor) was introduced into the lumen to achieve proximal and distal control.*

If loops or clamps**:** *Proximal and distal control of the posterior tibial artery was then performed using vessel loops/vascular clamps/Bulldog clamp. A 1-cm arteriotomy was then created in the anterior wall of the posterior tibial artery.*

The vein was transected at the appropriate length and was incised along its posterior aspect, spatulating the vein. The distal anastomosis to the posterior tibial artery was constructed with a running 7-0 prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate.

7. **Completion angiogram**
   A 20-gauge angiocatheter was then introduced into a side branch in the vein near the proximal anastomosis, and an intraoperative arteriogram was performed. The angiogram revealed a widely patent anastomosis and no evidence of filling defects or kinks. The angiocatheter was removed and its puncture site repaired with a 6-0 prolene suture.

8. **Closure**
   The suture lines and wounds were then rechecked for hemostasis. There was good Doppler signal in the foot at the posterior tibial artery level and a good augmentation of the signal with compressing and releasing the vein graft. The wounds were all irrigated with antibiotic solution and a Redon drain was left in each wound. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the distal part of the soleus muscle was approximated with 3-0 Vicryl sutures. The skin was closed with staples.

   A debriefing checklist was completed to share information critical to postoperative care of the patient.

   The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

216 Femoroanterior Tibial Bypass with Nonreversed Greater Saphenous Vein

Sung Woon Chung and Jamal J. Hoballah

Indications

- Tissue loss
- Gangrene
- Rest pain
- Disabling claudication

Essential Steps

1. Expose the target tibial vessel.
2. Expose the inflow femoral vessels.
3. Harvest the greater saphenous vein.
4. Create graft tunnel.
5. Construct the proximal anastomosis.
6. Incise the valves.
7. Check for hemostasis.
8. Pass graft through the tunnel.
9. Construct the distal anastomosis.
10. Completion angiogram.
11. Wound closure.
12. Pulse reevaluation.

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Note These Variations

- Tibial bypass are very rarely performed for intermittent claudication.
- Endovascular recanalization may be attempted first prior to creating a bypass.
- Grafts to the anterior tibial artery may be tunneled in various ways, including subcutaneous, subfascial, or anatomic tunnels. These grafts typically originate in the medial aspect of the groin. They cross to the lateral aspect of the extremity in the thigh or below the knee. Below the knee, they may cross anterior to the tibia subcutaneously or posterior to the tibia through the interosseous membrane.
- Control of the target vessels can be achieved in various ways, such as tourniquet, internal occluders, Silastic vessel loops, vascular clamps, or Yasargil clips.
- Various valvulotomes may be used to incise the valves.

Complications

- Bleeding
- Gangrene
- Thrombosis of graft
- Infection
- Myocardial infarction

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_216

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left leg disabling claudication*, *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Procedure *Right/left* common femoral artery to anterior tibial artery vein bypass with nonreversed right greater saphenous vein; completion intraoperative arteriogram.

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female* with *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*. Endovascular recanalization was not possible/ deemed appropriate.

Preoperative evaluation revealed infrainguinal occlusive disease with reconstitution of the anterior tibial artery in the *proximal/mid/distal* leg.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines, and *regional/general* anesthesia was induced. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

A 10- to 12-cm vertical skin incision was performed 2 cm lateral and parallel to the tibia. The skin incision was deepened through the subcutaneous tissue until the fascia was identified. The fascia was incised, exposing the tibialis anterior and extensor hallucis muscles. Gentle blunt dissection between these two muscles was performed, and a self-retaining retractor was placed deeper in the wound, exposing the anterior tibial artery and veins. A 2-cm segment of the anterior tibial artery was sharply dissected. Crossing venae comitantes were ligated and divided.

Attention was then directed to the groin. A *vertical/curvilinear* skin incision overlying the right common femoral artery was made extending down the upper medial thigh along the preoperatively mapped greater saphenous vein. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared. The greater saphenous vein was then identified. The vein was exposed from the saphenofemoral junction to the *mid/lower* leg through *one continuous incision/multiple incisions separated by skin bridges*. Dextran–heparin–papaverine solution was infused into the saphenous vein through a blunt needle that was placed in a side branch in the most distal aspect of the vein. The saphenous vein was harvested and its tributaries ligated with *3-0/4-0* silk ties.

A tunnel was then created using a *Zepplin/Kelly weck/Gortex tunneler*.

The tunnel was subcutaneous, *crossing from medial to lateral in the thigh and continuing laterally in the leg*.

The tunnel was subcutaneous along the medial aspect of the thigh and knee and crossed from medial to lateral below the knee anterior to the tibia.

The tunnel was subcutaneous/subfascial along the medial aspect of the thigh and knee. Below the knee, *the tunnel crossed from medial to lateral through the interosseous membrane*.

The patient was given 5,000 U of heparin intravenously. A side-biting clamp was applied on the common femoral vein, and the saphenous vein was transected, incorporating the saphenofemoral junction and a 1-mm rim of the femoral vein. The femoral venotomy was then closed with a running 5-0 prolene suture.

The saphenofemoral valve was then excised under direct vision using Potts scissors. The common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. The proximal anastomosis was constructed between the hood of the saphenofemoral junction and the femoral arteriotomy with a running 6-0 prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. The remaining valves were then lysed using a retrograde valvulotome introduced through side branches and the distal end of the saphenous vein. The flow through the vein was checked and was pulsatile. The end of the vein was ligated with a 2-0 silk tie. The vein was rechecked for hemostasis. The vein was then passed through the tunnel, avoiding any twists.

A tourniquet was placed above the knee, and an Esmarch rubber bandage was applied to the foot and wrapped proximally to exsanguinate the leg. On completion of this, the tourniquet was inflated to 250–350 mmHg. A 1-cm arteriotomy was then created in the anterior wall of the anterior tibial artery.

Choose One

If internal occluder: *A 1-cm arteriotomy was then created in the anterior wall of the anterior tibial artery, and a 2.0-/2.25-/2.50-mm internal occluder was introduced into the lumen.*

If loops or clamps: *Proximal and distal control of the anterior tibial artery was then performed using vessel loops/vascular clamps/Bulldog clamps.*

The vein was transected at the appropriate length. The transected end was incised along its posterior aspect, spatulating the vein. The distal anastomosis to the anterior tibial artery was constructed with a running 7-0 prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate.

A 20-gauge angiocatheter was then introduced into a side branch in the vein near the proximal anastomosis, and an intraoperative arteriogram was performed. The angiogram revealed a patent anastomosis with no evidence of any retained valves, filling defects, or kinks. The angiocatheter was removed and its puncture site repaired with a 6-0 prolene suture. The suture lines and the wounds were then rechecked for hemostasis. There was good Doppler signal in the foot at the dorsalis pedis with a good augmentation of the signal with compressing and releasing the vein graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the anterior tibial muscle and extensor hallucis muscles was partially closed with 3-0 Vicryl sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

In Situ Femoroperoneal Bypass

217

Jamal J. Hoballah

Indications

- Tissue loss
- Gangrene
- Rest pain
- Disabling claudication

Essential Steps

1. Expose the target peroneal vessel.
2. Expose the greater saphenous vein (GSV).
3. Expose the inflow femoral vessels.
4. Transect the GSV at the saphenofemoral junction.
5. Excise the saphenofemoral valve under direct vision.
6. Construct the proximal anastomosis.
7. Incise the valves.
8. Identify and ligate arteriovenous (AV) fistulae.
9. Construct the distal anastomosis.
10. Completion angiogram.
11. Recheck for hemostasis.
12. Wound closure.
13. Pulse reevaluation.

Note These Variations

- Femoroperoneal bypass is very rarely done for intermittent claudication. Endovascular revascularization is often attempted prior to offering a bypass option if the anatomy is favorable.
- Numerous variations exist in performing in situ bypasses. Instead of exposing the entire saphenous vein, only the proximal and distal ends of the vein may be exposed. Various long valvulotomes (some with detachable heads) can be used and are usually introduced from the most distal end of the vein. The venous side branches are identified by preoperative vein mapping or intraoperative angiography/angioscopy. Direct cutdowns are performed over these branches to ligate them. Alternatively, the branches are occluded by endovascular embolization.
- The peroneal artery can be exposed through a medial approach or through a lateral approach that involves excising a segment of the fibula.
- Control of the target vessels can be achieved in various ways, such as tourniquet, internal occluders, Silastic vessel loops, vascular clamps, or Yasargil clips.

Complications

- Wound complications (infection/skin necrosis)
- Bleeding
- Gangrene

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_217

- Graft thrombosis
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Procedure In situ *right/left* common femoral artery to peroneal artery vein bypass; completion intraoperative arteriogram.

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female* with *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*. Endovascular revascularization was not successful/deemed appropriate.

Preoperative evaluation revealed infrainguinal occlusive disease with reconstitution of the peroneal artery in the proximal/*mid/distal* leg.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines and *regional/general* anesthesia was induced. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

Choose One
If medial exposure of peroneal artery: *A 10- to 12-cm vertical skin incision was performed overlying the preoperatively mapped GSV at the level chosen for the construction of the distal anastomosis. The saphenous vein was identified and protected. The incision was deepened through the subcutaneous tissue, exposing the underlying fascia. The fascia was incised, exposing the soleus muscle. The soleus muscle was incised along its attachment down to its posterior deep fascia. This fascia was incised, exposing the posterior tibial and the flexor muscles. Gentle blunt dissection between these two muscles was performed, and a self-retaining retractor was placed deeper in the wound, exposing the posterior tibial artery and veins. The posterior tibial vascular bundle was then retracted anteriorly, and the dissection continued toward the fibula along the intermuscular septum, exposing the peroneal vessels.*

If lateral exposure of peroneal artery: *A 10- to 12-cm vertical skin incision was performed on the lateral aspect of the leg overlying the fibula. The incision was deepened until the fibula was exposed. A 6- to 8-cm segment of the fibula was isolated. A right-angle clamp was passed carefully behind the fibula, freeing its posterior border. The freed segment of fibula was then excised using a Gigli/electric saw. The underlying tissue was then incised, exposing the underlying peroneal vessels.*

The peroneal vein was then identified and mobilized, exposing the peroneal artery. A 2-cm segment of the peroneal artery was sharply dissected. Crossing venae comitantes were ligated and divided. Attention was then directed to the groin. A vertical curvilinear skin incision was started overlying the right common femoral artery. The incision was extended down the upper medial thigh along the preoperatively mapped GSV. The GSV was then identified and traced toward the saphenofemoral junction. The saphenofemoral junction and an adjacent 5-cm segment of the saphenous vein were circumferentially dissected. Venous branches originating from this segment were isolated and divided. The anterior aspect of the saphenous vein was then exposed from the saphenofemoral junction to the *mid/lower* leg through one continuous incision. Attention was then directed toward the common femoral artery. The subcutaneous tissues overlying the femoral pulse were incised with electrocautery. The common femoral artery was then exposed and sharply dissected circumferentially. The encountered lymphatics were ligated and divided. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared.

The patient was given 5,000 U of heparin intravenously. A side-biting clamp was applied on the common femoral vein, and the saphenous vein was transected, incorporating the saphenofemoral junction and a 1-mm rim of the femoral vein. The femoral venotomy was then closed with a running 5-0 prolene suture.

The saphenofemoral valve was then excised under direct vision using Potts scissors. The common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. The proximal anastomosis was constructed between the hood of the saphenofemoral junction and the femoral arteriotomy with a running 5-0 prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. With the vein arterialized, the skin overlying the vein was incised, and the vein sequentially exposed. The remaining valves were then disrupted using a retrograde valvulotome introduced through side branches and the distal end of the saphenous vein. Vein branches identified during dissection and by Doppler exam were ligated. The flow through the vein end was checked and was pulsatile. The distal end of the vein was controlled with a *Yasargil*/*Bulldog* clamp.

***If* tourniquet**: A tourniquet was placed above the knee, and an Esmarch rubber bandage was applied to the foot and wrapped proximally to exsanguinate the leg. Following leg exsanguination, the tourniquet was inflated to 250–350 mmHg.

If* clamps *or loops: Proximal and distal control of the peroneal artery was then performed using *Yasargil clamps*, *vascular clamps*, *Bulldog clamps*, *or Silastic vessel loops*.

A 1-cm arteriotomy was then created in the anterior wall of the peroneal artery. The vein was transected at the appropriate length. The transected end was incised along its posterior aspect, spatulating the vein. The distal anastomosis to the peroneal artery was constructed with a running 7-0 prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. A 20-gauge angiocatheter was then introduced into a side branch in the vein near the proximal anastomosis, and an intraoperative arteriogram was performed. The angiogram revealed a patent anastomosis with no evidence of any retained valves, filling defects, or kinks. The angiocatheter was removed and its puncture site repaired with a 6-0 prolene suture. The suture lines and the wounds were then rechecked for hemostasis. There was good Doppler signal in the foot at the level of the dorsalis pedis and posterior tibial arteries and a good augmentation of the signal with compressing and releasing the vein graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the soleus muscle was partially closed with 3-0 Vicryl sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

218 Femoroplantar Composite Vein Bypass

Jamal J. Hoballah

Indications

- Tissue loss
- Gangrene
- Rest pain

Essential Steps

1. Expose the target plantar vessel.
2. Expose the inflow femoral vessels.
3. Harvest the vein segments.
4. Construct an end-to-end anastomosis between the two vein segments.
5. Create graft tunnel.
6. Reverse composite vein graft.
7. Construct the proximal anastomosis.
8. Check for hemostasis.
9. Pass graft through the tunnel.
10. Construct the distal anastomosis.
11. Completion angiogram.
12. Wound closure.
13. Pulse reevaluation.

Note These Variations

- The vein segments can be connected with both being in a reversed direction. Alternatively, one segment can be reversed and the other nonreversed to provide a better match between the size of both ends. The valves of the nonreversed segment will be disrupted with a valvulotome.
- Grafts to the plantar artery may be tunneled in various ways, including subcutaneous, subfascial, or anatomic tunnels.
- Control of the target vessels can be achieved in various ways, such as tourniquet, internal occluders, Silastic vessel loops, vascular clamps, or Yasargil clips.

Complications

- Bleeding
- Gangrene
- Thrombosis of graft
- Infection
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Procedure *Right/left* common femoral artery to posterior tibial artery vein bypass with reversed right greater saphenous vein; completion intraoperative arteriogram.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_218

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female* with *right/left leg disabling claudication*, *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*. Endovascular revascularization was not successful/deemed appropriate.

Preoperative evaluation revealed infrainguinal occlusive disease with reconstitution of the lateral plantar artery at the ankle.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The anesthesia team placed appropriate lines and *regional/general* anesthesia was induced. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

A 6- to 8-cm vertical skin incision was performed on the medial aspect of the ankle 2 cm posteromedial to the medial malleolus. The skin incision was deepened through the subcutaneous tissue until the fascia was identified. The fascia was incised, exposing the posterior tibial artery and veins. The artery was traced distally toward its bifurcation into the medial and lateral plantar vessels. A 2-cm segment of the lateral plantar artery was sharply dissected. Crossing venae comitantes were ligated and divided. Attention was then directed to the groin. A vertical curvilinear skin incision overlying the right common femoral artery was made extending down the upper medial thigh along the preoperatively mapped greater saphenous vein. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared.

An incision over the preoperatively mapped vein segments was performed. Two vein segments of appropriate length were harvested. The vein ends were spatulated and then sutured together *with both veins in the same direction/with one vein reversed and the other in a nonreversed direction*.

A tunnel was then created using a *Zepplin/Kelly weck/Gortex tunneler*.

The tunnel was subcutaneous parallel to the course of the saphenous vein to the level of the exposed posterior tibial artery.

The tunnel was subcutaneous/subfascial along the medial aspect of the thigh and knee.

The tunnel was subfascial/subsartorial along the medial aspect of the thigh and then anatomic at the knee level passing between both heads of the gastrocnemius muscle. Below the knee the tunnel was posterior to the soleus muscle.

The patient was given 5,000 U of heparin intravenously.

The common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. The vein graft was then reversed, and its distal end was incised along its *posterior wall/incorporating a side branch creating a T-junction shape*. The proximal anastomosis was constructed between the spatulated vein and the femoral arteriotomy with a running *5-0/6-0* prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate.

The flow through the vein graft was checked and was pulsatile/*except for the nonreversed segment. A valvulotome was introduced through the distal end of the composite graft and used to disrupt the valves*. The end of the vein graft was ligated with a 2-0 silk tie. The vein was rechecked for hemostasis. The vein graft was then passed distended through the tunnel, avoiding any twists.

A tourniquet was placed above the knee, and an Esmarch rubber bandage was applied to the foot and wrapped proximally to exsanguinate the leg. The tourniquet was then inflated to 350 mmHg.

[Choose One:]
If internal occluder: *A 1-cm arteriotomy was then created in the anterior wall of the plantar artery. A 2.0-/2.25-/2.50-mm internal occluder* (*flowrestor*) *was introduced into the lumen to achieve proximal and distal control*.

If loops or clamps: *Proximal and distal control of the plantar artery was then performed using vessel loops/vascular clamps/Bulldog clamp. A 1-cm arteriotomy was then created in the anterior wall of the plantar artery*.

The vein graft was transected at the appropriate length. The transected end was incised along its posterior aspect, spatulating the transected vein. The distal anastomosis to the posterior tibial artery was constructed with a running 7-0 prolene suture. Prior to completing the suture line, back bleeding, forward flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. A 20-gauge angiocatheter was then introduced into a side branch in the vein near the proximal anastomosis, and an intraoperative arteriogram was performed. The angiogram revealed a widely patent anastomosis and no evidence of filling defects or kinks. The angiocatheter was removed and its puncture site repaired with a 6-0 prolene suture. The suture lines and wounds were then rechecked for hemostasis. There was a good Doppler signal in the foot at the plantar artery level and a good augmentation of the signal with compressing and releasing the vein graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the distal part of the soleus muscle was approximated with 3-0 Vicryl sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Superficial Femoral Artery/ Popliteal Artery/Tibial Angioplasty Stenting

219

Neelima Katragunta and Jamal J. Hoballah

Indications

- Disabling claudication
- Rest pain
- Tissue loss
- Gangrene

Essential Steps

1. Percutaneous contralateral access of the common femoral artery.
2. Control access with 5-French sheath.
3. Anticoagulate with IV heparin sulfate (3,000 U).
4. Place guidewire into the abdominal aorta under fluoroscopic guidance.
5. Perform diagnostic aortogram with contralateral distal leg runoff.
6. Decide about continuing the procedure from the contralateral approach by crossing the bifurcation and placing a crossover sheath or guiding catheter into the common femoral artery of the affected limb. Antegrade percutaneous or open access on the ipsilateral side.
7. Insertion of a long sheath or guiding catheter to the proximity of the lesion.
8. Measure length and degree of the stenotic/occluded lesion using DSA.
9. Additional anticoagulation at 75 UI/kg to keep ACT greater than 250 s.
10. Crossing the stenosis with a glide wire/crossing the occlusion using subintimal technique/occlusion crossing catheters.
11. Predilation with a 3 mm × 4 cm balloon for the superficial femoral or popliteal arteries or a 1.5 mm balloon for the tibial arteries; this will also serve as an additional method to measure the length of the stenosis and the diameter of the vessel to select the appropriate size balloon/stent.
12. Angioplasty and stenting.
13. Dilate with appropriately sized balloon.
14. Deploy stent across the lesion.
15. Post-stent dilatation.
16. Completion angiogram.

Note These Variations

- Preoperative MRA or CTA may guide the choice of the access and provide better planning.
- For lesions of the proximal superficial femoral artery (SFA), a contralateral approach

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_219

with crossing of the aortic bifurcation is usually preferred.

- For crossing occlusion in the mid or distal SFA or tibial artery, an antegrade puncture may provide better control and ability to cross chronic occlusions.
- A retrograde approach from the popliteal, tibial, or even pedal access may be needed to cross a challenging occlusion.
- Chronic occlusion may be crossed by navigating the wire through the occlusion, using subintimal angioplasty technique, or special catheters with lumen reentry capability.
- In chronic occlusions, predilation may be useful prior to introducing the stent.
- In chronic occlusions, primary stenting may be desirable.
- With subintimal technique, stenting may be limited to the distal reentry segment or may be used for the entire segment.
- In tibial disease, angioplasty is usually carried without the need for stenting.
- Tibial occlusion that could not be crossed using standard wire techniques may be crossed using laser recanalization or pedal access.
- In tibial disease or popliteal disease adjacent to significant branches, atherectomy may be used instead of balloon angioplasty once the lesion is crossed in the hope of preserving the branches.
- Drug-coated balloons (DCB) are a useful tool particularly in the superficial femoral or popliteal arteries where most interventionalists would like to avoid leaving behind a metal scaffold of a stent.
- It is important to avoid while using a DCB a "geographic miss" which results in higher rates of restenosis. This refers to failure of drug delivery with a DCB to an area of the vessel that was pretreated with a regular balloon.
- To avoid this pitfall, a precise method to mark the area of the vessel that is pretreated is needed. Some interventionalists use a reference overlay and marks on the monitor, while others use a radiopaque marker tape adherent to the patient's skin (not the drapes).
- It is also imperative to extend the area of treatment with a DCB beyond the margins of pretreatment.
- Effort should be made to minimize the transition time from the point of introduction to the point of treatment to minimize loss of the drug.
- An inflation time of 3 min is strongly recommended for In.Pact Admiral, whereas it is ≥30 s for Lutonix.

Complications

- Inability to cross the occlusion
- Distal embolization
- Dissection thrombosis
- Vessel rupture
- Renal failure

Template Operative Dictation

Preoperative Diagnosis Infrainguinal arterial occlusive disease with *right/left foot disabling claudication*, *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Procedure *Right/left* SFA/popliteal/anterior tibial/peroneal/posterior tibial angioplasty/stenting.

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female* with *right/left foot disabling claudication*, *right/left foot rest pain*, *right/left foot/toe ulcerations/gangrene*.

Preoperative evaluation revealed infrainguinal occlusive disease:

Superficial femoral artery/popliteal/anterior tibial/peroneal/posterior tibial stenosis/occlusion.

The risks and benefits of revascularization were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed on the angiography table. Both groins were prepped and draped in the usual sterile fashion. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The contralateral femoral artery was punctured using Seldinger technique with a micropuncture set which was exchanged to a size 5-French sheath. A 0.035″ Standard Hydrophilic Guidewire soft angled, 180 cm, was introduced into the aorta, and an Omni Flush catheter was introduced over the wire to the aorta to the level of L1 vertebra. An aortogram with iliac runoff was performed. There was no evidence on any significant aortoiliac occlusive disease. The Omni Flush catheter was then used to cross over the aortic bifurcation to the contralateral side of interest. The tip of the catheter was then advanced to the level of the distal external iliac artery. A distal leg angiogram and runoff were then obtained through the Omni Flush catheter. This revealed *superficial femoral artery/popliteal/anterior tibial/peroneal/posterior tibial stenosis/occlusion*.

The decision was to proceed with the procedure from the contralateral side. A stiff wire was introduced into the Omni Flush catheter and the Omni flushed was removed. The 5-French sheath was then replaced by a size 6-French Balkin sheath/6-French guiding catheter which was parked in the common femoral artery. The patient was administered 75 UI/Kg of heparin intravenously. A road map/angiogram under magnification was performed of the area of *stenosis/occlusion*. Using of a size 4-French angled glide catheter and a *straight/angled* glide wire, the glide catheter was advanced to the level of the *stenosis/occlusion* in the SFA. *The wire was negotiated across the stenosis/occlusion, and the lesion was crossed*; *a subintimal angioplasty technique/reentry catheter was used to cross the lesion*. The glide catheter was advanced across and then distal to the lesion into the popliteal artery. An angiogram through the catheter was then performed documenting intraluminal placement. A 0.035 wire, 260 cm long, was then introduced into the catheter and the catheter removed. The stenotic/occluded segment of the SFA were identified and predilated with size 4 mm × 4 cm balloon. A *size* ____ self-expending stent was then advanced and deployed at the desired location. The delivery system was removed and then an appropriately sized balloon ____ was used to postdilate the stent. An angiogram was performed and showed no evidence of any residual stenosis with no distal embolization.

Ipsilateral approach: *ideal for tibial disease*

Using a Seldinger technique and a micropuncture set, the ipsilateral common femoral artery was punctured. The micropuncture sheath was replaced by a size 5-French short sheath. An angiogram was performed revealing *stenotic/occlusive* disease in the *posterior tibial/anterior tibial/peroneal* artery. A size 6-French guiding catheter was then used to replace the 5-French sheath and advanced to the popliteal artery. Heparin 75 UI/Kg was then administered intravenously. The size 4-French angled glide catheter was advanced into *the posterior tibial/anterior tibial/peroneal artery*. A 0.014″ × 190 cm Hydrophilic Guidewire was negotiated across the stenosis. An angiogram under magnification was performed to further delineate the segment to be treated. An appropriate size balloon ____ was then inserted and inflated for 30 s. An angiogram revealed *no/minimal residual* stenosis with no extravasation. The catheter and wire were then removed, and the sheath was removed when the ACT drifted below 150. A debriefing checklist was completed to share information critical to postoperative care of the patient.

Retrograde Pedal Access

220

Carlos F. Bechara, Matthew E. Bennett, and Thomas M. Loh

Indications

1. Failure to cross a lesion via traditional antegrade access and flush femoral occlusion
2. Anticipated failure of traditional antegrade access secondary to heavy disease burden

Essential Steps

1. Groin/brachial access.
2. Advance sheath to proximal extent of lesion.
3. Ultrasound-guided mini-stick puncture of pedal vessel.
4. Heparinize to ACT >250.
5. Cross lesion with 0.018 (V-18) via pedal access.
6. Confirm intraluminal position.
7. Snare through and through wire via groin/brachial access.
8. Therapeutic intervention.

Technical Notes

- Use the smallest ultrasound probe available when accessing the pedal vessel as a bulky probe will interfere with access.
- Heavily calcified vessels will be difficult to cannulate with ultrasound and may be easier to access with fluoroscopy or road map injections.
- Curving the micropuncture needle slightly will facilitate access, particularly in the anterior tibial artery above the ankle or the posterior tibial artery.
- If in doubt, inject contrast to confirm pedal access.
- Positioning the foot is important: plantar flexion for the dorsalis pedis and anterior tibial arteries, eversion and dorsiflexion for the posterior tibial artery, or inversion and plantar flexion for the distal peroneal artery.

Complications

1. Inability to cannulate pedal vessel
2. Inability to cross the target lesion
3. Perforation of tibial vessel
4. Access site hematoma

Template Operative Dictation

Preoperative Diagnosis Right/left/bilateral lower extremity peripheral arterial disease (with claudication/rest pain/ulceration/gangrene)

Postoperative Diagnosis Same

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_220

Procedure

1. Ultrasound-guided [right/left] femoral access
2. Ultrasound-guided [right/left] [dorsalis pedis/posterior tibial] access
3. Selective [right/left] lower extremity arteriogram
4. Retrograde canalization of the [anterior/posterior] tibial artery
5. [Anterior/posterior] tibial artery angioplasty
6. Percutaneous closure of the [right/left] common femoral artery

Indications This ___-year-old man/woman presented with peripheral vascular disease and right/left/bilateral claudication/rest pain/ulceration/gangrene.

Choose One

1. The patient had an attempted antegrade revascularization which failed.
2. Preoperative CTA/duplex revealed significant tibial vessel disease which appeared too extensive to cross in an antegrade fashion.

   The risks and benefits of endovascular intervention with pedal access were explained to the patient who elected to proceed with the procedure.

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preindication and preincision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under [general endotracheal anesthesia/monitored anesthesia care]. The right/left lower extremity and bilateral groins were prepped and draped in standard fashion.

Access to the [right/left] groin was obtained using a micropuncture needle under ultrasound guidance. The micropuncture wire was advanced and position confirmed with fluoroscopy. The micropuncture sheath was placed. A short 5-French sheath was placed and a contra catheter advanced into the aorta over a glidewire. Aortogram was performed. The wire and catheter were advanced into the contralateral femoral artery, and a selective lower extremity angiogram was performed. Subsequently a 65-cm, 6-French sheath was placed with the tip just proximal to the lesion.

Access to the contralateral [right/left] [dorsalis pedis/posterior tibial] artery was obtained using a short micropuncture needle under [ultrasound/fluoroscopic] guidance. Back bleeding was observed. The micropuncture wire was advanced into the artery under fluoroscopy. The introducer sheath with Check-Flo valve was introduced into the vessel. 80 IU/kg heparin was administered intravenously for a target ACT of 250.

Using an exchange length 0.018 wire and quick-cross catheter, the lesion was [crossed successfully/unable to be crossed]. [If failed: We then attempted to cross using and 0.035 wire and quick-cross catheter, and this was successful.] The wire was removed and intraluminal position was confirmed by injection of contrast into the catheter.

A microsnare was advanced from the groin and used to capture the 0.018 wire advanced from the pedal access. The wire was pulled out through the groin so through-and-through access was obtained. Serial angioplasty was performed with 2.5 mm, then 3 mm balloons. Completion antegrade angiography revealed a widely patent [anterior/posterior] tibial artery with good perfusion down to the foot with no evidence of extravasation.

All wires and sheaths were removed. Hemostasis was secured through manual compression for 10 min. Hemostasis in the groin was obtained with a [Mynx/Starclose/Proglide/Angioseal] closure device. The patient tolerated the procedure well and sent to PACU in stable condition without complications. All instrument, needle, and sponge counts were correct at the conclusion of the procedure.

221 Midbypass Revision

Jamal J. Hoballah

Indications

- Failing bypass
- Vein bypass stenosis identified during duplex surveillance

Essential Steps

1. Mark the area of stenosis preoperatively under duplex guidance.
2. Perform a longitudinal skin incision over the bypass.
3. Identify the bypass and dissect the area of stenosis.
4. Confirm the site of stenosis by Doppler ultrasound.
5. Harvest an appropriate segment of the vein.
6. Anticoagulate.
7. Proximal and distal control.
8. Create a longitudinal incision in the graft.
9.
   - *Alternative 1: Perform a vein patch angioplasty.*
   - *Alternative 2: Excise the disease vein segment and replace it with the harvested vein.*
10. Angiogram to confirm the adequacy of the reconstruction.
11. Wound closure.

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Note These Variations

- Endovascular treatment (balloon angioplasty) is often attempted as a first revascularization option except if the stenotic segment is very long.
- A vein patch angioplasty is typically used with focal stenoses. If the stenosis is diffuse, the vein segment is excised and replaced with a vein segment.

Complications

- Recurrent stenosis
- Graft thrombosis
- Bleeding
- Infection

Template Operative Dictation

Preoperative Diagnosis Failing vein bypass with midgraft stenosis

Procedure Vein bypass revision with *vein patch angioplasty/interposition vein graft*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_221

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with a failing *femoro/popliteal/tibial* vein bypass identified on routine duplex surveillance. The stenotic area is at the midgraft level and extends for 1 cm. The risks of thrombosis and benefits and risks of surgical intervention were discussed with the patient, who elected to undergo surgical intervention. Percutaneous intervention was not successful/deemed appropriate.

Description of Procedure The patient was placed in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *local/regional/general* anesthesia. The *right/left* lower extremity was prepped and draped in a sterile manner. A longitudinal skin incision was performed over the anticipated marked area of stenosis. The incision was deepened in the subcutaneous tissue until the graft was identified. The graft was dissected and exposed for 1.5 cm proximal and distal to the area of stenosis. *Doppler ultrasonography/angiogram* was used to confirm the site of stenosis. A skin incision was then performed over the preoperatively marked *cephalic/basilic/short saphenous/long saphenous* vein. A ___-cm segment of vein was harvested. The patient was given 75 U/kg of heparin intravenously. Proximal and distal control of the bypass was then performed, and a longitudinal incision in the graft through the area of stenosis was then performed.

Choose One

If vein patch angioplasty: *The harvested vein segment was then incised longitudinally, creating a patch. The patch was then sutured using a continuous running suture of 6-0/7-0 prolene.*

If interposition vein graft: *A long segment of vein appeared to be stenotic with severe neointimal hyperplasia. The decision was made to replace that segment of the vein. The disease segment was excised, and remaining ends were spatulated. The harvested vein was reversed and then spatulated to match the bypass. An end-to-end anastomosis between the proximal part of the graft and the vein segment was then performed using a continuous running 6-0/7-0 prolene suture. Upon the completion of the anastomosis, the suture line was checked for hemostasis and was adequate. The distal end of the vein segment was then spatulated to match the distal end of the bypass. The distal anastomosis was then performed using a running suture of 6-0/7-0 prolene.*

The suture line was checked for hemostasis, which was adequate.

A 20-gauge *angiocath/butterfly* was then inserted in the graft proximal to the reconstruction, and an angiogram was obtained. The angiogram revealed patent reconstruction without any additional areas of stenosis.

Hemostasis was secured. The wound was irrigated with saline solution.

The wound was then closed using 3-0 Vicryl for the subcutaneous tissue and staples for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Distal Bypass Revision

222

Jamal J. Hoballah

Indications

- Failing bypass
- Distal vein bypass stenosis identified during duplex surveillance

Essential Steps

1. Mark the area of stenosis preoperatively under duplex guidance.
2. Perform a longitudinal skin incision over the bypass.
3. Identify the bypass and dissect a segment proximal to the area of stenosis.
4. Expose the target artery distal to the stenotic area.
5. Confirm the site of stenosis by Doppler ultrasound.
6. Harvest an appropriate segment of the vein.
7. Anticoagulate.
8. Proximal and distal control.
9.
   - *Alternative 1*: *Vein patch angioplasty*.
   - *Alternative 2*: *Interposition/jump graft. Create the proximal anastomosis end-to-end/end-to-side configuration*; *construct the distal anastomosis end-to-side configuration*.
10. Angiogram to confirm the adequacy of the reconstruction.
11. Wound closure.

Note These Variations

- Percutaneous balloon angioplasty is often attempted first.
- Distal anastomotic stenoses can be treated by vein patch angioplasty, which requires tedious dissection of the anastomosis, or interposition of a vein segment. If a long segment of the distal bypass is stenotic, replacement of that segment is carried. The proximal anastomosis may be performed in an end-to-end or end-to-side fashion. The latter is typically used when the retrograde flow into the target vessel is preserved and the stenotic area is in the most distal part of the distal anastomosis toward the target vessel.

Complications

- Recurrent stenosis
- Graft thrombosis
- Bleeding
- Infection

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_222

Template Operative Dictation

Preoperative Diagnosis Failing vein bypass with distal graft stenosis

Procedure Vein bypass revision with *vein patch angioplasty/interposition/jump vein graft*.

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with a failing *femoro/popliteal/tibial* vein bypass identified on routine duplex surveillance. The stenotic area is at the level of the distal anastomosis and extends for ___ cm. Endovascular revascularization was not successful/deemed appropriate. The risks of thrombosis and benefits and risks of surgical intervention were discussed with the patient, who elected to undergo surgical intervention.

Description of Procedure The patient was placed in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *local/regional/general* anesthesia. The *right/left* lower extremity was prepped and draped in a sterile manner. A longitudinal skin incision was performed over the anticipated marked area of stenosis. The incision was deepened in the subcutaneous tissue until the graft was identified. The graft was dissected and exposed for 1.5 cm proximal to the area of stenosis.

The dissection was then continued distally, exposing the anastomosis and the target vessel distal to it. Doppler ultrasonography/angiogram was used to confirm the site of stenosis. A skin incision was then performed over the preoperatively marked *cephalic/basilic/short saphenous/long saphenous* vein. A ___-cm segment of vein was harvested. The patient was given 75 U/kg of heparin intravenously. Proximal and distal control of the bypass was then performed.

Choose One

If vein patch angioplasty: *A longitudinal incision in the graft through the area of stenosis was then performed. The harvested vein segment was then incised longitudinally, creating a patch. The patch was then sutured using a continuous running suture of 6-0/7-0 prolene.*

If interposition/jump graft: *A long segment of the distal bypass was stenotic with severe neointimal hyperplasia. The decision was made to replace that segment of vein. The disease segment was excised by transecting the bypass proximal to the stenotic segment and just proximal to the distal anastomosis. The distal end of the bypass was oversewn with a running 6-0 prolene suture. The proximal end was spatulated. The harvested vein was then spatulated to match the bypass. An end-to-end anastomosis between the proximal part of the graft and the vein segment was then performed using a continuous running 6-0/7-0 prolene suture. Upon the completion of the anastomosis, the suture line was checked for hemostasis and was adequate. Proximal and distal control of the target vessel was then obtained, and a ___-cm arteriotomy was performed. The distal end of the vein segment was then spatulated to match the arteriotomy. The distal anastomosis was then performed using a running suture of 6-0/7-0 prolene.*

The suture line was checked for hemostasis, which was adequate.

A 20-gauge *angiocath/butterfly* was then inserted in the graft proximal to the reconstruction, and an angiogram was obtained. The angiogram revealed patent reconstruction without any additional areas of stenosis.

Hemostasis was secured. The wound was irrigated with saline solution. The wound was then closed using 3-0 Vicryl for the subcutaneous tissue and staples for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

223 Bypass Stenosis Angioplasty

Fady F. Haddad

Indication

- Salvage of patent but hemodynamically failing bypass because of in-graft stenosis and inflow or outflow stenosis (usually detected on Duplex surveillance).
- Alternatively, bypass angioplasty is performed after lysis or mechanical thrombectomy of a failed bypass and identifying a target culprit lesion or stenosis.

Essential Steps

1. If target lesion or plan is unclear from the preoperative duplex, we favor prepping and draping the patient from the start umbilicus to toes bilaterally in preparation for potential cutdown or open repair.
2. Get access from the contralateral leg if possible (refer to alternative below).
3. Advance angiographic catheter into aorta and perform aortoiliac and bilateral femoral imaging.
4. Manipulate catheter and wire to get crossover access to the contralateral iliac.
5. Perform selective angiography of the target extremity and bypass. Note that if stenosis is very tight, proper imaging of the bypass may not be obtained except after selective access of the bypass origin. Because of the increased resistance within the bypass, nonselective injection will visualize only the native vessels.
   - Decision to proceed with percutaneous angioplasty vs. open repair.
   - Select lesions to be treated (we recommend during these procedures the use of marked "Glow and Tell Tape," Le Maitre, or others, taped directly on the index limb).
6. Anticoagulate patient with systemic heparin. Target ACT ~250–300.
7. Exchange catheter for a long crossover sheath parked usually in the distal external iliac artery EIA (unless bypass originates from the popliteal, then longer sheath may be needed). Six French is usually satisfactory.
8. Access the bypass using 0.014 wire, using a selective catheter (options include 4-F vertebral or 4-F angled glide catheter, other appropriately angled catheter to access the ostium; the wire should be advanced than beyond all lesions to be treated.
9. Alternatively, initial access of the bypass could be done using a 0.035 hydrophilic angled Glidewire and later exchanged to a

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_223

smaller wire adapted to the selected balloon systems.

10. Image again through the sheath or through the selective catheter; keep the reference image; select and advance appropriate balloon and proceed with angioplasty.
11. Choice of balloons may vary, we typically use 0.014 systems with coronary balloons for the shorter stenosis and longer peripheral below the knee balloons for longer stenosis. More recently we have been using drug-coated balloons (DCB) in selected cases, especially in setting of recurrent stenosis.

Note These Variations

- Alternatively: If access from contralateral side is deemed impossible for some reason (bypass from the groin, severe tortuosity, iliac occlusion, etc.), then either proceed with brachial approach if the stenosis is proximal in the thigh and reachable or consider an open cutdown on the bypass which can be used for imaging proximally and distally and access for the angioplasty as well.
- Antegrade access may also be possible if the graft originates from or distal to the superficial femoral artery.

For any of the reasons above, or other anatomic consideration (very long stenosis, multiple stenosis, etc.), decision could be made to proceed with open repair of the bypass; this is done typically using a vein patch angioplasty or an interposition vein graft if the stenosis is long.

Template Dictation

Preoperative Diagnosis Right/left lower extremity bypass graft stenosis

Postoperative Diagnosis Same

Operation Contralateral retrograde femoral artery puncture

Selective lower extremity angiography

Proximal/distal/mid bypass graft balloon angioplasty using (balloon size and diameter) and/or proximal/distal anastomotic stenosis PTA

Indication Patient, comorbidities, a case of right/left critical limb ischemia, S/P right/left autogenous bypass (from-to), done around __ months ago, follow-up duplex scan showed the presence of a tight stenosis at __ (location) and another stenosis at __ (level) (or alternatively a hemodynamically failing bypass), planned for angiography and angioplasty for assisted primary patency.

Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Under local anesthesia using 1 % lidocaine (with or without sedation), both lower extremities and groins were prepped and scrubbed in the usual fashion from the umbilicus down to the ankles.

Ultrasound-guided retrograde access to the contralateral femoral artery was achieved using a micropuncture system, which was then exchanged to a 5-French sheath. Pigtail catheter (or preferably a VCF or Omni Flush 65 cm) was introduced over a starter wire (or hydrophilic wire) into the distal infrarenal aorta. Angiographic runs of the aortoiliac and proximal femoral arteries were taken bilaterally. A Glidewire (Terumo) was manipulated and advanced into the contralateral iliac down to the femoral artery, and the catheter was advanced over it (*alternatively*, *the flush catheter may need to be changed to a glide catheter if it does not progress as needed*). Selective images of the contralateral extremity and the bypass are taken, and the pathology was identified. At this point an exchange wire was advanced into the catheter (typically a Rosen wire or equivalent or an Amplatz wire if significant tortuosity), and the sheath was exchanged to a long 6-French sheath that is parked into the distal external iliac artery (typically a Balkan sheath from Cook or alternative). Patient is given systemic IV heparin to keep

ACT ~300. Road map or reference images of the bypass origin are taken in the appropriate orientation to open the anastomosis. Glidewire and a 4-French angled glide catheter are used to negotiate and get selective access to the bypass. Catheter is gently advanced in the bypass origin, and the wire is typically exchanged at this point to a 0.014″ wire (e.g., Nitrix-angled tip from EV3 or a Floppy II or a BMW). The wire is advanced without difficulty into the bypass as needed, for a good distance beyond all stenotic lesions and across the distal anastomosis when needed, especially if this one is to be treated as well. At this point, after all target lesions are identified, an appropriately sized low-profile balloon is used (typically anywhere between 2.5 and 4 mm depending on bypass size, starting with a conservatively lower estimate), and a 2- to 3-min inflation is done. Control angiography through the sheath is performed, and depending on the result, a larger balloon maybe used. In lesions which do not respond to regular balloon, a cutting balloon, undersized, is used initially, followed by a regular balloon dilatation. After satisfactory control, attention is given to the next stenosis. Following a final control of the totality of the bypass including the run off vessel, wire access is lost from the bypass; the long sheath is exchanged to a short 11-cm 6-French sheath. An ACT is checked, and more often than not, it is still prolonged at this point, and the sheath is left in place to be removed later in the recovery area. Alternatively, a closure system could be used and the sheath removed directly following the procedure.

At the end of the procedure, pulses and Dopplers in the DP/PT and in the bypass are checked.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

Part XX

Vascular Surgery: Thromboembolectomy

Aortic Saddle Embolus

224

Theodore H. Teruya
and Ahmed M. Abou-Zamzam

Indication

- Acute bilateral lower-extremity ischemia due to embolus

Essential Steps

1. Prep the patient (be prepared to do an axillary femorofemoral bypass).
2. Dissect the common, profunda, and superficial femoral arteries bilaterally.
3. Make arteriotomies bilaterally.
4. Perform distal thrombectomies.
5. Pass catheters proximal, simultaneously, and extract the thrombus.
6. Close the arteries.
7. Assess distal perfusion.
8. Assess the legs for compartment syndrome.

Note This Variation

- The femoral arteriotomies are made transverse if an embolic process is suspected and longitudinal if aortoiliac occlusive disease is suspected. The thromboembolectomy can be performed using fluoroscopic guidance.

Complications

- Bleeding
- Hematoma
- Ongoing ischemia
- Compartment syndrome
- Limb loss
- Renal failure
- Death (due to underlying illness)

Template Operative Dictation

Preoperative Diagnosis Bilateral lower-extremity ischemia

Procedure Aortobiiliac thromboembolectomy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* presenting with bilateral cold pulseless extremities of ___-h duration. On physical examination, the patient

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_224

had no palpable femoral pulses and no Doppler signals in either lower extremity. Motor and sensory examination revealed sensation and motor function to be *normal/diminished/absent*. The patient was given 10,000 U of heparin when ischemia was identified. The patient *had/had no* documented femoral and pedal pulses prior to current presentation.

There was fresh thrombus extracted from the distal aorta and bilateral iliac arteries. There was good back-bleeding from the profunda and superficial femoral arteries bilaterally. The patient had palpable DP and PT pulses bilaterally at the termination of the procedure.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general/local* anesthesia. The patient was placed supine on the operating table and appropriate monitoring lines and catheters were placed. The patient had received 10,000 U of heparin prior to arriving at the operating room. The chest, abdomen, femoral regions, and lower extremities were prepped and draped in standard sterile fashion. (The chest, abdomen, and lower extremities need to be included in the sterile field in case an axillary femorofemoral bypass is necessary).

Bilateral vertical femoral incisions were made, two finger breadths lateral to the pubis. The subcutaneous tissue was dissected with ligation and division of small vessels and lymphatics and the common, profunda, and superficial femoral arteries were dissected free bilaterally. Each vessel was double looped using a vessel loop. A transverse arteriotomy was made over the origin of the profunda. (*Longitudinal arteriotomies were made as there was a concern that there is chronic aortoiliac occlusive disease and a bypass may need to be done*.) There was good back-bleeding from the profunda femoris and superficial femoral artery and these vessels were controlled using vascular clamps.

Number 5 Fogarty thromboembolectomy catheters were then passed proximally into the aorta from both femoral arteries, simultaneously. The catheters were inflated simultaneously and withdrawn. This was repeated until all thrombus was extracted. The inflow was tested and noted to be brisk. (*An adequate inflow could not be obtained*, *and an axillary femorofemoral bypass was needed*.) The common femoral arteries were then clamped. The arteriotomies were then closed using interrupted 6-0 Prolene sutures. (*If longitudinal arteriotomies were performed*, *the vessel should be closed with a vein/Dacron/PTFE patch*.) Flow was established to the lower extremities bilaterally. The patient had palpable PT and DP pulses bilaterally.

The legs were assessed for compartment syndrome *clinically/with pressure device and fasciotomies were/were not necessary*.

Thrombin-soaked Gelfoam was placed over the suture lines until hemostasis was obtained. Bleeding from the subcutaneous tissue was controlled with electrocautery. The wound was closed using multiple layers of 3-0 Vicryl sutures. The skin incisions were closed using 4-0 absorbable monofilament sutures.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the intensive care unit in stable condition.

Lower-Extremity Thromboembolectomy

225

Jason Chiriano and Theodore H. Teruya

Indication

- Acute lower-extremity ischemia secondary to embolism or thrombotic event
- Diagnosis
- Acute onset of pain, pallor, paresthesia, poikilothermia, and paralysis in any extremity
- Complete pulse/Doppler exam
- Differentiate between embolic vs. thrombotic etiology:
  - Embolism more likely with normal pulse exam on opposite extremity, history of aneurysm, or cardiac arrhythmia

Essential Steps

1. Identify the likely site of obstruction based on history and physical examination.
   - Most common site is in distal common femoral artery at bifurcation of superficial and deep femoral artery.
   - Second most common site is at distal popliteal artery.
2. Complete dissection of either the common femoral artery from the inguinal ligament to the bifurcation, or the below-knee popliteal artery to the origin of the anterior tibial artery and tibioperoneal trunk (if inadequate thromboembolectomy from the femoral approach).
   - Longitudinal groin cut down most common; however, transverse incision may be adequate if pure embolic disease is strongly suspected.
3. Obtain proximal and distal control with vessel loops at the site through which the thromboembolectomy will be performed.
4. Make arteriotomy with an 11 blade scalpel – transverse if vessel is healthy, longitudinal if there is atherosclerotic disease that may require endarterectomy.
5. Catheter thromboembolectomy – must make continual passes with gentle inflation until two sequential returns of balloon catheter with no thrombus and adequate pulsatile inflow/brisk back-bleeding.
   - Iliac arteries – #5 Fogarty catheter.
   - Superficial femoral/popliteal arteries – #4/#5 Fogarty catheter.
   - Profunda femoris artery – #3/4 Fogarty catheter.
   - Tibial arteries – #2/#3 Fogarty catheters.
6. Arteriotomy closure – primary if transverse, patch if longitudinal.
7. Assess distal perfusion – if adequate Doppler signals/palpable pulses terminate procedure,

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_225

otherwise perform intraoperative angiogram (see adjunct procedures/technical notes).

8. Consider need for four-compartment fasciotomy – prolonged ischemia time over 4 h, degree of preoperative ischemia, presence of overt compartment syndrome.

Adjunct Procedures

1. Perform intraoperative angiogram through either a micropuncture dilator or small 20 g angiocatheter in the common femoral artery if no signals at the end of case.
2. Consider bolus of TPA (tissue plasminogen activator) – if no signals at end of case and angiogram suggests residual thrombus. Inject through sheath or catheter. Dose: 2–10 mg.
3. Bolus of vasodilator – papaverine 10–60 mg, nitroglycerin 500–1,500 μg. Use if no signals and angiogram suggests severe spasm of tibial vessels.
4. Angiojet device/Trellis – mechanical thrombectomy devices for retained clot.
5. Over the wire Fogarty balloon catheters for residual thrombus or further embolization during procedure.
6. Consider bypass procedure if severely diseased vessels and unable to establish flow to the foot.

Technical Notes

1. Preoperative imaging for suspected embolic disease is rarely needed. Patients should be expedited to the operating room as quickly as possible.
2. When exposing the below-knee popliteal artery, it is often necessary to identify and ligate the anterior tibial vein to fully expose the origin of the anterior tibial artery. Individual tibial artery thrombectomy is necessary.
3. If there are no signals at the end of case pedal, cut down procedures are helpful to perform retrograde thrombectomy with #2/3 Fogarty catheters for retained tibial thrombus.
4. If after all above fails to restore flow to foot, terminate procedure and take to ICU for further care. Severe spasm of the tibial arteries is the norm not the exception, and signals are often present within 24 h of the operation.
5. Avoid amputation at the same setting unless absolutely necessary, such as the following:
   - Severe reperfusion syndrome
   - Non-salvageable limb with severe rhabdomyolysis leading to renal failure

Complications

- Bleeding
- Infection
- Ongoing ischemia
- Compartment syndrome
- Reperfusion syndrome
- Limb loss
- Death

Template Operative Dictation

Preoperative Diagnosis Acute *right/left upper/lower*-extremity ischemia

Procedure (1) *Right/left iliofemoral* thrombectomy. (2) *Right/left popliteal-tibial* thrombectomy

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* who developed acute onset of *right/left* foot pain at rest. Physical examination revealed a pulseless, cool foot. Sensory and motor functions were *present/diminished/absent*. The patient received 10,000 U of heparin intravenously at that time. The patient had *well-known/no prior history* of claudication, rest pain, nonhealing ulcers, or gangrene. Additionally, the patient had *well-known history/no prior history* of atrial fibrillation/congestive heart failure/myocardial infarction.

Operative Findings *There was fresh thrombus in the right iliac, common femoral, superficial femoral, and profunda femoris arteries. After the iliofemoral thrombectomy, the patient had no Doppler signals at the ankle. An arteriogram demonstrated occlusion of the below-knee popliteal artery. Popliteal and tibial artery thrombectomy was then performed. There was dense old clot in the anterior and posterior tibial arteries. There was fresh thrombus in the tibioperoneal trunk and peroneal arteries. After tibial thrombectomy the patient had biphasic/triphasic Doppler signals (or palpable pulses) at the ankle in the posterior tibial/anterior tibial/peroneal arteries.*

Alternate Findings

- There was severe atherosclerotic disease in the distal external iliac artery and common femoral/superficial femoral artery/profunda femoris artery/popliteal artery that required endarterectomy.
- There were no signals at the end of case after tibial thrombectomy requiring pedal vessel exposure and retrograde tibial thrombectomy.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general/local* anesthesia (may start under local for femoral thromboembolectomy). The patient was placed in the supine position, and the abdomen and lower extremities were prepped and draped in the standard fashion. Perioperative antibiotics were administered.

A *vertical/transverse* skin incision was made over the femoral artery. The subcutaneous tissue was dissected with cautery and veins and lymphatics were ligated and divided as necessary. The common femoral artery was dissected free and small side branches were controlled. The proximal common femoral artery was controlled with a vessel loop at the level of the inguinal ligament. The profunda femoral artery was dissected free and controlled with a vessel loop. The superficial femoral artery was then dissected free and controlled in the same manner.

The patient was given 100 U/kg of heparin intravenously. After 3 min, a transverse arteriotomy was created on the common femoral artery using a #11 blade scalpel. The arteriotomy was extended using angled Pott's scissors. (Use longitudinal arteriotomy if artery is diseased.) A balloon catheter thrombectomy of the profunda was successfully performed using a #3 Fogarty catheter. The superficial femoral artery was cleared of thrombus using a #4 Fogarty catheter. There was good back-bleeding at this point from the superficial femoral and profunda femoris arteries. The #4 Fogarty catheter was then passed retrograde into the iliac artery and thrombus was removed with the establishment of excellent pulsatile inflow. The arteriotomy was then closed using interrupted 6-0 Prolene sutures. (Use patch angioplasty with a longitudinal arteriotomy.) Excellent Doppler signals in the DP and PT were noted.

If no DP, PT Doppler signals: *A continuous-wave Doppler was then used to insonate the tibial vessels. There were no Doppler signals at the ankle at this time. An excellent popliteal Doppler signal was noted. Intraoperative arteriography was performed using a 20-gauge angiocatheter inserted into the common femoral artery. The proximal common femoral artery was clamped. Contrast was injected and fluoroscopy was utilized. The angiogram demonstrated that the superficial femoral artery was widely patent, with an abrupt occlusion of the distal popliteal artery.*

A medial incision was made below the knee, 1.5 cm posterior to the medial margin of the tibia. The subcutaneous tissue and fascia were divided. The gastrocnemius muscle was retracted posteriorly. The popliteal artery was palpated and dissected free from the accompanying vein and nerve. The vein was retracted posteriorly. The artery was controlled proximally and distally; the dissection was carried out beyond the origin of the anterior tibial artery. The anterior tibial vein *was dissected free and ligated proximally and distally and divided. The anterior tibial artery and the tibioperoneal trunk were controlled with vessel loops. A transverse/longitudinal incision was then made in the popliteal artery and extended with angled Pott's scissors. There was pulsatile inflow. A #2/#3 Fogarty catheter was then carefully passed into the anterior tibial artery and thrombus was withdrawn with the balloon partially inflated. This was repeated until all of the thrombus was removed. The posterior tibial and peroneal arteries were then cleared of thrombus in the same manner. There was excellent back-bleeding from the tibial arteries at this point.*

The popliteal artery was then closed primarily/by patch angioplasty with 6-0/7-0 Prolene suture. The vessels were back-bled and flushed prior to completing the repair. The clamps were removed. Doppler was again used to insonate the PT and DP arteries at the ankle. There were good triphasic (*biphasic*, *monophasic*) *signals at this time*.

If still no signals in the foot: *A continuous-wave Doppler was then used to insonate the tibial vessels. There were no Doppler signals at the ankle at this time. An excellent popliteal Doppler signal was noted. Intraoperative arteriography was repeated. The angiogram showed widely patent femoral/popliteal and proximal filling of* (*AT/PT/peroneal*) *with abrupt occlusion in the calf*.

A longitudinal incision was made in the dorsum of the foot near the ankle. Dissection was carried through the subcutaneous fat and extensor retinaculum. The extensor hallucis and extensor digitorum muscles were retracted and the dorsalis pedis artery was visualized. The artery was dissected away from the veins and controlled with vessel loops proximally and distally. A transverse arteriotomy was made in the artery and a #2/#3 Fogarty catheter was retrograde passed the origin of the anterior tibial artery. Thrombus was removed with the balloon partially inflated with the return of pulsatile inflow. The catheter was then gently passed antegrade with the removal of a small amount of thrombus. Manual compression of the foot was used to remove additional thrombus. There was good back-bleeding at this point. The artery was then closed with interrupted 7-0 Prolene suture. The artery was back-bled and flushed prior to completion of repair.

A longitudinal incision was then made posterior to the medial malleolus. The dissection was carried down through the subcutaneous fat and crural fascia. The posterior tibial artery was visualized and dissected away from the vein. It was controlled with vessel loops proximally and distally. Thrombectomy was then performed in a similar fashion to the dorsalis pedis artery, *with the removal of thrombus and establishment of pulsatile inflow and brisk back-bleeding. The artery was repaired with interrupted 7-0 Prolene suture. Prior to the completion of repair*, *the artery was back-bled and flushed. Doppler was again used to insonate the PT and DP arteries at the ankle. There were good triphasic* (*biphasic*, *monophasic*) *signals at this time*.

The leg muscle compartments were assessed for the need for fasciotomy.

The incisions were closed using multiple layers of 3-0 braided absorbable sutures and the skin was closed using 4-0 monofilament absorbable sutures.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was extubated and transported to the postanesthesia care unit in stable condition. The patient had triphasic (biphasic, monophasic) Doppler signals in the foot on arrival to PACU.

226 Upper-Extremity Thromboembolectomy

Jamal J. Hoballah

Indication

- Acute upper-extremity ischemia secondary to embolism or thrombotic event

Essential Steps

1. Identify the likely site of obstruction, based on history and physical exam.
2. Obtain proximal and distal control.
3. Circumferential dissection of the brachial artery at the antecubital fossa.
4. Circumferential dissection of the origin of the radial and ulnar arteries.
5. Make arteriotomy (transverse vs. longitudinal).
6. Catheter thromboembolectomy (avoid overdistension and repeated passes). This may be performed using fluorsocopic guidance.
7. Artery closure (primary vs. patch).
8. Assess distal perfusion.
9. Evaluate the arm for compartment syndrome.

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Note These Variations

- The brachial artery can be exposed through a transverse or S-shaped skin incision overlying the antecubital fossa.
- Dissection of the origin of the radial and ulnar arteries is optional.
  The thromboembolectomy may be performed using fluoroscopic guidance to avoid overdistension of the balloon and better appreciate the anatomy. A completion angiography may be performed to document revascularization.

Complications

- Bleeding
- Infection
- Ongoing ischemia
- Compartment syndrome
- Limb loss

Template Operative Dictation

Preoperative Diagnosis Upper-extremity ischemia; right brachial artery and radial and ulnar artery occlusions

Procedure Brachial, ulnar, and radial artery thromboembolectomy

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_226

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* who developed acute onset of *right/left* upper-extremity pain, with bluish discoloration. The patient was found to have a pulseless, cool hand. Sensory and motor functions were *present/diminished/absent*. The patient received 10,000 U of heparin intravenously ___ min prior to the start of the procedure. The patient had no prior history of hand pain, nonhealing finger ulcers, or gangrene. The patient has a history of *atrial fibrillation/congestive heart failure/myocardial infarction*. Duplex evaluation revealed a clot in the brachial, ulnar, and radial arteries. The risks and benefits of the procedure were explained to the patient, who elected to proceed with surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *local/axillary block/general* anesthesia. With the patient in the supine position, the *right/left* upper extremity was prepped and draped in the usual sterile fashion. The skin over the antecubital space was infiltrated with *1.0/0.5 %* lidocaine. A 5-cm skin incision overlying the antecubital fossa was then performed and deepened through the subcutaneous tissue and fat. The biceps aponeurosis was incised over the brachial pulse. The brachial artery was circumferentially dissected to its bifurcation into the ulnar and radial arteries. The patient was already receiving heparin anticoagulation. The brachial artery was controlled with Silastic vessel loops and a transverse arteriotomy was performed. Clot was extruded and good inflow was established. A #*2/3* Fogarty catheter was then introduced into the ulnar artery, and thromboembolectomy of the ulnar artery was performed until no clot could be retrieved and a good back bleeding was established. The same was then performed to the radial artery. Thorough irrigation with heparinized saline was then performed. The arteriotomy was closed using *6-0/7-0 interrupted/running* sutures. At the completion of the procedure, there was evidence of palpable pulse in the *radial/ulnar* artery with excellent signals in the radial and ulnar arteries. The suture line was hemostatic. The wound was then irrigated with antibiotic solution and closed using 3-0 Vicryl for the subcutaneous tissue and 4-0 Monocryl for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Part XXI

Vascular Surgery: Aneurysmal Disease

Open Thoracoabdominal Aortic Aneurysm Repair

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Loay Kabbani and Farah Mohammad

Indications

- Thoracoabdominal aortic aneurysm (TAAA) that are symptomatic, or measure >6 cm in diameter.

Essential Steps

Preoperative:

- Cardiac clearance is essential in these patients. A cardiac catheterization or coronary CTA study is routinely performed, even if the patients are not symptomatic.
- Bowel prep with magnesium citrate, and a clear liquid diet is prescribed for 3 days prior to the operation.

  Nursing Support:

- Foley catheter with thermal probe
- Bean bag, with gel pad
- Axillary role
- Pillows for feet
- Upper and lower body "Bair hugger"
- 2 Bovies
- Cell saver

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- Wall suction
- Left arm rest for lateral decubitus position.
- Renal perfusion solutions:
  – Lactated Ringer's (LR); 2 Liters, heparin; 2,000 units, Solu-Medrol; 1 g, 8.4 % Sodium bicarbonate; 30 ml, 25 % Mannitol; 25 ml.
- Omni retractors

Anesthesia support:

- Right radial A- lines are usually placed in the operating room. An additional right femoral A line may be needed as well.
- Central line Cordis or Swan-Ganz catheter may be placed.
- TEE should be available in the room, especially if there is concern about the cardiac status.
- A naso- or orogastric tube, to decompress stomach before TEE is placed. The naso- or orogastric tube will need to be replaced at the end of the case if taken out.
- Antibiotics per protocols.
- Arterial blood gases, with lactate, hemoglobin and ACT should be monitored hourly after heparin is given.
- Double lumen endotracheal tube, used for types I–III, and single lumen ET for type IV TAAA.
- Spinal drain, to be placed by the anesthesia team the morning of surgery

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_227

(a) Drain 18 ml/h, or 120 ml, for the duration of the operation.
(b) Drain *50 ml* of cerebrospinal fluid (CSF) from the time the spinal drain is placed until thoracic stent graft is deployed. (may clamp spinal drain if you reach this number before it is time to cross clamp)
(c) Allow CSF to drain freely, aiming for an intrathecal pressure (ITP) of 10 cm of H2O, and to a maximum of *120 ml*, *for the entire case*.

- Keep mean arterial pressure at or above 90 mmHg while the aorta is cross clamped, to maintain spinal cord perfusion pressure.
- Keep mean arterial pressure above 70 mmHg after the cross clamp is removed.

Positioning:

- Mark pedal Doppler signals.
- Center patient on table, with the hips at the breaking point of the table
- Place bean bag up to patient's shoulders. Shoulder rolls placed after patient is in right lateral decubitus position
- Place right arm rest so the arm is bent at the elbow
- Place left arm on tiered arm support
- Count ribs, mark incision with curve toward midline
- Upper and lower body bair huggers

Exposure:

- Enter fifth or sixth intercostal space (ICS) for type I and II TAAA
- Enter seven or eighth ICS space for type III
- Enter tenth or eleventh ICS for type IV
- Divide inferior pulmonary ligament.
- Dissect out intercostals if possible.
- When dividing the diaphragm, place stitches every 4 cm to help with orientation during closure at the end of the operation.
- May perform the dissection completely retroperitoneally, or may enter the peritoneum and perform a medial visceral rotation by rotating the descending colon, spleen, pancreas, left renal and abdominal viscera, exposing the aorta in the retroperitoneal space.
- Dissect out the aorta from the aortic hiatus to the iliac bifurcation. Lymphatics are ligated with 3-0 Vicryl ties, and/ or a Harmonic scalpel. The lumbar branch of left renal vein is divided between 3-0 Vicryl ties.
- Look for the ureter (may use urethral stents in redo operations).
- Divide left diaphragmatic crus.
- Identify and dissect out the left renal artery.
- Dissect proximal aorta, left iliac artery, celiac artery and superior mesenteric artery (SMA). There is thick sympathetic tissue around the celiac and SMA.

Bypass procedure:

- When treating types I, II, III TAAA a cardiac perfusionist needs to set up a bypass pump to perfuse the distal body.
- The outflow is an 8 mm Dacron graft sutured on the distal aorta, left iliac artery or left common femoral artery (CFA) to use as a conduit. A 7-French straight Argyle perfusion catheter is secured into the graft.
- The inflow into the pump is the left inferior pulmonary vein for partial cardiopulmonary bypass (CPB), or a long venous cannula placed in the femoral vein for complete CPB.

Operation:

- Vascular clamps are placed first distally, then proximally.
- The aneurysm is opened and the intercostal and lumbar arteries that are not going to be re-implanted are ligated.
- A 9 and 10 F cardioplegia catheters is placed in the left and right renal arteries, and SMA. Cold perfusion is initiated. Initially, 250 ml of cold perfusion is given over 15 min, then a 50 ml bolus is given every 15 min.
- The sequence of anastomoses may vary, but usually after completing the proximal anastomosis, the intercostals are re-implanted, followed by the right renal artery, the visceral vessels, the distal anastomosis, and finally the left renal.

- Time performing the anastomosis is time well spent. Repairing any leaks is a waste of time and may be dangerous.

Closure:

- The diaphragm is closed with 0-Prolene in a continuous fashion.
- The chest wall needs to be approximated, with 1-PDS, using a blunt needle.
- The abdomen is closed in layers, using 0-PDS

End of operation:

- Change double lumen ET tube to a single lumen

Postoperative:

- Intravenous fluids (LR) are maintained at 250–350 ml/h until the patient is resuscitated over the next 12–24 h.
- Urine replacement fluid (Most patients have excessive diuresis postoperatively) : LR with 20 meq/L extra of potassium. Replace with 0.5 ml of fluid for every ml of urine, as long as the urine output is more than 100 ml/h,
- ABG/lactate and Hg are checked every 4 h
- The lumbar drain is kept at 10 ml of drainage for 48 h, clamped for 8 h, then discontinued.

Note These Variations

- There are four types of thoracoabdominal aneurysms. Types I, II, III require partial bypass to the lower extremities.
- Leave the left kidney down when there is a retroaortic renal vein.
- Motor evoked potentials may help detect early spinal cord ischemia.

Complications

- Myocardial infarction
- Spinal ischemia with subsequent paraplegia/paralysis
- Renal dysfunction and acute renal failure
- Prolong intubation and pneumonia
- Coagulopathy
- Hepatic ischemia
- Small bowel ischemia
- Respiratory failure and pneumonia
- Acute kidney injury
- Bleeding
- Gut ischemia

Template Operative Dictation

PREOPERATIVE DIAGNOSIS: Crawford extent (I, II, III, IV) thoracoabdominal aneurysm secondary to aortic dissection/degenerative disease.

POSTOPERATIVE DIAGNOSIS: same.

PROCEDURE: Repair of (XXX) thoracoabdominal aneurysm (+/− utilizing cardiopulmonary bypass) with (+/− circulatory arrest).

SURGEONS:

ASSISTANTS:

ANESTHESIA:

Indications for procedure: Patient is a ___ -year-old male/female with findings of a symptomatic/asymptomatic thoracoabdominal aneurysm type ___. The maximal aortic diameter reached ___ cm. After assessment of symptoms, size of aneurysm, and observation with serial imaging, a thorough discussion of treatment options was discussed with the patient. The nature of thoracoabdominal aneurysms and associated operative risks and complications (including, but not limited to bleeding, infection, myocardial infarction, stroke, death, spinal cord ischemia, limb loss, mesenteric ischemia, renal failure, and failure to achieve desired result) were discussed in detail with the patient and his family. The patient consented to proceed with the operation.

Description of procedure:

Timeouts were performed, using both pre-induction and pre-incision safety checklists, to verify correct patient, procedure, site, and additional critical information, prior to beginning the procedure.

The patient was brought to the operating room and placed on the OR table in supine position. Following identification by two independent identifiers, the patient was seated on the OR table and a lumbar spinal drain was placed by the Anesthesia Team. A right radial arterial line was placed, and a central line (**triple lumen tube/cordis introducer and a Swan-Ganz Catheter**) placed in the right internal jugular. The patient was then anesthetized and intubated with a (**double/ single**)-lumen endobronchial tube. He was rolled on his right side in a modified left thoracotomy position. This position was maintained with a vacuum bean bag. The patient's lower left chest, left flank, abdomen, and both groins were then prepped and draped in the usual sterile fashion.

A ___ interspace thoracoabdominal incision was then made, brought over to the midline and extended down to just below the umbilicus. The intercostal muscles were divided posteriorly and the left chest entered. The back of the ___ rib was shingled. The abdominal cavity was entered and the diaphragm taken down in a peripheral fashion, leaving a 2-cm rim. Approximately 50 % of the diaphragm was incised.

If performing a type I or II TAAA:

The aneurysm begins just beyond the left subclavian artery. The mediastinal pleura was incised, and the left subclavian artery identified, as well as the aorta. Using a combination of sharp and blunt dissection, the left subclavian artery was encircled with a tape as was the arch between the left subclavian artery and the left common carotid artery. This appeared to be a suitable location for clamping. The recurrent laryngeal nerve was identified and preserved. The mediastinal pleura overlying the aorta in the chest was incised. ___ pairs of intercostal arteries were identified and dissected free for subsequent reimplantation or clamping.

A retroperitoneal exposure plane was then developed posterior to the left kidney, reflecting the left kidney and abdominal viscera anteriorly. Initial dissection of the infrarenal artery was carried out. The aorta at the level of the inferior mesenteric artery was identified and the aorta cleared of surrounding lymphatic and areolar tissue, using a combination of Harmonic scalpel and cautery. The left renal artery was initially identified and dissected free from surrounding tissues and encircled with a vessel loop.

Attention was then focused on the supraceliac aorta, where the left crus of the diaphragm was divided longitudinally, and the supraceliac aorta dissected out until this exposure communicated with the lower portion of the thoracic exposure. Once we were satisfied that a clamp could be placed at this level, dissection proceeded more distally where the celiac artery and then the SMA were identified. These two vessels were encircled with vessel loops.

If going on pump:

A transverse incision was made in the left groin and the femoral artery exposed. The patient was partially heparinized with 5,000 units of heparin, and the femoral artery controlled proximally and distally. An 8 mm Dacron limb was then sewn on to the femoral artery in end-to-side fashion. A purse-string suture of 5-0 Prolene was then placed on the femoral vein, and an Estech femoral venous cannula was introduced via Seldinger technique into the right atrium, with its tip location confirmed in the superior vena cava by TEE.

The patient was fully heparinized and an ACT was monitored to ensure adequate level of anticoagulation. the arterial and venous cannulae were hooked up to the cardiopulmonary bypass circuit and bypass initiated. The mid descending thoracic aorta was then clamped, while raising the bypass flow to maintain a mean arterial pressure in the right femoral artery to 65–70 mmHg.

Proximal anastomosis:

The left subclavian artery was then clamped as was the aortic arch. just distal to the left carotid artery. The aorta was opened (**and the septum of the dissection was excised**). Multiple back-bleeding bronchial and intercostal arteries were carefully oversewn.

The aortic neck was then trimmed just distal to the left subclavian artery, where there appeared to be a reasonable sewing ring, this was sized to a ___mm graft. An albumin-impregnated Dacron graft was then brought to the table and sutured to the aorta in an end to end fashion with a running stitch of 4-0 Prolene. Following the application of BioGlue, the anastomosis was tested and noted to be hemostatic. Attention was directed to the more distal aorta.

Re-implantation of the intercostal arteries:

A clamp was placed on the proximal abdominal aorta at the level of the hiatus, just above the celiac artery. The pairs of intercostal arteries in the lower chest that had been dissected out were clamped. The aorta was then opened to the level of the diaphragm. Examination of the preserved intercostal arteries showed them to originate at the T8–T12 level. The graft was distended and an area marked to correspond to the planned reimplantation of the intercostals. The graft was re-clamped, an ellipse of graft material removed, and a side-to-side anastomosis between the graft and the distal descending thoracic aorta, at the level of the intercostals, was performed. Following completion of this anastomosis and back-bleeding the intercostal arteries, the anastomosis was checked and noted to be hemostatic. A clamp was placed across the graft just below the diaphragm.

Re-implantation of the visceral arteries:

The infrarenal aorta, IMA, SMA, celiac, and supraceliac aorta were clamped. The aortotomy was then extended down through the visceral segment to the level of the infrarenal aorta. A 9-French perfusion catheter was then placed in the right and left renal artery orifices for cold perfusion. A 10-French catheter was placed in the origin of the SMA, and perfusion with a cold protection solution initiated. Inspection of the aorta at this level revealed reasonably healthy aortic tissue, which appeared to be amenable to a very small reimplantation disc. (*or the aorta was unhealthy and a branched aortic graft was used*). The graft was distended and an ellipse marked out for the creation of a side-to-side anastomosis. The graft was re-clamped, using an eye cautery, an ellipse of graft material was removed, and a side-to-side visceral/renal patch anastomosis was created between the graft and the aorta, including the origins of the right renal, SMA, and celiac, using a running stitch of 4-0 Prolene. Just prior to completion of this anastomosis, the perfusion catheters in the right renal and SMA were removed and these arteries were back-bled. A clamp was placed across the graft distally after flushing, and the anastomosis completed. The anastomosis was noted to be hemostatic. At this time, the patient was noted to have a good Doppler signal in the right renal, the SMA, and the celiac arteries. Flow was finally restored to the viscera and right renal artery after a total cross clamp time of ___ minutes. There was an appropriate drop in blood pressure with restoration of flow.

Distal anastomosis:

Attention was then directed to the distal aorta, where the aorta was transected just above a large pair of lumbar arteries. *The dissection septum within the distal aorta was excised in a V-shaped fashion*. The graft was then distended and trimmed, and an end-to-end anastomosis made between the graft and the infrarenal aorta. Following appropriate venting, this anastomosis was bioglued and noted to be hemostatic. The perfusionist now began rewarming the patient. At this point, the patient was noted to have good Doppler flow in both feet, and was making good amounts of urine. Heparin anticoagulation was therefore reversed with protamine (alternative: wait to remove the pump cannulas before giving protamine).

Re-implanting of the left renal artery:

Attention was directed to the left renal artery reimplantation. The left renal artery had been previously excised from the aorta, and the aortic wall was trimmed to create an appropriate reimplantation "button." A Lambert Kay clamp was applied across the aortic graft to partially occlude it. A button of aortic graft was removed at an appropriate site, and an end of renal artery to side of aortic graft anastomosis created with a running stitch of 5-0 Prolene. Following appropriate venting, flow was restored to the left renal artery with a good Doppler signal.

(***alternatively An*** *__mm PTFE side branch*, *which had been sutured to the aortic graft in end-to-side fashion on the back table*, *was then trimmed to an appropriate length*, *and an end-to-end anastomosis to the left renal arteries was performed with a running stitch of 6-0 Prolene*)

Discontinuation of the pump:

Once the patient had warmed up to an appropriate temperature, the venous cannula was removed and a purse-string stitch in the left femoral vein was cinched down, with good hemostasis. Blood from the pump was returned to the patient through the arterial cannula until the pump was empty, and then the cannula was removed and the graft oversewn at the level of the left femoral artery. The patient was given protamine and clotting factors to reverse his coagulopathy. Over the next 45 min, the operative field eventually dried, and careful attention was given to bleeding sites which were secured with electrocautery and stitch ties. We were ready for closure.

Closure:

The aneurysm was then closed over the graft. The crus of the diaphragm was sutured over the graft with interrupted stitches of 0-PDS,and the diaphragm was approximated, first with running and then interrupted stitches of 0-Prolene. Looped 1-0 PDS pericostal stitches were placed to reapproximate the ribs following the placement of two chest tubes. The abdomen was then closed in layers, using 0- PDS for the midline, and running stitches of 0-PDS on the different layers of the lateral abdominal wall, up to the costal margin. The chest was closed in two layers with running 0-PDS. The subcutaneous tissues were then reapproximated with 3-0 Vicryl stitches. The skin of the abdominal and medial thoracic incisions were closed with staples. Following application of a dry sterile dressing, the patient was prepared for transport to the Surgical Intensive Care Unit, having tolerated this rather complex procedure well.

A debriefing checklist was completed to share information critical to postoperative care of the patient

EBL for the case was ___ liters.

Fluids for the case included ___ liters of crystalloids, ___ units of packed red cells and ___ units of Cell Saver. ___ units of FFP, ___ pack of platelets, and ___ pack of cryoprecipitate.

Complications: None.

Condition: Stable to ICU.

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Thoracic Endovascular Aortic Repair (TEVAR) for Thoracic Aortic Aneurysm, Dissection, and Blunt Aortic Injuries

Loay Kabbani, Sherazuddin Qureshi, and Ziad Al Adas

Indications

- Thoracic aortic aneurysm (symptomatic, luminal diameter exceeding 5.5 cm, saccular aneurysm, or postoperative pseudoaneurysm)
- Thoracic aortic dissection (acute, with symptoms of rupture or malperfusion, or chronic degenerative dissection with a luminal diameter exceeding 5.5 cm)
- Thoracic aortic trauma (type II, III, and IV injuries)

Essential Steps

1. The single most important task that determines the success of these operations is preoperative planning. (Be wary of vessels with small caliber, severe tortuosity, or significant calcifications that can make vessel access difficult.)
2. CT angiography (CTA) with centerline reconstruction is ideal for preoperative planning. Centerline images can accurately estimate the diameter and length of the landing zones.
3. The patient should have appropriate landing zones known as "necks" proximal and distal to the aneurysm, so as to provide an adequate "seal" between the aortic wall and the endoprosthesis.

   Ideally, the proximal landing zone should be distal to the origin of the left subclavian artery (zones 3 or 4). The distal landing zone should be proximal to the celiac artery (zone 5). At times, the landing zones need to be extended. This is accomplished by either covering or bypassing the adjacent vessels.
4. Place the patient in the supine position. Unless brachial access is planned, the left arm is usually tucked. Secure central venous access and place an arterial line in the right arm.
5. Neuroprotection of the spinal cord is enhanced by placement of a spinal drain prior to the procedure. Allow cerebrospinal fluid to drain freely to achieve an intrathecal pressure of 10 cm of H2O. Drain a maximum of 18 mL/h or 120 mL for the entire case.
6. Insert a Foley catheter, and apply sequential compression devices on both lower extremities for DVT prophylaxis.
7. Identify and mark pedal Doppler signals.
8. Access the common femoral artery (CFA) to place the stent graft (This will be considered the main body side).
   (a) Choose the CFA that has the least pathology and an adequate iliac diameter as measured on preoperative CTA.
   (b) CFA access can be obtained via open common femoral artery exposure, or

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_228

percutaneously, after placement of a Perclose ProGlide Suture-Mediated Closure System® (Abbott).

(i) If open: after exposing the CFA, access it with an 18 g needle and a 0.35 in., 150 cm, J-tip Starter Wire® (Boston Scientific). Then, place a 5 F sheath.

(ii) If percutaneous: under ultrasound guidance, access the CFA with a micropuncture access set. Obtain an angiogram of the femoral artery bifurcation to confirm proper access of the CFA. Upsize the microsheath to a 5 F sheath proceed with placement of two to three ProGlides devices. Then upsize to a short 8 F sheath.

9. Access the opposite CFA and place a 5 F sheath or an 8 F sheath if intravascular ultrasound (IVUS) is planned (This will be the diagnostic side).
10. From the main body side place a 0.35 in., 150 cm Glidewire® (Terumo) into the sheath and follow the wire under fluoroscopy to the ascending aorta.
    (a) For aortic dissection, ensure that the wire remains in the true lumen. Straight or angled catheter support may be needed to navigate fenestrations.
11. Place a Kumpe Access Catheter® (Cook Medical) over the Glidewire from the main body side.
12. Remove the Glidewire and place an 0.35 in., 300 cm curved Lunderquist wire® (Cook Medical).
13. Mark the end of the Lunderquist wire on the table with a surgical marking pen.
    (a) If the stent graft requires a sheath, upsize the sheath on the main body side to an appropriately sized sheath over the Lunderquist wire. Make sure to follow the large sheath under fluoroscopy, while introducing it into the iliacs. At this point, ensure the patient is heparinized and follow the level of anticoagulation with serial activated clotting times (ACT).
14. From the diagnostic side, place a Glidewire into the ascending aorta followed by a marker flush catheter.
15. Obtain an aortic arch angiogram in a left anterior oblique view with the proximal landing zone in a perpendicular plane to the image intensifier. IVUS can also be used to locate important branches and evaluate the landing zone for size, length, and presence of thrombus.
    (a) If placing the stent graft down to the celiac axis, additional cross-table lateral views need to be obtained to identify the celiac artery origin.
16. Appropriately sized stent graft(s) are inserted through the main body side and deployed as per the manufacturer’s recommendations.
17. For aortic aneurysms only, the stent graft is molded onto the aortic wall with a compliant balloon to help establish a good seal. This should be avoided in aortic dissections and trauma cases.
18. The flush catheter is withdrawn over a Glidewire and then placed back through the stent graft into the ascending aorta.
19. A completion angiogram is obtained from the ascending aorta.
20. CFA access sites are secured, and if done through an open incision, the wound is closed in layers at the end of the operation.

Note These Variations

- Left subclavian artery coverage for acute complicated aortic dissections or ruptured aneurysms is acceptable.
- Balloon molding of the stent graft should not be performed for aortic dissection or trauma.
- The brachial artery may be used for the diagnostic arch angiogram and for marking the arch vessels.

Complications

- Retrograde aortic dissection into the arch and ascending aorta
- Spinal cord ischemia with subsequent paraplegia/paralysis
- Endoleaks

- Stroke
- Failure to deploy the stent graft into the true aortic lumen (for aortic dissection cases)

Template Operative Dictation

Date of Procedure : _________

Preoperative Diagnosis Thoracic aortic aneurysm

Postoperative Diagnosis Same

Surgeon : ___________

Assistant : ___________

Anesthesia General (Or local with IV sedation)

Procedure

1. Ultrasound-guided access of bilateral common femoral arteries
2. Bilateral catheter introduction into aorta
3. Placement and endovascular repair of thoracic aneurysm using ------ endograft
4. Placement of distal (or proximal) extension piece of ------endograft
5. Supervision, performance, and interpretation of thoracic aortic angiogram and endograft deployment
6. Percutaneous closure of bilateral common femoral arteries using Perclose devices

Estimated Blood Loss ___mL.

Complications : ___________

Contrast Used : ___________ ml

Fluoroscopy Time : ___________ min

Implants : ___________

Indications for Procedure Patient is a ___-year-old *male/female* with findings suggestive of a *symptomatic/asymptomatic* thoracic aortic *aneurysm*. After a thorough clinical evaluation (including review of preoperative imaging studies), the risks, benefits, and alternatives of a thoracic endovascular repair were discussed with the patient and his family, including the risks of bleeding, infection, retrograde dissection, paraplegia, endoleak, stroke, and death. The patient was consented for the operation.

Description of Procedure The patient was brought into the operating room and placed on the operating room table in a supine position. Sequential compression devices were placed on both lower extremities. Time-outs were performed using both pre-induction and pre-incision safety checklists to verify the patient, procedure, site, and additional critical information prior to beginning the procedure. A spinal drain was placed by the anesthesia team. General anesthesia was induced. A Foley catheter was inserted under sterile conditions. The right arm was placed on an arm board and an arterial line was secured. Central venous access was established. Pedal Doppler signals were identified and marked. The lower abdomen, bilateral groins, and upper thighs were prepped and draped in a sterile fashion. Preoperative antibiotics were administered.

For Percutaneous CFA Access (Main Body Side)

Under ultrasound guidance, the common femoral artery was accessed using a 4 F micropuncture kit. The microintroducer was placed and an IV extension tube was attached. A femoral artery angiogram was obtained in an ipsilateral oblique view confirming placement of the microinducer into the common femoral artery. A J-tipped wire was guided into the microintroducer and it was exchanged for a 5 F sheath. Two ProGlides were placed in a standard fashion, and the access site was then back-plugged with an 8 F sheath.

Attention was directed toward the contralateral common femoral artery. Under ultrasound guidance, the common femoral artery was accessed using a 4 F micropuncture kit, which was exchanged over a wire for a 5 F sheath. *This was upsized to an 8 F sheath for IVUS*.

From the main body side, a 0.35 in., 150 cm Glidewire was placed into the ascending aorta. A Kumpe catheter was placed over the Glidewire and was exchanged for a 0.35 in., 300 cm Lunderquist wire. From the contralateral common femoral artery, a separate Glidewire was advanced into the ascending aorta. A pigtail catheter was advanced into the ascending aorta and connected into the power injector. An aortic arch angiogram in a left anterior oblique view was obtained. Based on the intraoperative and preoperative CTA measurements, an appropriately sized stent graft was brought into the field. The patient was given heparin, and the ACT was maintained at a value two times the baseline. A ___French sheath was then placed into the ipsilateral common femoral artery and passed through the iliac arteries under fluoroscopic guidance. A ____endograft was selected and inserted into the ipsilateral sheath. It was advanced under fluoroscopic guidance to the descending thoracic aorta. Another angiogram was performed to confirm proper positioning of the endograft, and the endograft was deployed. *A cross-table lateral angiogram was obtained to identify the celiac axis. A second stent graft was placed distally with appropriate overlap*. A compliant balloon was placed, and the seal zones and stent overlap zones were molded. A Glidewire was placed up the contralateral common femoral artery to reposition the flush catheter through the stent graft and into the ascending aorta. Finally, a completion angiogram was obtained. No endoleaks were identified.

Attention was then directed toward closure of the common femoral artery access sites. The Lunderquist wire was exchanged for a J-tipped wire over a Kumpe catheter. The ProGlides were then deployed in the standard fashion as the sheath was withdrawn. The puncture site was closed with a single Vicryl suture, and the skin edges were approximated.

For Open Common Femoral Artery Approach (Main Body Side)

The inguinal ligament was identified and a *transverse/longitudinal* incision was made over the common femoral artery. The incision was deepened through the underlying subcutaneous tissue and deep fascia. The common femoral artery was identified, dissected to some length proximally and distally, and controlled with vessel loops. An 18 g needle was used to puncture the common femoral artery *through a counter incision in the skin*. A J-tipped wire was advanced under fluoroscopy. A 5 F sheath was placed and secured.

At the end of the procedure:

A vascular clamp was placed on the distal common femoral artery. With another vascular clamp in place at the proximal common femoral artery, the sheath and wire were withdrawn, allowing some back-bleeding prior to clamp removal. The arteriotomy was closed with 6-0 Prolene suture in a *running/interrupted* fashion. The wound was closed in layers. A sterile dressing was applied.

Before removing the *5 F/8 F* sheath in the contralateral common femoral artery, anticoagulation was reversed. Systolic blood pressure was controlled and the sheath was removed. Direct pressure applied for ___ minutes. There was no hematoma. A sterile dressing was applied. Pedal Doppler signals were preserved bilaterally. *A debriefing checklist was completed to share information critical to the postoperative care of the patient*. The patient was taken to the intensive care unit in a stable condition for monitoring.

Drains Foley catheter, *spinal drain*

Dispo Intensive care unit, stable medical condition

Creation of Iliac Conduit Prior to Tevar/Evar

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Sung Woon Chung and Jamal J. Hoballah

Indication

- Iliac anatomy that precludes insertion of a large aortic device through the femoral/iliac artery

Essential Steps

1. 10-cm oblique skin incision mid-distance between the costal margin and the anterior superior iliac crest
2. Division of the external, internal oblique muscles and the transversalis abdominal fascia
3. Dissection in the retroperitoneum with mobilization of the peritoneal contents medially
4. Exposure and control of the common, internal, and external iliac arteries
5. Heparinization: 75 UI/kg
6. Applying vascular clamps on the common, internal, and external iliac arteries
7. Performance of another angiogram under magnification
8. Creation of a 12-mm arteriotomy in the external/common iliac artery
9. Construction of an anastomosis with a 10-mm Dacron graft
10. Exposure of the common femoral artery through a transverse inguinal incision
11. Creation of a tunnel from the retroperitoneum to the inguinal incision
12. Passage of the graft in the tunnel

Note This Variation

- The iliac conduit may be ligated at the end of the procedure or anastomosed to the common femoral artery in the presence of severe iliac occlusive disease.

Complication

- Bleeding/disruption of the anastomosis while passing or removing the aortic device

Template Dictation

Preoperative Diagnosis Performance of TEVAR/EVAR in the presence of small/occluded external iliac arteries

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_229

Procedure Creation of iliac artery conduit

Postoperative Diagnosis Same

Indications The patient has a thoracic/abdominal aortic aneurysm and is a candidate for endovascular treatment. His iliac arteries were of a *small size/occluded* not allowing the passage of the stent graft necessitating the construction of a conduit to the common iliac artery.

Details of the Operation Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. With the patient in the supine position and after induction of general anesthesia, the abdomen and chest were prepped and draped in the usual sterile fashion. A transverse incision was then performed over the lateral aspect of the flank. This was deepened through the external and internal oblique muscles. The transverse fascia was then incised. The retroperitoneum was entered and the peritoneal contents were mobilized medially exposing the iliac vessels. The external iliac artery was then identified and encircled with a vessel loop. Dissection proximally was performed until the mid-level of the common iliac artery. The takeoff of the internal iliac artery was also identified and controlled. The patient was then given 5,000 units of IV heparin, and the common, internal, and external iliac arteries were clamped. A 12–15 mm arteriotomy was then performed in the common iliac artery. A size 10-mm diameter Dacron graft was then obtained and beveled to match the opening in the common iliac artery. The anastomosis was then conducted using a 4-0 Prolene running suture. At the completion of the anastomosis, there was evidence of excellent hemostasis. The graft was flushed. A transverse incision was then made in the groin and the common femoral artery was dissected. The graft was then tunneled from the retroperitoneal space into the inguinal incision. The wound was packed with a lap pad, and the procedure was then continued for the endovascular *thoracic/abdominal* aortic aneurysm repair.

Percutaneous Fenestration and Stenting of Complicated Acute/Subacute Type B Aortic Dissections

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Mel J. Sharafuddin and Joss D. Fernandez

Indication

- Evidence of end-organ malperfusion as a result of a visceral and/or iliac branch vessel complicating TBD.
- This is usually required after initial stent-graft exclusion of the primary tear at the level of the subclavian artery, with persistent malperfusion or, at times, development of new-onset malperfusion.

Essential Steps

1. Initial evaluation requires demonstration of the upper and lower limits of the dissection flap and the characteristics of each branch vessel obstruction. Our preference is a thin collimation (1 mm) CT angiography (CTA).
2. At times, extension of the proximal thoracic stent graft or reinforcement using uncovered stents (petticoat approach) may suffice to reverse malperfusion. In other occasion primary visceral or iliac stenting from the "well-perfused" lumen (true or false) may be a better approach than fenestration. Fenestration is usually reserved to multivessel malperfusion that is ill suited to stenting or when the compromised branches are primarily supplied from a compressed lumen that is clearly compromised.
3. Intravascular ultrasound (IVUS) is invaluable in assessing the location of the guidewires whether in the true or false lumen. Angiography alone can be deceptive especially in the stenting of dynamic branch compromise.
4. Proper selection of the access vessels based on individual dissection patterns is critical. This can usually be based on the CTA findings. Antegrade true lumen access via the right brachial or axillary artery is rarely needed.
5. Systemic anticoagulation.
6. Access and verify position of the guidewire in the true lumen using IVUS or alternatively transesophageal echography.
7. Establish guidewire access across the dissection septum by catheter-guidewire access across a native fenestration of via transseptal needle puncture.
8. Serial balloon dilation of the intimal flap fenestration.
9. Alternatively "cheese cutter" approach can be used by pulling a snared guidewire down to achieve a controlled tear of the septum.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_230

10. Final angiography to ascertain equalization of filling in both true and false lumens at the level of the fenestration(s).
11. Stenting of branch vessels with significant luminal compromise after fenestration.

Complications

- Aortic rupture
- Propagation of dissection flap
- Embolization
- End-organ ischemia due to failure to re-perfuse a visceral branch

Template Operative Dictation

Preoperative Diagnosis Malperfusion secondary to descending aortic dissection

Procedure (1) Thoracic endograft of acute aortic dissection, (2) percutaneous fenestration of intimal dissection flap, (3) _________(celiac, SMA, Rt renal, Lt renal) artery stenting, (4) intravascular ultrasound of the aorta, (5) aortogram, and (6) selective _________(mesenteric, renal) arteriogram

Postoperative Diagnosis Malperfusion secondary to descending aortic dissection

Indications This ___-year-old *male/female* patient presented with severe back and abdominal pain. Computed tomographic angiography demonstrated a dissection within the descending aorta. The visceral vessels were originating from either the true or false lumen as follows: ___________________________. Following stent-graft exclusion of the primary tear in the proximal descending aorta, there is (continued) evidence of malperfusion of the _______(visceral, *renal*) *vessels* manifested with *renal insufficiency or abdominal pain and elevated white blood cell count and rising acidosis*.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *general/spinal/epidural* anesthesia. The patient was positioned on the operating table in a supine position. The right arm and bilaterally groins were prepped and draped in a sterile fashion.

Percutaneous access into both the bilateral common femoral arteries is established under ultrasound guidance. Access into the true lumen is established on the right side, guided by the CTA. On the left the guidewire is directed into the false lumen. Single Perclose ProGlide device is deployed on each side prior to upsizing to a 45 cm long 10 Fr sheath on the right and a 45 cm long 9 Fr sheath on the left. An intravascular ultrasound catheter is advanced from the left groin to the level of the left subclavian artery. The position of both wires with respect to the intimal flap is then confirmed. If present the position of the stent graft and the relationship of its proximal end to the primary tear are ascertained, as well as the diameter of the true lumen distal to the stent graft. The configuration of the dissection septum and its relationship to the visceral and iliac vessels is documented. The locations of any native fenestrations that could be subsequently expanded are noted and compared to the preoperative CTA.

Positions of the ____________ (any of the visceral vessels) are confirmed by ultrasound to be originating from the true lumen which is compressed. The decision is made to fenestrate the infrarenal aorta.

Through the right femoral access sheath, a Rösch-Uchida transjugular liver access needle sheath is advanced over the Amplatz wire to the level of the infrarenal aorta based on IVUS within the true lumen. The level of puncture should allow enough room from the needle to be safely passed into the false lumen. Under fluoroscopic and intravascular US control, the needle assembly was positioned until it could be clearly seen indenting the intimal flap. The puncture is created from the true to the false lumen using a coaxial 50 cm 21-gauge Sheba needle, under real-time guidance using the IVUS catheter position across the other side of the septum. Once position in the false lumen is confirmed, a 0.018 in. guidewire (V-18 or SV-5) is advanced through the Sheba needle into the false lumen. The tract is dilated using a 5×40 mm microballoon. The microware is then exchanged into a stiff 0.035 in. stiff guidewire, and serial dilation up to the desired diameter is then performed (using 10, 14, and 20 mm balloons). Angiography is performed by positioning the sheath 10 cm above the fenestration point to confirm improved visceral filling and lack of extravasation or other possible complications. Pressure gradient between the false and true lumens can also be determined, with a less than 10 mm gradient required.

Flush catheter is then placed at the level of the left subclavian artery, and flush aortogram is performed demonstrating adequate perfusion to all visceral branches.

Alternatively flush aortogram demonstrated persistent compromised perfusion to the right renal artery. The decision was therefore made to proceed with stenting from the false (alternatively true) lumen. The right renal artery was selected using a 0.035 in. guidewire through a Sos Omni angiographic catheter and exchanged for a Rosen wire. A 6 French Ansel 1 sheath was advanced into the main right renal artery and used to deliver a 6×22 mm iCAST stent graft ensuring at least 10 mm of seal in the main renal artery and 4–5 mm protrusion into the false (alternatively true) lumen. The ostium is then flared using a 10×20 mm balloon. Completion arteriography demonstrated much improved patency of the renal artery with a brisk nephrogram.

The sheaths were removed. Hemostasis was completed using the percutaneous closure devices.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

Notes

Preoperative Imaging

Contrast CT angiogram of the chest, abdomen, and pelvis with 1–2 mm collimation and 3D reconstruction

Contraindications

The presence of large thrombus burden
Confirmed prolonged renal non-perfusion

New dense neurologic deficit
Evidence of aortic rupture or leak

231 Endovascular Aneurysm Repair with Parallel Graft Technique or CHIMPS

Neelima Katragunta

- CHIMPS (Chimney, Periscope, Snorkel) is used to describe the deployment of a stent into a branch vessel parallel to the main body graft to extend the seal zone while maintaining blood flow to the branch vessel.
- Although the terms chimney, periscope, snorkel are often used interchangeably, they are determined by the flow directionality.
- Chimney or snorkel usually refers to the extension of the seal zone cranially by cannulating the branch arteries through a transbrachial approach, such that the proximal end of the stent is parallel to the main body stent graft. A good example is parallel grafts into the visceral vessels while cranially extending the seal zone of an endovascular abdominal aortic aneurysm repair (EVAR).
- Periscope refers to the extension of seal zone caudally by placing a parallel graft into the branch vessel through a transfemoral approach, such that the distal end of the stent is parallel to the main body stent graft. For example, stents are placed into the visceral vessels through a femoral approach to caudally extend the seal zone of a thoracic endovascular aneurysm repair (TEVAR).
- Sandwich technique is a related term that refers to any combination of chimney/snorkel or periscope grafts that are sandwiched between two main body grafts. The inflow to the branch stents comes from this overlap area of the two main body grafts. For example, in a thoracoabdominal aortic aneurysm, the chimney/snorkel visceral stents can be sandwiched between the proximal and distal thoracic aortic graft pieces.

Considerations

- There has to be at least 5 mm seal zone beyond the most proximal or distal branch vessel stent.
- If a sandwich technique is used, overlap of the sandwiched area needs to be at least 5 cm (8 cm in the aortic arch) to prevent a "gutter leak" (a type III endoleak that results from the space between the parallel stents).
- We recommend that the aortic stent graft be oversized slightly more than that recommended by the IFU.
- We recommend the use of stent grafts, self-expanding (Viabahn), or balloon expandable (iCast), for stenting the branches.

Indications

This technique is outside instructions for use (IFU) and should, therefore, be reserved for the situations where a fenestrated endovascular

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_231

abdominal aneurysm repair (FEVAR) is not feasible and the patient is a poor surgical candidate.

- A symptomatic or ruptured abdominal aortic aneurysm (AAA) that has inadequate seal below the renal arteries, and the patient is a poor candidate for open surgical repair
- As a bailout procedure, when an aortic stent graft is deployed with partial or complete coverage of one or both renal arteries
- AAA in a patient who is not a candidate for a FEVAR due to anatomical constraints (for example, the cranial most renal artery is too close to the superior mesenteric artery (SMA))
- Prior open or endovascular aortic intervention that precludes a FEVAR
- Tortuous or severely angulated visceral aortic segment that can prevent alignment of fenestrations with the vessel origins during a FEVAR
- Hostile iliofemoral access vessels that preclude safe entry of large sheaths for FEVAR due to small size, excessive tortuosity, and/or extensive calcification

Preoperative Imaging

Contrast CT scan of the abdomen and pelvis with fine cuts (2 mm) and 3D reconstruction (M2S, Vitrea, TerraRecon, etc.)

Contraindications

- Any condition of the patient that threatens to infect the graft (active UTI, sepsis, wound infection, etc.)
- Allergy to graft materials

Essential Steps

1. Access the common femoral artery on either side using micropuncture technique, confirm puncture site with an angiogram, and place a 6 Fr sheath. Then place two Proglide devices on each side and replace the 6 Fr sheath with a 9 Fr sheath.
2. Systemically anticoagulate the patient with 80 units/kg intravenous heparin with a goal activated clotting time (ACT) of 250–300. Administer boluses as needed through the remainder of the procedure.
3. Place a glide wire into the thoracic aorta under fluoroscopic guidance on either side.
4. On the ipsilateral side, exchange for a stiff Amplatz wire or Lunderquist wire using a glidecath.
5. Access the left brachial artery using a brachial artery cutdown (percutaneous access with ultrasound and micropuncture kit is also an option). Exchange this for a short 6 Fr sheath over a glide wire.
6. Direct a glide wire into the abdominal aorta using an appropriate catheter (e.g., glide catheter or multipurpose catheter). Exchange the short 7 Fr sheath for a long one (55 cm) and place its tip in the visceral aorta.
7. Using the contralateral femoral access, place a flush catheter at the level of L1 vertebra and remove the glide wire. Connect the catheter to a power injector.
8. Position the gantry or c-arm with an orthogonal angle calculated from the preoperative CT angiogram (usually around 10° cranial).
9. Obtain an aortogram to include the renal arteries and bilateral hypogastric arteries (using 15 cc/s at 30 cc and 900 psi).
10. Measure the distance between the lowest renal artery and the ipsilateral iliac bifurcation (a marker catheter can be left in place over the ipsilateral wire during the angiogram to aid in accurate measurement).
11. Obtain an aortogram with a magnified view of the origins of the renal arteries (10 cc/s at 20 cc and 900 psi). Use this image as a reference overlay or mark the position of the renal arteries on the screen.
12. Through the previously placed long left brachial sheath, using an appropriate catheter such as a multipurpose catheter, cannulate one of the renal arteries.
13. Once true lumen entry is confirmed with an angiogram, advance the sheath into the renal artery over a dilator. Introduce and deploy the renal stent. While maintaining wire access into this renal artery, stent the other renal artery in a similar fashion, and maintain wire access.

14. Exchange the ipsilateral femoral sheath for a large sheath sized appropriately for the main body, and introduce the main body of the EVAR graft under fluoroscopic guidance making sure the contralateral gate is oriented as desired.
15. Deploy the aortic stent graft such that it is slightly below the cranial ends of the chimney renal stents and below the SMA origin. Use an aortogram with steep lateral view to locate the SMA prior to deploying the main body.
16. Cannulate the contralateral gate using an angled catheter of choice such as a glide or multipurpose catheter. Confirm entry into the graft either by ensuring that a formed pigtail catheter can easily spin in the proximal graft or with an arteriogram.
17. Place a stiff wire through the contralateral gate into the thoracic aorta. Exchange the smaller sheath for an appropriate sheath for the contralateral limb.
18. Place the marked pigtail catheter over this wire with its proximal marker overlapping the flow divider marker on the graft.
19. Obtain an angiogram through the contralateral sheath using an oblique view to splay the contralateral iliac bifurcation. Measure the distance between the flow divider and the iliac bifurcation using the marked pigtail catheter that is in place.
20. Introduce and deploy the contralateral limb.
21. After obtaining an ipsilateral sheath angiogram with an oblique view, completely deploy the ipsilateral limb.
22. Introduce a compliant balloon (Reliant or Coda) balloon through the smaller contralateral sheath first and use it to model the distal seal zones as well as all the overlapping zones. Repeat the step from the ipsilateral side.
23. Obtain a final angiogram (15 cc/s at 30 cc at 900 psi) while using a large syringe connected to each sheath to establish forward flow during the angiogram. Look for the position of the graft and any endoleaks, kinks, dissection, or migration and ensure patency of the renal and hypogastric arteries.
24. Remove all wires and catheters. Close the access sites using the previously placed Proglide devices on each femoral access site.
25. Close the brachial artery access site with 6′0 Prolene, the wound with Vicryl, and the skin with Monocryl sutures (or hold pressure for 15–20 min if percutaneously accessed).
26. Confirm hemostasis and check distal pulses.

Potential Complications

- Gutter leak (type III endoleak that occurs due to space between the parallel grafts)
- Kinking of the branch stent leading to stenosis or occlusion
- Fracture or fragmentation of the branch stent
- Branch stent migration
- Type I leak due to poor seal at the seal zone

Template Operative Dictation

Preoperative Diagnosis Juxtarenal AAA

Procedure Endovascular abdominal aortic aneurysm repair with bilateral renal artery stenting using CHIMPS technique

Postoperative Diagnosis Juxtarenal AAA

Findings Juxtarenal AAA

Estimated Blood Loss ___ cc

Indications This ___-year-old man/woman was found to have an asymptomatic/symptomatic ___ cm juxtarenal AAA. Preoperative imaging was reviewed, and the patient was deemed not to be a good candidate for a fenestrated EVAR. It was felt that the patient might not tolerate an open procedure due to the severe comorbidities, and therefore an EVAR along with CHIMPS technique was felt to be the best option.

Description of Procedure The procedure was performed under general/spinal/epidural anesthesia.

After obtaining an informed consent, the patient was brought to the hybrid suite and placed in a supine position. Prophylactic intravenous antibiotic was administered. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The patient was prepped and draped in an appropriate sterile fashion from the neck down to the knees to include the left arm.

Under ultrasound guidance, the common femoral arteries were accessed on either side with a micropuncture needle and wire. Once the wire position was confirmed, the microsheath was exchanged for a 6 Fr sheath over a glide wire. Using pre-close technique, two Proglide devices were deployed on each side, and the sheath was exchanged for a 9 Fr sheath. The patient was systemically heparinized at this point with 80 units/kg IV heparin. ACT was maintained between 250 and 300 for the remainder of the procedure with additional boluses as needed.

The glide wire on the ipsilateral side was exchanged for a stiff Amplatz wire using a glide catheter. The glide wire was then exchanged for a marker catheter to allow for measurements. A flush catheter was introduced into the contralateral sheath and connected to the power injector.

We then directed our attention to the left brachial artery access. We chose to perform a brachial artery cutdown using a longitudinal incision along the distal bicipital groove. This was deepened with electrocautery, and the brachial sheath was carefully entered with sharp dissection. The brachial artery was identified and controlled between silastic vessel loops. This was punctured using a micropuncture kit. The microsheath was exchanged for a short 6 Fr sheath. A glide wire was then introduced into the brachial artery and directed into the abdominal aorta using a glide catheter. We then exchanged the sheath for 7 Fr × 55 cm one with the tip placed near the visceral aorta.

An aortogram was then obtained using the flush catheter placed in the contralateral femoral access site. Measurements were obtained to confirm the length of the main body of the graft to be used. We then obtained another angiogram with a magnified view of the renal arteries. Through the brachial artery sheath, we then cannulated and stented each renal artery with a 7×5 mm Viabahn stent graft after exchanging the wire for a 0.018 wire.

We then exchanged the ipsilateral 9 Fr sheath for a 22 Fr sheath and introduced the main body of the aortic stent graft through it. An aortogram was obtained using a steep lateral angle to determine the origin of the SMA. The main body was then deployed carefully to land below the origin of the SMA and just below the cranial ends of the renal stents.

The ipsilateral limb remained constrained, and the gate was cannulated through the contralateral sheath using a glide wire and glide catheter. Entry into the main body of the graft was confirmed by spinning a pigtail catheter inside it. This was then exchanged for a stiff Amplatz wire, and an angiogram was obtained with an oblique angle to locate the origin of the hypogastric artery of the contralateral side. The sheath was exchanged for a 14 Fr sheath through which the contralateral limb was introduced and deployed. We completed the deployment of the constrained ipsilateral limb after obtaining a sheath angiogram with an oblique angle to locate the hypogastric artery.

After this, a Coda balloon was used to profile the overlap areas and the distal seal zones. We obtained a final angiogram that showed no endoleaks and patent renal and hypogastric arteries bilaterally.

We then closed the bilateral femoral access sites with the previously placed Proglide devices. The brachial artery access site was closed using a 6′0 Prolene interrupted sutures, and the wound was closed with 3′0 Vicryl and the skin with subcuticular 4′0 Monocryl sutures.

The patient tolerated the procedure well, and there were no intraoperative complications. He/she had palpable pedal and left wrist pulses at the end of the procedure.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

He/she was extubated uneventfully and was moving all four extremities prior to transfer to the postoperative recovery unit.

Elective Transabdominal Replacement of Infrarenal Abdominal Aortic Aneurysm

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Jamal J. Hoballah

Indications

- Diameter >5.5 cm in men, 5.0 cm in women
- Rapid growth >1 cm in 1 year
- Distal embolization
- Tenderness

Essential Steps

1. Midline xiphoid to pubis incision.
2. Abdominal exploration for unexpected findings.
3. Retract the transverse colon anteriorly and to the right.
4. Retract the splenic flexure posteriorly and laterally.
5. Divide the peritoneal periaortic attachment of the duodenum.
6. Wrap the small bowel in a wet towel and retract to the right.
7. Incise the retroperitoneum overlying the aorta and continue proximally.
8. Identify the left renal vein.
9. Dissect the aortic aneurysm neck and prepare it for clamping.
10. Incise the retroperitoneum overlying the aorta and continue distally.
11. Expose the right common iliac artery and its bifurcation.
12. Dissect the right external and internal iliac arteries and prepare them for clamping.
13. Incise the peritoneal attachments of the sigmoid colon to the lateral abdominal wall.
14. Reflect the sigmoid medially and expose the left external iliac artery.
15. Extend the dissection to expose the left common iliac artery and its bifurcation.
16. Dissect the left external and internal iliac arteries and prepare them for clamping.
17. Anticoagulate with heparin 75–100 U/kg and wait for 5 min.
18. Cross-clamp the external and internal iliac arteries and then the aorta.
19. Enter the aneurysm and remove aneurysmal content.
20. Oversew bleeding lumbars and control the inferior mesenteric artery (IMA).
21. Prepare the proximal neck for construction of the anastomosis.
22. Construct the proximal anastomosis and check for hemostasis.
23. Construct the right distal anastomosis and check for hemostasis.
24. Perfuse into the internal iliac artery first and then the external iliac artery.
25. Repeat the same on the left.
26. Check sigmoid viability.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_232

27. Reevaluate hemostasis.
28. Close the aneurysm wall.
29. Close the abdomen.
30. Recheck distal pulses.

Note These Variations

- Endovascular repair (EVAR) is typically offered first as an option if the anatomy is appropriate.
- When constructing the proximal anastomosis, the aneurysm neck can be completely transected or Td off, leaving the posterior wall intact.
- The distal anastomosis is carried at the aortic bifurcation or iliac level depending on the distal extent of the aneurysmal disease.
- Every attempt is made to reperfuse at least one hypogastric vessel. The IMA is reimplanted if there is concern regarding the adequacy of the pelvic reperfusion.

Complications

- Bleeding
- Myocardial infarction
- Pneumonia
- Renal failure
- Wound infection
- Wound dehiscence
- Limb ischemia
- Bowel ischemia
- Buttock ischemia
- Spinal cord ischemia

Template Operative Dictation

Preoperative Diagnosis *Asymptomatic/tender* abdominal aortic aneurysm

Procedure Replacement of *infrarenal/juxtarenal* abdominal aortic aneurysm with *tube/bifurcated* graft

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with an *asymptomatic/tender* abdominal aortic aneurysm measuring ___ cm. The risks of rupture and surgical intervention were discussed with the patient and *he/she* elected to undergo surgical intervention. The patient was not deemed to be a good candidate for EVAR.

Description of Procedure The patient was placed supine on the operating table. *His/her* arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Anesthesia placed appropriate lines and induced and intubated the patient without complications. A Foley catheter was then placed under sterile technique. The patient's anterior abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

The skin incision was then made from the subxiphoid to the suprapubic region. The subcutaneous tissue was divided with electrocautery. The linea alba was exposed and incised. The peritoneum was elevated and entered sharply. The abdominal wall incision was then extended to the full length of the skin incision.

There was *no/moderate number of* adhesions requiring lysis.

Abdominal exploration revealed *no/the following* incidental findings (detail).

The transverse colon was then elevated superiorly out of the wound, wrapped in a moist towel. A moist rolled lap pad was placed in the bed of the splenic flexure of the colon, which was retracted laterally and posteriorly. The remainder of the small bowel was then deflected to the right, exposing the aortic aneurysm. Sharp dissection of the ligament of Treitz and the distal fourth portion of the duodenum allowed further exposure of the aneurysm and retraction of the small bowel to the right. The small bowel was then wrapped in a moistened towel and held in place using an Omni retractor.

The retroperitoneum overlying the aorta was incised and continued proximally to the level of the left renal vein. *The inferior mesenteric vein was encountered*, *ligated*, *and divided*. The lymphatics overlying the aortic neck were ligated and divided.

The abdominal aortic aneurysm neck was then sharply dissected.

The infrarenal neck appeared to be adequate for clamping and constructing the proximal anastomosis.

The infrarenal neck appeared to be inadequate for clamping and constructing the proximal anastomosis. Further mobilization of the left renal vein was performed. The left gonadal, *lumbar*, *and adrenal veins were ligated and divided. The left renal vein was circumferentially mobilized and retracted proximally*, *exposing the renal arteries. The suprarenal aorta was sharply dissected and appeared adequate for clamping*.

The dissection was then carried out in the pelvic region for exposure of the iliac arteries.

The retroperitoneum overlying the aorta was incised distally, exposing the right common iliac artery and its bifurcation. The right external and internal iliac arteries were dissected and prepared for clamping. The right ureter was identified and protected.

The peritoneal attachments of the sigmoid colon to the lateral abdominal wall were incised. The sigmoid colon was reflected medially, exposing the left external iliac artery. The dissection was extended proximally, exposing the left common iliac artery and its bifurcation. The left external and internal iliac arteries were dissected and prepared for clamping. The left ureter was identified and protected.

Heparin 75–100 U/kg and mannitol 12.5 g were administered intravenously. After 5 min from the heparin administration, the external arteries were cross-clamped, followed by the internal iliac arteries and then the aorta.

The aneurysm wall was then incised longitudinally on its anterior aspect, keeping to the right of the origin of the inferior mesenteric artery. The aneurysm cavity was entered and the aneurysm content and debris removed. The IMA had pulsatile back-bleeding and was oversewn with 2-0 silk sutures/*the IMA had sluggish back-bleeding and was controlled with a double-looped Silastic tape*. The bleeding lumbar arteries and middle sacral artery were oversewn with figure-of-eight 2-0 silk sutures.

The aneurysm neck was then prepared for the construction of the proximal anastomosis. The incision in the aorta was carried to the level of the neck of the aneurysm. The incision was then Td off on each side of the neck, leaving the posterior wall intact/*transecting the posterior wall*.

A *20×10/18×9/16×8 Dacron/PTFE* graft was then soaked in antibiotic solution. The body of the graft was trimmed for the proximal anastomosis. The anastomosis was constructed in a running fashion using 3-0 Prolene sutures. At the completion of the suture line, the sutures were tied and the anastomosis checked for hemostasis. Hemostasis was *adequate/except for a suture line bleeding controlled with an interrupted mattress suture/needle hole bleeding controlled with the topical application of Gelfoam soaked with thrombin*.

Attention was focused on the iliac anastomoses.

The right side was performed first. The incision in the right common iliac artery was carried beyond the aneurysmal disease. The incision was then Td off on each side, leaving the posterior wall intact/*transecting the posterior wall*.

The right limb of the graft was then sized and cut. The anastomosis was then performed with 4-0 Prolene running sutures. Prior to completing the anastomosis, the iliac clamps were released, allowing for back-bleeding of the right external and internal iliac arteries. The aortic clamp was released for forward-flushing of the graft. The anastomosis was copiously irrigated with heparinized saline solution. The clamps were then released, allowing flow into the internal iliac artery first, followed by the external iliac artery. The right femoral artery was palpated and had a strong pulse.

Attention was then focused on the left iliac anastomosis. An incision in the left common iliac artery was carried beyond the aneurysmal disease. The incision was then Td off on each side, leaving the posterior wall intact/*transecting the posterior wall*.

The left limb of the graft was then tunneled *through/anterior to* the left common iliac artery and then sized and cut. Again, this was done in similar fashion with 4-0 Prolene running sutures. Prior to completing the anastomosis, the graft limb was forward-flushed and the anastomosis back-bled and copiously irrigated with heparin saline solution. The anastomosis was then completed and blood flow resumed first into the internal iliac artery, followed by the external iliac artery. The left femoral artery was palpated and had a strong pulse.

The aneurysm lumen was reinspected. Hemostasis was *adequate/bleeding from a lumbar artery was identified and was controlled with figure-of-eight 2-0 silk sutures*.

The IMA was reevaluated. There was evidence of good back-bleeding and good Doppler signals in the sigmoid mesentery. The IMA was oversewn with a 3-0 Prolene sutures/*there was poor back-bleeding and poor Doppler signals in the sigmoid mesentery. IMA reimplantation was performed. The IMA was prepared by creating a circular button of aortic wall around the orifice of the IMA. An eversion endarterectomy of the orifice was performed. A partially occluding clamp was then applied to the aortic graft. An incision was then created in the graft and the anastomosis to the IMA was performed using 4-0 Prolene running sutures. After the completion of the anastomosis*, *there was evidence of good Doppler signals in the sigmoid mesentery*.

Reinspection of all the suture lines was performed and revealed adequate hemostasis.

The field was then irrigated with antibiotic solution.

The redundant aneurysm wall was then sutured over the aortic graft using 3-0 Vicryl suture, minimizing the dead space between the aortic graft and the aortic wall.

The retroperitoneum was then closed with 3-0 Vicryl in a running fashion.

The bowel was then placed back in the anatomic position.

Abdominal wall closure was then performed with *running/interrupted* 0 Prolene sutures.

The wound was reirrigated and dried, and the skin edges were opposed with skin staples.

The peri-incisional prep and drape were cleaned and dried, followed by 4×4 gauze, silk tape.

The feet were inspected and there was evidence of strong Doppler signals.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, was awakened, and was taken to the *postanesthesia care unit/intensive care unit* in stable condition.

233 Left Posterolateral Retroperitoneal Abdominal Aortic Aneurysm Repair

Dale Maharaj and R. Clement Darling III

Indications

- As for the conventional transperitoneal approach – especially if juxtarenal, for reoperative aortic procedures, inflammatory aneurysms, aneurysms associated with a horseshoe kidney
- Particularly useful in patients with previous transperitoneal procedures and in obese patients

Complications

- Hemorrhage
- Graft thrombosis
- Trash foot
- Spinal ischemia
- Splenic injury
- Ureteric injury
- Flank bulge/hernia
- Intercostals neuralgia
- Anastomotic pseudoaneurysm

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Essential Steps

1. Incise the skin and muscle obliquely between the tenth and eleventh interspace.
2. The posterior peritoneum and posterior Gerota's fascia are retracted anteriorly, medially, and cephalad.
3. Obtain distal arterial control before proximal (iliac or femoral).
4. Anticoagulate with heparin after dissection and just prior to clamping.
5. If the right common or external iliac segments are involved, a right suprainguinal counterincision is made for access to the external iliac or vertical groin incisions for access to the femoral vessels.
6. Identify and clamp the common iliac arteries. Use sharp dissection to avoid iliac vein injury.
7. The neck of the aneurysm is located using the following landmarks – the left crus of the diaphragm, the lumbar branch of the left renal vein, and the left renal artery.
8. Ligate the lumbar branch of the left renal vein. Retract the left kidney and peritoneum medial, cephalad, and anterior.
9. The non-aneurysmal neck of the aorta is cross-clamped either above, below, or between the renal arteries.
10. The lumbar and inferior mesenteric arteries can be controlled from outside the aneurysm sac or suture ligated from within.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_233

11. The aneurysm sac is opened and any residual back-bleeders are oversewn with 3/0 polypropylene.
12. The proximal anastomosis is performed with 3-0 48-in. polypropylene continuous suture using the parachute technique.
13. The distal aortic, iliac, or femoral anastomoses are performed either in an end-to-end or in an end-to-side configuration as dictated by the anatomy.
14. Assess the anastomotic sites and secure hemostasis.
15. Inspect the spleen and descending colon via a small peritoneal window.
16. Close the wound.

Operative Note

Preoperative diagnosis	Suprarenal/infrarenal AAA or aortoiliac aneurysm (R or L iliac involvement)	
Procedure	Aneurysmorrhaphy with a tube/bifurcation graft	
	Distal anastomosis to	Aorta
		Right common iliac/external iliac/femoral
		Left common iliac/external iliac/femoral
	PTFE	Dacron
Postoperative diagnosis	Same	
Indications	_____-year-old man/woman with:	
	Symptomatic/asymptomatic/ruptured _____cm AAA found on	
	Duplex/angiography/MRA	
	Diameter _____cm	

Description of the Procedure The patient was placed on a beanbag in the right lateral decubitus position with the left shoulder elevated to 45° and the left thigh elevated 15 in. above the horizontal plane (corkscrew).

The table was extended to open the space between the costal margin and the iliac crest.

Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under general endotracheal anesthesia:

The abdomen, flank, and both groins were prepped and draped in a standard surgical fashion.

An oblique incision was made extending from the posterior axillary line to the lateral border of the rectus muscle, through the tenth or eleventh interspace.

The incision was deepened through the muscle layers with electrocautery.

The retroperitoneal space was entered and the peritoneum and Gerota's fascia were retracted anterior and cephalad. Care was taken not to retract too vigorously on the cephalad retractor to prevent splenic trauma. The fascia is left intact on the left psoas muscle.

Exposure was maintained using a Buckwalter self-retaining retractor.

30 U/kg of heparin was administered intravenously just before clamping.

The right and left common iliac arteries were dissected and cross-clamped using a double rubber and/or a straight Cooley clamp.

The aneurysm neck was identified. This was facilitated by division of the lumbar branch of the left renal vein.

Circumferential control of the proximal aorta was achieved and the aorta was cross-clamped above the level of the aneurysm neck using a Fogarty clamp or a large DeBakey aortic clamp.

The inferior mesenteric and the lumbar vessels were clip ligated before opening the aneurysm sac.

The sac was then opened using electrocautery and the back-bleeding lumbar arteries were oversewn with 3/0 polypropylene suture.

The aorta was then transected at the level of the aneurysm neck.

A 16-mm PTFE tube/bifurcation graft was sutured to the proximal cut end of the aorta using a 3/0 polypropylene continuous suture.

A second vascular clamp was placed on the graft, and the proximal clamp on the aorta was opened to assess for bleeding along the suture line, especially posteriorly. Hemostasis was confirmed.

The lumen of the graft then irrigated with heparinized saline.

The distal graft was anastomosed to the aorta (iliacs or femorals) in an end-to-end (end-to-side) fashion using 3/0 (5/0) polypropylene suture.

The common iliacs were unclamped sequentially and allowed to back-bleed, thus confirming good hemostasis at the distal suture line.

The external iliacs were Dopplered and excellent flow signals were noted bilaterally.

A 4-cm window was created in the peritoneum to assess for splenic injury and colonic ischemia. The spleen and the left colon were normal and the peritoneum was closed with 3/0 polypropylene.

Hemostasis was ensured.

The muscle was closed in three layers using 0 polypropylene or #1 PDS suture continuously.

The skin was closed with staples.

Sterile dressings were applied.

Adequate circulation to both feet was assessed.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was taken to the recovery room in stable condition.

234 Endovascular Abdominal Aortic Aneurysm Repair with the Gore Excluder Endograft

Cassius Iyad Ochoa Chaar and Michel S. Makaroun

Indications

- Infrarenal abdominal aortic aneurysm (AAA)
- Iliac artery aneurysm

Essential Steps

1. Use general anesthesia or alternatively regional block in well-chosen patients.
2. Puncture both femoral arteries using micropuncture kit.
3. Advance a 0.035-in. starter wire and exchange to 8-Fr sheaths to start a tract.
4. Place Prostar (Abbott) sutures in the femoral arteries and exchange to short 11-Fr sheath on the contralateral side. On the ipsilateral side, use a 180-cm superstiff Amplatz wire through the Prostar device and insert an 18-Fr sheath, 30 cm in length. If you are using a 31-mm main body endograft, you need to use a 20-Fr sheath.
   - (Note: Use a Lunderquist wire in cases of severe iliac tortuosity.)
   - (Steps 1–3 are used preferentially to perform percutaneous EVAR. As an alternative, the common femoral arteries can be exposed through transverse groin incisions prior to sheath placement.)
5. Heparinize the patient with one bolus of 100 U/kg. There is no absolute need for ACT monitoring.
6. Pass a 5-Fr pigtail marker catheter over the guide wire through the contralateral artery.
7. Obtain aortogram and pelvic angiogram with a power injection of intravenous contrast. A 15-ml injection at a rate of 15 ml/s is usually adequate. Less contrast volume can be used with smaller channels and renal compromise or this step can be completely avoided if needed.
8. Measure the length of the aorta from the lowest renal artery to the ipsilateral common iliac artery bifurcation. This will determine the length of the endograft needed. If you are hesitating between two lengths, choose the longer one as you will lose length through the body of the AAA especially if you cross the legs of the endograft. You should aim to cover down to the iliac bifurcation.
9. Prepare the appropriate device. The diameter should have been chosen by evaluating the preoperative computerized tomography (CT) scan.
10. Advance the ipsilateral sheath as far into the aorta as possible.
11. Insert the main body of the Excluder endograft through the ipsilateral femoral sheath and position in the infrarenal aorta.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_234

12. Orient the endograft under fluoroscopy to the desired position. Crossing the limbs is usually a good option. It is also preferable to have the contralateral gate slightly anterior in order to facilitate subsequent cannulation.
13. Obtain a repeat aortogram orthogonal to the neck with magnification for final positioning. A 15° cranial angulation is usually required even in the absence of angulation of the neck of the aneurysm. A left anterior oblique (LAO) of 10–15° can better visualize the origins of the renal arteries in most cases. This however should be guided by the origin of the renal arteries on the CT scan.
14. Mark the lowest renal artery and pull the pigtail into the aorta.
15. Position the proximal marker of the endograft right under the lowest renal artery.
16. Pull back the long sheath to the light-colored shaft marker on the delivery device to expose the endograft completely in the aorta.
17. Loosen the deployment knob and exert a continuous pull to deploy the main body.
18. Confirm the position of the endograft with fluoroscopy.
19. Introduce a 180-cm stiff 0.035-in. Glidewire (Terumo) from the contralateral side and retrieve the pigtail catheter.
20. Use an angled 5-Fr selective catheter (e.g., KMP from Cook) and a torque device to cannulate the contralateral gate.
21. Confirm the position in the endograft either by twirling the angled catheter without the wire or use of a balloon.
22. Introduce a superstiff 180-cm 0.035 Amplatz wire through the selective catheter into the descending thoracic aorta.
23. Place the pigtail catheter in the contralateral limb up to the long radiopaque marker of the main body proximally.
24. Obtain a retrograde iliac angiogram from the short iliac sheath and mark the iliac bifurcation and the distance to the gate.
25. Choose and prepare the contralateral limb.
26. Replace the short 11-Fr sheath with a 30-cm-long 12-Fr sheath or a larger sheath if a large limb is desired. Advance the sheath into the contralateral gate.
27. Insert the contralateral limb of the endograft to the level of the graft bifurcation 3 cm cephalad to the ring marker.
28. Pull back the long sheath to the light-colored shaft marker on the delivery device.
29. Loosen the deployment knob and exert a continuous pull to deploy the endograft. If C3 device is being used: Gradually deploy the graft till the contralateral gate is open by turning the white outer deployment knob in a counterclockwise manner and removing it. Continue deployment if position is satisfactory and reconstraint the graft by turning the gray knob in a clockwise manner.
30. Balloon angioplasty the neck, the sealing zones of the iliac limbs, and the zone of overlap between the main body and the contralateral iliac limb.
31. Obtain completion angiogram and confirm the absence of endoleaks.
32. Remove the sheath and catheters and reverse the heparin with protamine.
33. Close arteriotomies with Prostar sutures and skin with 4-0 Polysorb. Alternatively, the arteriotomies can be closed with 5-0 Prolene and the skin and the subcutaneous in the standard surgical manner.

Complications

- Early: Bleeding, iliac artery dissection or rupture, distal embolization, kinking, systemic complications.
- Late: Endoleak, aneurysm rupture, migration, limb thrombosis, structural graft failure, graft infection.

Template Operative Dictation

Preoperative Diagnosis Infrarenal AAA

Postoperative Diagnosis Same

Procedure

1. Percutaneous puncture of both common femoral arteries and placement of sheaths

2. Advancement of catheter into the aorta
3. Aortogram and pelvic angiogram
4. Supervision and interpretation (S&I)
5. Endovascular repair of abdominal aortic aneurysm with a bifurcated modular Excluder prosthesis (S&I)
6. Closure of femoral arteries

Surgeon Text

Anesthesia General or regional anesthesia

Indications This ___-year-old *male/female* was found to have an asymptomatic, ___-cm infrarenal AAA suitable for endovascular repair on CT scan.

Description of Procedure The patient was placed in the supine position on the operating table. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *general endotracheal/regional* anesthesia. A Foley catheter and arterial line were placed for monitoring. The abdomen and both groins were prepped and draped in the standard sterile fashion.

Prophylactic intravenous antibiotics were given prior to skin incision.

The common femoral arteries were accessed using a Seldinger technique. A starter wire was advanced into the aorta and an 8-Fr sheath was placed on each side. Prostar sutures were deployed in both femoral arteries and tagged outside the punctures. An 18-Fr sheath was placed on the right and an 11-Fr sheath on the left. The patient was heparinized (mention dose).

(For open access: The common femoral arteries were dissected bilaterally through transverse incisions and controlled below the inguinal ligament.)

A 5-Fr marker pigtail catheter was advanced to the level of the renal arteries, and an aortogram and pelvic angiogram were obtained. Single renal arteries were noted on both sides (or alternatively describe the anatomy of the renal arteries). The SMA was patent. The aneurysm starts 15 mm below the renal arteries and ends at the bifurcation (describe other anomalies, branches, involvement of the iliac arteries, etc.). The length of the aorta from the lower renal artery to the right common iliac artery bifurcation was measured.

A ___×____mm, ___cm Gore Excluder endograft was prepared and advanced through the right sheath into the infrarenal aorta under fluoroscopy. Final positioning was obtained with serial injections at the level of the renals under magnification. The sheath was pulled back and the device deployed at the desired location.

The pigtail catheter was exchanged over a 0.035-in. stiff Glidewire to a 5-Fr KMP catheter. The contralateral gate was cannulated. The marker pigtail catheter was reintroduced through the left femoral sheath over an Amplatz wire, and a retrograde left iliac angiogram was obtained to mark the common iliac artery bifurcation and confirm the length of the desired limb. A ____mm × ___ cm contralateral limb was prepared. The 11-Fr sheath was exchanged for a 30-cm-long 12-Fr sheath which was advanced into the contralateral gate. The limb was introduced and deployed at the graft bifurcation. A 14 mm × 4 cm balloon was used to secure the overlap zone, while a large compliant balloon was used to mold the endograft in the neck and both iliac sealing zones.

A completion angiogram was obtained. It showed good position of the endograft with complete exclusion of the aneurysm. There were no apparent endoleaks. The wires, catheter, and sheaths were withdrawn. The arteriotomies were closed with the Prostar sutures and the closure was hemostatic. The skin was closed using a 4-0 Vicryl U-stitch. The heparin was reversed with protamine (mention dose). A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

(For a cut down, the common femoral artery was repaired with a 5-0 Prolene suture. Hemostasis was assured and the wounds were closed using 3-0 Vicryl sutures. The skin was closed with a subcuticular suture.)

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Endovascular Repair of an Abdominal Aortoiliac Aneurysm with GORE EXCLUDER Iliac Branch Endoprosthesis (IBE)

Elizabeth Hartmann

Indications

- Treatment of common iliac artery and aortoiliac aneurysms with preservation of blood flow in the external and internal iliac arteries
- Intended to be used with Gore Excluder AAA endoprosthesis

Preoperative Imaging/Planning

High-resolution CT angiography of the abdomen and pelvis with 3D reconstruction with fine cuts (1–3 mm).

Determine the accurate size of anatomy and proper size of iliac branch component (IBC), internal iliac component (IIC), contralateral leg endoprostheses, and trunk-ipsilateral leg endoprosthesis.

Anatomic Requirements

- Adequate iliac/femoral vessel size and morphology compatible with vascular access and sheaths required to deliver device (no significant occlusive disease, thrombus, tortuosity that would compromise outflow of stent-grafts)
- Minimum common iliac diameter of 17 mm at the proximal implantations zone of the IBE
- External iliac artery treatment diameter range of 6.5–25 mm and length of 30 mm with seal zone length of at least 10 mm
- Internal iliac artery treatment diameter range of 6.5–13.5 mm and length of 30 mm with seal zone length of at least 10 mm
- Adequate length from the lowest major renal artery to the internal iliac artery to accommodate the total endoprosthesis length, calculated by adding the minimum lengths of required components, taking into account appropriate overlaps between components (165 mm for contralateral gate, up to 205 mm for ipsilateral limb)
- Anatomic suitability for the Gore Excluder AAA endoprosthesis

Contraindications

- Patients with known sensitivities or allergies to ePTFE, FEP, nitinol, or gold
- Patients with a systemic infection who may be at increased risk of endovascular graft infection
- Anatomy outside of size criteria

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_235

Essential Steps

1. Femoral access is obtained by surgeon preference (percutaneous vs open exposure). Advance a maker catheter through intended iliac treatment side and perform digital subtraction angiography to confirm the correct device component sizing and deployment locations.
2. Advance two 0.035″ “super-stiff” guidewires under catheter protection into the descending thoracic aorta. Place a 16 Fr GORE DrySeal introducer sheath on the intended IBE treatment side and a 12 Fr 45 cm flexible reinforced sheath on the contralateral side.
3. Systemic anticoagulation using 80 U/kg IV heparin. ACT target >300. Monitor ACT q30min and redose appropriately.
4. Place a second wire (0.035″ 260 cm) through the 16 Fr sheath to the level of the aortic bifurcation for snaring. After removing the stiff wire, advance a snare catheter through the 12 Fr sheath and snare the second flexible wire thus generating a flexible throughwire.
5. Cannulate the removable guidewire tube (RGT) on the iliac branch component with the 0.035″ throughwire. Remove the RGT after cannulation, leaving the through wire in the constrained endoprosthesis. Then advance the iliac branch component (IBC) device catheter over the two wires (stiff aortic wire and flexible throughwire) within the 16 Fr sheath to the approximate level of intended landing zone.
6. Maintain IBC position while withdrawing the introducer sheath. Do not rotate the device inside the delivery sheath as this can form wire wrap that can lead to catheter breakage. Perform angiography to confirm correct orientation of the IBC with the long radiopaque marker oriented toward the internal iliac artery and the internal leg ring proximal to the internal iliac origin.
7. Loosen the white outer deployment knob on the IBC, and deploy using a steady and continuous pull of the deployment knob. The external iliac leg will remain constrained on the delivery catheter.
8. Replace the 12 Fr sheath dilator over the through wire and advance the sheath over the aortic bifurcation and into the IBC down to the internal iliac leg hole. Leave the through wire in place and remove the dilator. Introduce and advance a second wire (0.035″ Glidewire) into the 12 Fr sheath and cannulate the internal iliac artery using a guide catheter to assistance if needed. Replace the Glidewire for a 0.035″ “super-stiff” wire.
9. Prepare and advance the internal iliac component (IIC) device catheter over the guidewire within the internal iliac. Align the radiopaque marker of the proximal end of the IIC device with the long marker of the partially deployed IBC. This alignment will achieve 2.5 cm overlap between the devices.
10. Maintain IIC position while withdrawing 12 Fr to ensure the entire IIC is out of the sheath. Stabilize the IIC catheter and introducer sheath while loosening the deployment knob. Deploy IIC by using a steady, continuous pull of the knob to release the component. Then remove the delivery catheter. Confirm adequate position via angiography. If needed, extension into the internal can be performed now by repeating the above steps (3 cm overlap required for iliac extenders).
11. Advance and inflate a 14 mm PTA balloon catheter to seat the proximal end of the IIC within the internal iliac artery leg hole overlap region. Advance and inflate the appropriate size PTA balloon to seat the distal end of the IIC. After balloon angioplasty and satisfactory deployment, the through wire and internal iliac wire can be removed.
12. Continue deploying the IBC by loosening the gray inner deployment knob by 90° counterclockwise. Deploy the external iliac leg by using a steady and continuous pull of the deployment knob.
13. Withdraw the delivery catheter of the IBC. Advance and inflate the appropriate size PTA balloon to seat the distal end of the external iliac leg of the IBC.
14. Withdraw the 12 Fr sheath to the aortic bifurcation, if not already done, and advance a

guidewire into the descending thoracic aorta. With a catheter, exchange for a "super-stiff" guidewire, and exchange the 12 Fr sheath for the appropriate size introducer sheath to deliver the trunk-ipsilateral leg of the GORE EXCLUDER AAA endoprosthesis into the aortic neck.

15. Position and deploy the main body and gate of the trunk-ipsilateral leg endoprosthesis after performing an angiogram to identify renal arteries. Cannulate the gate using the desired combination of the guidewire and catheter. Confirm correct cannulation within the main body, and verify the length from long radiopaque marker on the trunk-ipsilateral leg endoprosthesis to the long marker on IBC with marker catheter.
16. Under fluoroscopy, advance the contralateral leg bridge (only 23 mm or 27 mm diameters are compatible with the IBC) into the main body to the level of the long radiopaque maker. This will ensure 3 cm overlap. At this point, the rest of the ipsilateral leg endoprosthesis of the main body can be deployed.
17. While maintaining delivery catheter position, withdraw the introducer sheath below the level of the contralateral leg endoprosthesis. Confirm both proximal and distal markers of the leg are aligned with the trunk and IBC. Deploy the contralateral leg endoprosthesis.
18. Perform balloon angioplasty of the aortic neck and graft overlaps using the aortic molding balloon of choice. Perform completion angiogram to ensure aneurysm exclusion, patency of iliac branch component, and presence of endoleaks.
19. Remove all wires, catheters, and sheaths. Close femoral access sites by either open repair or preplaced percutaneous closure devices.

Potential Complications

- Access site complications such as bleeding, hematoma, pseudoaneurysm
- Dissection, perforation, or rupture of vessels
- Embolization with ischemia
- Endoleak
- Endoprosthesis migration, separation, occlusion, infection, fracture
- Impotence
- Radiation injury
- Acute renal insufficiency

Template Operative Dictation

Preoperative Diagnosis Infrarenal AAA and CIA aneurysm

Postoperative Diagnosis Infrarenal AAA and CIA aneurysms

Procedure Endovascular repair of abdominal aortoiliac aneurysm with GORE iliac branch endoprosthesis

Findings There was no endoleak seen on the completion angiogram. Bilateral internal and external iliac arteries were widely patent.

Estimated Blood Loss __ cc

Indications This is a __ yo man/woman who was found to have an infra-renal AAA measuring ____ cm in diameter as well as a ___ (right/left)-sided CIA aneurysm. Upon review of the preoperative imaging, it was felt he/she would be a good candidate for an EVAR with an IBE. All risks, benefits, and alternative treatment options were explained and an informed consent was obtained.

Description of the Procedure The patient was brought to the hybrid suite and placed in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *general/spinal/epidural* anesthesia and anesthesia was smoothly administered. He/she was prepared and draped in an appropriate sterile fashion from the neck down to the knees.

Using ultrasound guidance, each common femoral artery (CFA) was identified and accessed using a micropuncture needle and wire. These were exchanged for a Glidewire and a 6 Fr sheath. Using preclose technique, two ProGlide devices were placed in each CFA, and the sheath was upsized to 9 Fr. The patient was systemically heparinized with a goal ACT of 250–300 maintained for the remainder of the case with additional boluses.

The marker catheter was then introduced through the intended iliac treatment side, and a digital subtraction angiography was performed to confirm the measurements. A stiff 0.035″ (*Amplatz/Lunderquist*) wire was introduced on either side with its tip in the thoracic aorta. GORE DrySeal sheaths are introduced bilaterally (16 Fr on the CIA aneurysm side and a 12 Fr sheath on the other side). A second 0.035 exchange length wire is then introduced into the 16 Fr sheath and snared (using a Gooseneck or Ensnare) through the 12 Fr sheath after the stiff wire was removed from it, thus providing through-and-through bilateral femoral access to stabilize the sheaths.

The iliac branch component (IBC) of the IBE is then introduced through the 16 Fr sheath by cannulating the through wire into the removable guidewire tube as well as the stiff wire and advanced to the level of aortic bifurcation. We ensured that the long internal limb marker was aimed toward the internal iliac artery and that the gate was above the internal iliac origin. While carefully maintaining the position of the IBC, the introducer sheath was withdrawn and any rotation of the device was avoided. The IBC was then deployed to the level of the internal iliac limb ring. The 12 Fr sheath was advanced over its dilator across the aortic bifurcation to the level of the internal iliac limb ring while maintaining traction on the through wire. The dilator was then removed and a second wire, 0.035″ Glidewire, was advanced into the 12 Fr sheath. The internal iliac artery was then cannulated using the Glidewire and a *JB-1/TEG* catheter. Angiogram was obtained to confirm correct cannulation of the internal iliac artery and the Glidewire was exchanged for a stiff wire, and the catheter removed.

The internal iliac component (IIC) was then advanced through the 12 Fr sheath, over the stiff wire and into the internal iliac artery. The radiopaque markers of the IBC and IIC were aligned, the sheath was withdrawn to proximal extent of the stent, and the IIC was completely deployed. The delivery catheter was removed, and a 14 mm PTA balloon catheter was advanced to the overlap area of the IBC and IIC and angioplasty was performed. A __mm balloon was then used to angioplasty the distal end of the IIC. Angiogram was performed to identify satisfactory placement and then the internal wire and through wire were removed. The external limb of the IBC was then deployed, completing the IBC deployment. A ___mm PTA balloon was advanced into 16 Fr sheath and angioplasty of the external iliac leg of the IBC was performed.

The 12 Fr sheath was then withdrawn to the aortic bifurcation and a guidewire advanced through this into the descending aorta. This was then exchanged for a stiff 0.035″ (*Amplatz/Lunderquist)* wire using a diagnostic catheter. The 12 Fr sheath was exchanged for a __ Fr sheath to accommodate the main body device. The trunk-ipsilateral main body GORE EXCLUDER AAA endoprosthesis was then advanced to the level of the renal arteries. After confirming the position with angiogram, the main body was deployed to the level of the contralateral gate. The gate was then cannulated through the 16 Fr sheath using a Glidewire and *JB-1* catheter. We confirmed gate cannulation by spinning a marker pigtail catheter within the main body. We also visually confirmed adequate length for our bridging component from the contralateral limb to IBC radiopaque markers. We then exchanged the pigtail catheter for a stiff wire through the gate and advanced the ___ mm contralateral leg bridge into the gate. After alignment of the radiopaque markers on the leg bridge to those on the IBC and main body, it was deployed. We then finished our deployment of the ipsilateral leg endoprosthesis of the main body. Balloon angioplasty was with performed of the aortic neck and both iliac overlaps and distal seal zones using a ___ (*Coda/Reliant*) balloon. A final angiogram was then obtained demonstrating widely patent renal, internal, and external iliac arteries without evidence of endoleak. All the wires and catheters were removed and the pre-placed Perclose devices were secured in place with excellent hemostasis. A debriefing checklist was completed to share information critical to postoperative care of the patient. The patient was extubated and transported to the post anesthesia unit in stable condition. There were no complications noted.

236 EVAR Using the AFX Endovascular AAA System (Endologix)

Carlos F. Bechara

Indications

- Asymptomatic 5.5 cm or greater infrarenal aneurysm in male
- 5.0 cm infrarenal aortic aneurysm in female
- Contained rupture in hemodynamically stable patient

Essential Steps

1. Examine femoral and lower extremity pulses preoperatively.
2. Measure length, diameter, and angulation of infrarenal aortic neck.
3. Determine size of landing site for device.
4. Femoral cutdown or percutaneous access on side of device introduction (ipsilateral side).
5. Percutaneous access on the contralateral side with 9-F sheath (contralateral side).
6. Biplanar aortogram.
7. Heparinize patient. Send ACT. Re-bolus heparin if inadequate.
8. Place the 17-Fr AFX introducer sheath (ipsilateral side) at the level of the aortic bifurcation.
9. Snare the wire, coming out of the wire guide, from the contralateral side.
10. Advance the AFX device over stiff wire through introducer sheath.
11. Stent-graft orientation is crucial.
12. No gate cannulation is needed in this stent graft.
13. Deploy the bifurcated graft and place it over the aortic bifurcation.
14. Deploy ipsilateral limb of graft then the contralateral limb.
15. Deploy the aortic extension from the main body to just below the renal arteries and then iliac limb extensions when necessary.
16. Remove catheter and wires.
17. Remove access sheath and close arteriotomy.
18. Hold pressure/use automatic closure device.

Note These Variations

- Need for extension cuffs proximally
- Need for additional iliac limbs
- Preoperative coiling for feeder vessel

Complications

- Endoleak
- Stent-graft migration
- Percutaneous access site pseudoaneurysm.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_236

Operative Template

Preoperative Diagnosis Infrarenal abdominal aortic aneurysm

Procedure EVAR using Endologix AFX stent graft

Postoperative Diagnosis Same as above

Indications for Procedure Patient is a_-year-old (male/female) with a history of (asymptomatic/symptomatic) abdominal aortic aneurysm. After noting appropriate anatomy for EVAR, and risks/benefits of open vs. endovascular repair, patient decided upon endograft placement.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The patient was prepped and draped in a sterile fashion. A (right/left) femoral artery cutdown (could be done percutaneously using either a Proglide or Prostar device) was performed sharply after which blunt and sharp dissection was used to encircle the SFA, profunda, and common femoral artery with vessel loops. On the contralateral (right/left) side, a 9-F catheter was inserted percutaneously, under fluoroscopic guidance. 5,000 units of heparin were then administered intravenously.

The 17-Fr AFX introducer sheath (ipsilateral side) was advanced to the level of the aortic bifurcation over a stiff 0.0035″ wire. The bifurcated device delivery system was advanced into the introducer sheath. A wire was placed through the guidewire and snared from the contralateral side through the 9-Fr sheath. Keeping the flush port medial, we advanced the bifurcated delivery system until it clicked into the introducer to make it a single unit. The inner core is advanced over the wire under fluoroscopy until the marker matches the sheath. We made sure the contralateral limb wire is in great position and not coiled or tangled around the delivery system. The delivery system is advanced until the limbs are above the bifurcation. Then the bifurcated device is unsheathed until the introducer sheath is below the aortic bifurcation. The inner core is pulled while stabilizing the sheath to seat the bifurcated stent graft on the aortic bifurcation. Then we removed the floppy tip from contralateral wire and advanced an 0.014″ guidewire through the hollow center through the device into the thoracic aorta. The main body was deployed by twisting and pulling the control core handle. The stent-graft position was (adequate/repositioned). The inner core was pulled to deploy the ipsilateral limb. The delivery system for the bifurcated device was removed, and the dilator was placed over the wire to advance the sheath to above the level of the renal arteries, for aortic cuff extension. The contralateral limb was deployed by pulling on the wire. Then aortic extension was deployed under the renal arteries. The inner core and delivery system were removed. A limb extension (was/was not) placed. A contralateral limb (was/was not) deployed. A pigtail catheter was inserted above the renal arteries over a guidewire, and an aortogram was performed using ___ cc of contrast.

The delivery system was removed, followed by removal of guidewire. The arteriotomy in the (right/left) common femoral artery was closed with interrupted 6-0 Prolene suture (or closed using the preclose technique). The groin was closed in three layers with 2-0 Vicryl, followed by 3-0 Vicryl, and 4-0 Monocryl suture for the skin. The 9-F sheath was removed and manual pressure held for 20 min on the access site or a closure device was used. A debriefing checklist was completed to share information critical to postoperative care of the patient. Sterile dressings were placed on the wounds, distal pulses were checked, and patient was taken to recovery. All counts were correct.

237 Endovascular Abdominal Aortic Aneurysm Repair with the Cook Zenith Flex or Zenith LP Endograft

Fady F. Haddad and Jamal J. Hoballah

Indications

- Infrarenal abdominal aortic aneurysm (AAA) >5.5 cm (nonruptured) in men and 5.0 cm in women, enlarging AAA >4.0 cm (grown >5 mm in 6 months), common iliac artery aneurysm.
- Anatomic exclusions:
  - Neck:
    Infrarenal neck length <15 mm
    Diameter >32 or <18 mm
    Neck angulation >60° relative to aneurysm long axis
    Neck angulation >45° relative to suprarenal aorta
    Inverted funnel
    Circumferential thrombus
  - Iliacs:
    Iliac fixation site <10 mm in length and >20 mm in diameter

Essential Steps

1. General or regional anesthesia in well-selected patients.
2. Prepare surgical field as for an open repair (from nipples to knees).
3. Expose and control of the common femoral arteries through small transverse inguinal incisions (or alternate vessels: iliac conduit if needed). Percutaneous access with preparation of a pre-close device is an option, especially for the contralateral side.
4. Introduce size 7 French sheath in each common femoral artery.
5. Anticoagulate with IV heparin sulfate (100 U/kg) (keep ACT ~ 300 throughout the case).
6. Introduce guide wires (started, J or hydrophilic) into the thoracic aorta under fluoroscopic guidance bilaterally. Exchange with stiff 260-cm guide wires, *Lundquist (alternatively Amplatz)* through diagnostic catheters on the site selected for main device insertion.
7. Place pigtail or straight marked diagnostic catheter into the infrarenal aorta via the contralateral side.
8. Confirm the level of the renal arteries and measure the distance to the aortic bifurcation to verify that the contralateral gate will open few centimeters proximal to the aortic bifurcation with angiography (15 cc/s for 20 cc).
9. Prep the main device and flush with heparinized solution. Appropriately orient the device and position of the contralateral gate and check mark (usually slightly anterior for ease of cannulation).

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_237

10. Remove the ipsilateral sheath and insert main device over the stiff guide wire to the level of the renal arteries while maintaining the desired orientation of the device.
11. Position proximal markers (top of fabric) at the approximate desired location (just below lowest renal artery).
12. Tilt the image intensifier cephalad to align markers, accommodating for common anterior angulation of the neck.
13. Repeat the angiogram (15 cc/s for 15 cc) under a magnified view to mark the position of the renal arteries.
14. Using continuous fluoroscopy begin deployment of the Zenith graft at the desired level until the first two stents are opened and a diamond shape stent is seen. At this point, one can still readjust position of the device.
15. Confirm endovascular graft position to the renal arteries by angiography (15 cc/s for 15 cc) and then retract the contralateral catheter to the aortic bifurcation level.
16. Complete the deployment just until the contralateral limb is opened. In the new Zenith LP, continue with deployment of the suprarenal bare stent by release of the distal (first) trigger wire.
17. Access the contralateral limb using floppy wires and directional catheters.
18. Confirm wire position within the graft by coiling the wire and then by angiography using a straight diagnostic catheter. (In the Zenith LP, the top is already open, confirm by rotating a pigtail in the body and angiography in the graft).
19. Release and push the cap covering the suprarenal stent only 2–3 mm to allow visualization of the renal arteries while perform an angiogram for final confirmation of the level of deployment in relationship to the renal arteries (optional) (refer below to variations).
20. Push the cap to the level of the diaphragm thus fully deploying the suprarenal stent (advance the top cap 1–2 cm beyond the deployed stent). (Steps 19 and 20 apply only to Zenith Flex.)
21. Advance the catheter and wire into the thoracic aorta from the contralateral leg.
22. Replace the wire with a stiff 260-cm Amplatz or Lunderquist wire.
23. Place a marking catheter over the wire.
24. Perform an angiogram through the contralateral sheath to document the origin of the hypogastric artery.
25. Select the contralateral limb size based on the measured length from the contralateral gate to the internal iliac (keeping in mind a 1–1.5 stent overlap into the main body contralateral leg).
26. Prep the contralateral limb.
27. Remove the 7 French sheath and insert the device with the contralateral limb.
28. Deploy the graft under continuous fluoroscopic guidance overlapping the gate completely.
29. Retrieve the nose cone with the delivery system under fluoroscopic control.
30. Complete the deployment of the ipsilateral limb.
31. Release the last trigger wire (holding the graft to the delivery system).
32. In the Zenith LP, just retrieve the delivery system under fluoroscopy, leaving the sheath in place. For the Zenith Flex, advance the gray pusher on the ipsilateral side to the level of the cap and allow it to dock into the cap (suprarenal stent cover) and retrieve the cap under continuous fluoroscopic control.
33. Place marking catheter and perform retrograde angiogram to identify the origin of the ipsilateral hypogastric artery and verify the selected ipsilateral limb.
34. Prep the ipsilateral limb and introduce into the main device sheath.
35. Deploy the ipsilateral limb at the desired location (keep in mind 1–3 stent overlap with the main body ipsilateral limb).
36. Mold junction and attachment sites with appropriately sized Coda balloon.
37. Place pigtail catheter into the aorta above the stent graft.
38. Evaluate graft position, patency, and the presence of endoleaks by angiography.

39. Remove catheters, sheaths, and wires sequentially.
40. Close arteriotomies.
41. Confirm hemostasis.
42. Check distal pulses.
43. Close the wounds.

Note This Variation

- An additional size 5 French sheath may be placed in the contralateral femoral artery or through the left brachial artery through which a straight diagnostic catheter can be parked above the renals to provide continuous evaluation on the level of the renal arteries prior to final deployment of the suprarenal fixation stent.

Complications

- Early: mal deployment, coverage of the renal arteries, renal failure, bleeding, iliac artery dissection or rupture, distal embolization, kinking, systemic complications.
- Late: endoleak, aneurysm rupture, migration, limb thrombosis, structural graft failure, graft infection.

Template Operative Dictation

Preoperative Diagnosis Infrarenal AAA

Postoperative Diagnosis Same

Procedure (1) Exploration of bilateral common femoral arteries. (2) Advancement of catheter into the aorta. (3) Aortogram and pelvic angiogram. (4) Supervision and Interpretation (S&I). (5) Endovascular repair of abdominal aortic aneurysm with a bifurcated modular Zenith endoprosthesis. S&I (6) Repair of femoral arteries.

Indications This ___-year-old *male/female* was found to have an asymptomatic, ___-cm infrarenal AAA suitable for endovascular repair on CT scan.

Description of Procedure The patient was placed in the supine position on the operating table. Time-outs were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general endotracheal/regional* anesthesia. A Foley catheter and arterial line were placed for monitoring. The abdomen and both groins were prepped and draped in the standard sterile fashion.

Prophylactic intravenous antibiotics were given prior to skin incision.

The common femoral arteries were exposed through small transverse inguinal skin incisions. (Alternatively, percutaneous access with placement of the pre-closure device ties.) Using Seldinger technique, a size 7 French sheath was introduced in each common femoral artery. The patient was anticoagulated with IV heparin sulfate (100 U/kg). Floppy guide wires were introduced into the thoracic aorta under fluoroscopic guidance bilaterally. On the *right/left side (main body side)*, the floppy wire was exchanged with stiff 260-cm guide wires *(Lundquist)* through diagnostic catheters. A *pigtail/straight* marked diagnostic catheter was introduced into the infrarenal aorta via the contralateral side. An aortogram was performed confirming the level of the renal arteries, and the distance from the lowest renal artery to the aortic bifurcation was measured. The selected main body device was prepped with heparinized saline solution and appropriately oriented under fluoroscopy. The ipsilateral sheath was removed, and the main device inserted over the stiff guide wire to the level of the renal arteries while maintaining the desired orientation of the device. A repeat angiogram (15 cc/s for 15 cc) under a magnified view was performed, and the position of the renal arteries was marked. Using continuous fluoroscopy deployment of the

Zenith graft was started at the desired level (with the top markers just below the lowest Renal artery) until the first two stents are opened and a diamond shape stent is seen. The endovascular graft position to the renal arteries was confirmed appropriate again by repeat angiography (15 cc/s for 15 cc). *The diagnostic catheter was pulled back to the aortic bifurcation level*. The deployment was continued until the contralateral limb was fully opened. (For the Zenith LP, the suprarenal stent was opened at this point by release of the constraining trigger wires; then the contralateral gate was cannulated; proper position within the graft confirmed by advancing and rotation a pigtail in the main body and angiographic control; j wire and catheter pushed up into the thoracic aorta; and wire exchanged to a stiff Amplatz or Lunderquist.)

For the Zenith Flex: The gate of the contralateral limb was cannulated using a glide wire and a *multipurpose/KMP/cobra/double curve* directional catheters. The wire was allowed to coil inside the body of the graft suggesting its position inside the graft. An MP catheter was introduced over the wire, and an angiogram was obtained further confirming the intragraft position of the catheter. (Optional: The cap covering the suprarenal stent was released and pushed forward by only 2–3 mm. An angiogram through the MP catheter confirmed appropriate position of the graft in relationship to the renal arteries.) A j wire was placed again in the graft and allowed to loop again. The topcap was then advanced to the level of the diaphragm thus fully deploying the suprarenal stent. The straight catheter and the wire were then advanced into the thoracic aorta. The wire was exchanged with a stiff 260-cm *Amplantz/Lunderquist* wire. A marking catheter was advanced over the wire, and a retrograde angiogram through the contralateral sheath was performed documenting the origin of the hypogastric artery. The length from the contralateral gate to the internal iliac artery was measured, and the appropriate contralateral limb measuring ___ was selected. The contralateral limb was prepped. The 7 French sheath was then removed and the device with the contralateral limb inserted into the desired location. The graft limb was deployed under continuous fluoroscopic guidance overlapping the gate completely (1–1.5 stent overlap). The nose cone was retrieved and the delivery system was removed under fluoroscopic control. Attention was then directed to the ipsilateral limb where the deployment of the main graft body was completed. Graft released from the delivery system by releasing the last trigger wire. (For the Z-LP, the delivery system is removed under fluoroscopy leaving the sheath in place.)

For the Z-Flex: After releasing the pin vise, the gray pusher on the ipsilateral side was advanced to the level of the cap and allowed to dock into the cap (suprarenal stent cover) under continuous fluoroscopic control and the cap retrieved leaving the sheath in place.

The marking catheter was introduced into the main graft body and a retrograde angiogram was performed to identify the origin of the ipsilateral hypogastric artery. The distance from the ipsilateral gate to the origin of the internal iliac artery was measured, and the appropriate ipsilateral graft limb was selected (size___). The ipsilateral limb was prepped with heparinized saline and introduced through the main device sheath. The ipsilateral limb was deployed at the desired location (*with___number of stents overlap with the main body, recommended 1–3)*. The cone and delivery systems were retrieved. The infrarenal attachment site as well, and the graft overlap and the distal attachment sites were molded using a Coda balloon.

A pigtail catheter was introduced into the aorta above the stent graft and an angiogram was performed. This revealed appropriate placement of the graft with patent limbs and no evidence of type 1 or 3 endoleaks. (*There was evidence of type 1 and 3 endoleak necessitating reinsertion of the Coda balloon and remolding of the junction and attachment site. There was evidence of type 2 endoleak which will be monitored)*.

All catheters, sheaths, and wires were removed sequentially. The arteriotomies were closed using 5-0/6-0 Prolene interrupted/continuous sutures. (Alternatively if closure devices used, the ties were sealed sequentially after sheath removal.)

Hemostasis was secured. The distal pulses were present. Heparin was reversed *(or not)* using protamine sulfate. The subcutaneous tissue was closed with 3-0 Vicryl sutures, and the skin was closed with 4-0 Monocryl subcuticular sutures. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was transferred to the recovery room in a stable condition.

238 Endovascular Aneurysm Repair (Talent-Bifurcated Graft)

F. Ezequiel Parodi and Murray L. Shames

Indication

- Infrarenal abdominal aortic aneurysm (AAA) >5 cm (nonruptured), enlarging AAA >4.0 cm (grown >5 mm in 6 months)

Essential Steps

1. Access and control of the common femoral arteries (or alternate access vessels).
2. Anticoagulate with IV heparin sulfate (100 U/kg).
3. Access the artery and exchange floppy guide wires with stiff guide wires *Amplatz and Lundquist* through diagnostic catheters, into the thoracic aorta under fluoroscopic guidance.
4. Select the *femoral/iliac* artery (healthiest, straightest, longest) for main device insertion.
5. Insert a 6-French sheath into the contralateral side over the guide wire.
6. Place pigtail or straight diagnostic catheter into the infrarenal aorta via the contralateral side.
7. Confirm level of the renal arteries and the renal to ipsilateral hypogastric artery length with angiography (15 cc/s for 30 cc).
8. Insert main device over stiff guide wire to the level just above the renal arteries and appropriately orient the device, using radiopaque markers.
9. Repeat the angiogram (15 cc/s for 15 cc) under a magnified view to mark the position of the renal arteries.
10. Using continuous fluoroscopy begin deployment of the Talent graft just above the desired level; after the first two stents are opened, gently pull device distally to desired level. Top of figures of 8 should be just below the renal arteries.
11. Confirm endovascular graft position by angiography (15 cc/s for 15 cc).
12. Complete graft deployment.
13. Retract the pigtail catheter into the aneurysm over a guide wire.
14. Retrieve the nose cone, remove the delivery system, and place a 14-French sheath.
15. Access the contra lateral limb using floppy wires and directional catheters.
16. Confirm wire positions within the graft using a pigtail catheter or angiogram.
17. Measure length from the contralateral gate to the internal iliac artery using marker pigtail and a retrograde angiogram.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*, DOI 10.1007/978-3-319-44797-1_238

18. Exchange the pigtail catheter to stiff wire.
19. Remove the 6-French sheath and insert the device with the contralateral limb.
20. Deploy the graft under continuous fluoroscopic guidance overlapping the gate completely.
21. Retrieve the nose cone, remove the delivery system under fluoroscopic control, and place 14-French sheath.
22. Mold junction and attachment sites with appropriately sized (based on artery diameter) balloons as needed (Reliant).
23. Place pigtail catheter into the aorta above the stent graft.
24. Evaluate graft position, patency, and the presence of endoleaks by angiography.
25. Remove catheters, sheaths, and wires sequentially.
26. Close arteriotomies.
27. Confirm hemostasis.
28. Check distal pulses.
29. Close the wounds.

Note This Variation

- In the presence of common iliac arteriomegaly, the procedure is modified to avoid an endoleak. One option is to use a flared iliac extension. Another option is to embolize the internal iliac artery and extend the iliac limb into the external iliac artery, which is typically free of aneurysmal disease.

Complications

- Arterial injury (dissection, disruption, thrombosis, embolization)
- Graft migration
- Type I or III endoleaks
- Renal failure

Template Operative Dictation

Preoperative Diagnosis Infrarenal AAA

Procedure Endoluminal repair of AAA using Talent endovascular graft

Postoperative Diagnosis Infrarenal AAA

Indications This ___-year-old *male/female* patient was found to have an *asymptomatic/symptomatic* ___-cm infrarenal AAA. Preoperative imaging was reviewed and the patient is a good candidate for endovascular repair.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *general/spinal/epidural* anesthesia. The patient was positioned on the operating table in a supine position. A prophylactic intravenous antibiotic (Ancef) was administered. The patient was prepped and draped in the standard fashion. A *longitudinal/oblique* incision was made at the level of the inguinal ligament and carried down to the common femoral artery bilaterally. The common femoral arteries were dissected and encircled with vessel loops proximally and distally.

The anesthesia team administered 100 U/kg or 5,000 U of heparin sulfate. The distal vessel loops were cinched down and clamped. The common femoral artery was accessed using the Seldinger needle, and a *Bentson/Glide* wire passed under fluoroscopic guidance into the thoracic aorta and was then exchanged through a catheter for Amplatz (or other still) wire. On the side of the contralateral limb, a wire was similarly placed, a 6-French introducer sheath was advanced, and through it a graduated pigtail catheter was positioned at the level of the renal arteries. On the ipsilateral limb, a 6-mm arteriotomy was performed. The Talent stent graft was flushed and advanced over the ipsilateral guide wire to above the level of the renal arteries. The graft was oriented using the radiopaque markers. All the manipulations were performed under fluoroscopic guidance. An angiogram was performed under magnification and the renal arteries were marked on the screen. The device was positioned slightly proximal to the desired landing zone and deployment started. Once the first two stents were opened, the device was gently pulled down to the desired level making sure the figures of 8 were just below the renal arteries. Repeat arteriogram assured proper infrarenal positioning. Deployment was continued until the device was fully deployed. The contralateral pigtail catheter was straightened with a wire and pulled into the aneurysm sac. The ipsilateral device was retrieved without difficulty. The pigtail catheter was exchanged for a directional catheter. Under continuous fluoroscopy, the contralateral limb was cannulated with a floppy wire and the catheter advanced into the proximal aorta. The diagnostic catheter was again exchanged for the pigtail to assure an intragraft position. A retrograde angiogram was performed to locate the contralateral hypogastric artery and select the contralateral limb. Once the appropriate limb extension was selected, the pigtail was exchanged for a stiffer wire and the delivery system with the contralateral limb was advanced into the gate of the main device. Under continuous fluoroscopy, the limb deployed overlapping the gate. The delivery system was retrieved and a 14-French sheath was placed. The pigtail catheter was then reintroduced over a guide wire and positioned proximal to the device. An angiogram was performed to assess for endoleaks and confirm positioning. The endovascular repair was free of stenoses, kinks, or endoleaks. All catheters and sheaths were carefully removed while observing the patient's vital signs. Finally, the wires were removed and the arteriotomies closed with 5-0 Prolene sutures. The vessels were flushed prior to closure. Once hemostasis was confirmed, the wounds were copiously irrigated and closed in layers with running sutures.

Examination of distal pulses confirmed no change from preoperative assessment.

Dressings were applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Angiogram Supervision and Interpretation

1. ***Flush aortogram:*** A pigtail catheter is seen at the level of the renal arteries. *Single/multiple* renal arteries are present bilaterally. No significant disease is present in either renal artery. An aneurysm is seen originating distal to the renal arteries. The iliac arteries are free of significant disease. Both internal iliac arteries are patent.
2. ***Level of deployment:*** The Talent stent graft has a suprarenal stent, figures of 8 mark the beginning of the graft, and they should be positioned below the renal arteries. There is no evidence of stenosis, kinks, or endoleaks. The renal, internal iliac arteries are widely patent. There is no evidence of stenosis or dissection in either external iliac artery.

Notes

Preoperative Imaging

Contrast CT scan of the abdomen and pelvis with 3-mm increments and 3D reconstruction

Selective use of contrast angiography

Anatomic Requirements

Proximal healthy aortic neck ^{3}10 mm in length

Proximal aortic diameter 18–32 mm

Iliac artery diameter 8–22 mm

Contraindications

Neck angulation >60°

Presence of thrombus at landing sites

Severe bilateral iliac occlusive disease (or lumen less than 7 mm)

Severe iliac artery tortuosity and calcification

Necessary Equipment

X-ray compatible operating table

Angled C-arm with:

- High-resolution fluoroscopy
- High-definition angiography
- Digital subtraction capabilities

Power injector

Seldinger needles

Selection of 0.035″ guide wires (Bentson, Glide, Amplatz, Lundquist)

Selection of catheters (MPA, graduated pigtail, Cobra, SOS, Simmons)

Arterial sheaths (6–14 F)

Talent endovascular graft with the necessary extension limbs and cuffs

Angioplasty balloons (Reliant)

Cell saver unit (optional)

Additional Aortic Endografts

Excluder endovascular graft (W.L. Gore and Associates, Flagstaff, AR)

Zenith endovascular graft (Cook Medical, Bloomington, IN)

IntuiTrack (Endologic, Irvine, CA)

Specific devices have different steps that should be included in the dictations.

239 Internal Iliac Artery Embolization

Jamal J. Hoballah

Indications

- Dilated common iliac artery in the presence of otherwise suitable anatomy for EVAR
- Internal iliac artery aneurysm
- Pelvic bleeding following pelvic fracture

Essential Steps

1. Percutaneous access of the contralateral femoral artery.
2. Placement of a size 5 French sheath.
3. Introduce a wire followed by Omni Flush catheter into the aorta.
4. Perform an aortogram with iliac runoff and confirm the iliac pathology.
5. Crossing from the contralateral iliac artery into the ipsilateral common iliac artery where the interior iliac artery is to be embolized.
6. Changing the projection to an LAO/RAO oblique.
7. Replacement of the size 5 French sheath with a size 6 guiding catheter or a long 5 French (Balkin) sheath.
8. Canalization of the ipsilateral internal iliac artery.
9. Advancement of a size 5 French catheter into the internal iliac artery at the level of embolization. Insertion of Volcano/Nester Coils/Amplatzar plug into the internal iliac artery preserving flow in the distal branches.
10. Packing the coils into internal iliac artery without spilling into the common or external iliac artery.
11. Angiogram completion angiogram.
12. Reversal of anticoagulation and removal of the sheath.

Note This Variation

- Occasionally access into the internal iliac artery may be achieved through an ipsilateral approach, and other types of embolization devices with a retrievable option (Amplatzer Vascular Plug) are also available and have been successfully used for occluding the internal iliac artery.

Complications

- Extension of the coil into the common iliac artery
- Migration of the coils into the external iliac artery

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_239

- Access site bleeding
- Pelvic ischemia
- Buttock claudication
- Sexual dysfunction

Template Operative Dictation

Preoperative Diagnosis Common iliac artery aneurysm extending into the iliac bifurcation in a patient who is otherwise a good candidate for EVAR/internal iliac artery aneurysm/persistent pelvic bleeding in a patient with pelvic fractures follow blunt trauma

Procedure Aortogram with iliac runoff; *right/left* internal iliac artery embolization

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with a large abdominal aortic aneurysm and aneurismal dilatation of the common iliac artery extending into the iliac bifurcation. The patient is otherwise a good candidate for EVAR. Embolization of the internal iliac artery is indicated to provide a suitable landing zone for the EVAR limb into the external iliac artery. The contralateral iliac artery is patent without any significant pathology. The patient has been informed of the risks and benefits the embolization of the internal iliac artery, and has agreed to the procedure.

Description of Procedure The patient was brought to the angiography suite and was placed in the angiography table in the supine position. The right and left groins were prepped and draped in the usual sterile fashion. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The contralateral groin was infiltrated with 1 % Lidocaine, and the common femoral artery was accessed using a Seldinger technique. A size 5 French sheath was inserted in the common femoral artery, and a glide wire was advanced in to the aorta. An Omni flush catheter was then advanced into the aorta and an aortogram with iliac runoff was obtained delineating the anatomy. The *Omni Flush/Cobra* catheter was then used to cross over to the contralateral common iliac artery. The 5-French sheath was then replaced by a size *5/6 French guiding catheter/5 Balkin sheath*. The tip of the sheath was parked in the common iliac artery just proximal to the take off of the internal iliac artery. A *right/left anterior oblique RAO/LAO* projection was then obtained, and another angiogram was performed delineating the orifice of the *right/left* internal iliac artery. Using an *MP/angle glade/catheter/cobra catheter*, the internal iliac artery was accessed with a 0.035 hydrophilic glide wire, and the catheter was advanced into the distal segment of internal iliac artery. An angiogram through the *MP/angle glade/catheter/cobra catheter* was obtained further documenting its position and its relationship to the common iliac artery and internal iliac artery branches. A size 10 Tornado coil/Amplatzar plug was then introduced and deployed into the desired location in the internal iliac artery preserving the collateral of the internal iliac artery. Multiple coils were introduced until the entire iliac artery was filled and packed with coils. An angiogram was then performed documenting absence of any spillage of coils into the common iliac or external iliac arteries. The catheter, wires, and sheath were then removed after the patient's anticoagulation was reversed with protamine sulfate. The sheath was removed and pressure was applied to the groin. A debriefing checklist was completed to share information critical to postoperative care of the patient.

240 Transabdominal Replacement of Ruptured Infrarenal Abdominal Aortic Aneurysm

Jamal J. Hoballah

Indications

- Abdominal pain
- Hypotension
- Shock

Essential Steps

1. Large-bore intravenous lines.
2. Prepping and draping prior to induction of general anesthesia.
3. Midline xiphoid to pubis incision.
4. Incise the triangular ligament and mobilize the left lobe of the liver to the right.
5. Incise the lesser omentum and retract the stomach to the right.
6. Divide the right crus of the diaphragm.
7. Supraceliac aortic cross-clamping.
8. Retract the transverse colon anteriorly and to the right.
9. Retract the splenic flexure posteriorly and laterally.
10. Divide the peritoneal periaortic attachment of the duodenum.
11. Wrap the small bowel in a wet towel and retract to the right.
12. Incise the retroperitoneum overlying the aorta and continue proximally.
13. Identify the left renal vein.
14. Dissect the aortic aneurysm neck and prepare it for clamping.
15. Clamp the infrarenal aorta and release supraceliac clamp.
16. Incise the retroperitoneum overlying the aorta and continue distally.
17. Expose the proximal right common iliac artery.
18. Expose the proximal left common iliac artery.
19. Cross-clamp the right and left common iliac arteries.
20. Enter the aneurysm and remove aneurysmal content.
21. Oversew bleeding lumbars and control the inferior mesenteric artery (IMA).
22. Prepare the proximal neck for construction of the anastomosis.
23. Construct the proximal anastomosis and check for hemostasis.
24. Prepare the aortic bifurcation for the distal anastomosis.
25. Construct the distal anastomosis.
26. Perfuse into the right common iliac artery with manual compression of the right external iliac artery.
27. Check for femoral pulse.
28. Repeat the same on the left.
29. Check sigmoid viability.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_240

30. Reevaluate hemostasis.
31. Close the aneurysm wall.
32. Close the abdomen.
33. Recheck distal pulses.

Note These Variations

- Endovascular repair (EVAR) may be offered first in institutions with appropriate resources and expertise if the anatomy is appropriate.
- Proximal aortic control is typically obtained at the supraceliac level. This can be achieved blindly or under direct visualization. Rescussitative Endovascular Balloon Occlsion of the Aorta (REBOA) is a new endovascular technique that can be used to obtain proximal aortic control.
- Tube replacement is most expedient and is usually attempted unless the iliac aneurysmal disease is extensive and the aortic bifurcation does not allow such a reconstruction.

Complications

- Bleeding
- Myocardial infarction
- Pneumonia
- Renal failure
- Wound infection
- Wound dehiscence
- Limb ischemia
- Trash foot
- Bowel ischemia
- Buttock ischemia
- Spinal cord ischemia

Template Operative Dictation

Preoperative Diagnosis Ruptured abdominal aortic aneurysm (AAA)

Procedure Replacement of ruptured infrarenal abdominal aortic aneurysm with tube graft

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with *abdominal pain/back pain/hypotension/tender pulsatile abdominal mass* and the presumptive diagnosis of a ruptured AAA. The risks of nonoperative management and surgical intervention were discussed with the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The patient was placed supine on the operating table. Time-outs were performed using both preinduction and preincision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The arms were placed at 80° and the anesthesia team placed large-bore intravenous lines and monitoring lines. Normal bony prominences were padded. A Foley catheter was then placed under sterile technique. The patient's anterior abdomen and both upper thighs were prepped and draped in the usual sterile fashion.

Preoperative antibiotics were administered prior to skin incision.

The patient was induced and intubated.

Immediately thereafter, the skin incision was made from the subxiphoid to the suprapubic region. The subcutaneous tissue was then divided with electrocautery. The linea alba was exposed and incised. The peritoneum was elevated and entered sharply. The abdominal wall incision was then extended to the full length of the skin incision.

[Choose One:]

If supraceliac control under direct visualization: *The triangular ligament of the liver was incised and the left lobe of the liver was mobilized to the right; the lesser omentum was incised and the stomach retracted to the left; the right crus of the diaphragm was divided; the supraceliac aorta was dissected and cross-clamped.*

If supraceliac control without direct visualization: *The lesser omentum was incised and the supraceliac aorta was palpated, dissected blindly, and cross-clamped.*

The transverse colon was then elevated superiorly out of the wound, wrapped in a moist towel. A moist rolled lap pad was placed in the bed of the splenic flexure of the colon, which was retracted laterally and posteriorly. The remainder of the small bowel was then reflected to the right, exposing the aortic aneurysm. Sharp dissection of the ligament of Treitz and the distal fourth portion of the duodenum allowed further exposure of the aneurysm and retraction of the small bowel to the right. The small bowel was then wrapped in a moistened towel and held in place using an Omni retractor.

The retroperitoneum overlying the aorta was incised and continued proximally to the level of the left renal vein. The inferior mesenteric vein was encountered, ligated, and divided.

The abdominal aortic aneurysm neck was then sharply dissected, avoiding any injury to the left renal vein. The infrarenal aorta was clamped and supraceliac clamp released.

The dissection was then carried out in the pelvic region for exposure of the iliac arteries.

The retroperitoneum overlying the aorta was incised distally, exposing the proximal right and left common iliac arteries and avoiding any injury to the iliac veins. The common iliac arteries were then cross-clamped.

The aneurysm wall was then incised longitudinally on its anterior aspect, keeping to the right of the origin of the IMA. The aneurysm cavity was entered and the aneurysm content and debris removed. The IMA had pulsatile back-bleeding and was oversewn with 2-0 silk sutures; *the IMA had sluggish back-bleeding and was controlled with a double-looped Silastic tape*. The bleeding lumbar arteries and middle sacral artery were oversewn with figure-of-eight 2-0 silk.

The aneurysm neck was then prepared for the construction of the proximal anastomosis. The incision in the aorta was carried to the level of the neck of the aneurysm. The incision was then Td off on each side of the neck, *leaving the posterior wall intact/transecting the posterior wall*.

A *20/18/16 Dacron/PTFE* graft was then soaked in antibiotic solution. The body of the graft was trimmed for the proximal anastomosis. The anastomosis was constructed in a running fashion using 3-0 Prolene sutures. At the completion of the suture line, the sutures were tied and the anastomosis was checked for hemostasis. Hemostasis was adequate, *except for a suture line bleeding controlled with an interrupted mattress suture/needle-hole bleeding controlled with the topical application of Gelfoam soaked with thrombin*.

Attention was focused on the distal anastomosis.

The aortic bifurcation was prepared for the distal anastomosis. The incision in the aorta at the level of the aortic bifurcation was Td off on each side, *leaving the posterior wall intact/transecting the posterior wall*.

The graft was then sized and cut. The anastomosis was then performed with 3-0 Prolene running sutures. Prior to completing the anastomosis, the iliac clamps were released, allowing for back-bleeding of the iliac arteries. The aortic clamp was released for forward-flushing of the graft. The anastomosis was copiously irrigated with heparinized saline solution and the sutures tied. The aortic clamp was released, allowing blood flow into one common iliac artery at a time. The flow was directed first into the internal iliac and then into the external iliac artery by manually compressing the external iliac artery/*common femoral artery* when the common iliac artery was initially perfused. Strong palpable pulses were noted in both femoral arteries.

The aneurysm lumen was reinspected. Hemostasis was adequate; *bleeding from a lumbar artery was identified and was controlled with figure-of-eight 2-0 silk sutures*.

The IMA was reevaluated.

If good IMA back-bleeding: *There was evidence of good back-bleeding from the IMA and good Doppler signals in the sigmoid mesentery. The IMA was oversewn with a 3-0 Prolene suture*.

If poor IMA back-bleeding: *There was poor back-bleeding from the IMA and poor Doppler signals in the sigmoid mesentery. Because the patient was hemodynamically stable, the IMA was reimplanted*.

Reinspection of all the suture lines was performed and revealed adequate hemostasis.

The field was then irrigated with antibiotic solution.

The redundant aneurysm wall was then sutured over the aortic graft using 3-0 Vicryl sutures, minimizing the dead space between the aortic graft and aortic wall.

The retroperitoneum was then closed with 3-0 Vicryl in a running fashion.

The bowel was then placed back in the anatomic position.

Abdominal wall closure was then performed with *running/interrupted* 0 Prolene sutures.

The wound was reirrigated and dried, and the skin edges opposed with skin staples.

The peri-incisional prep and drape were cleaned and dried, followed by 4×4 gauze, silk tape.

The feet were inspected and there was evidence of strong Doppler signals in the pedal arteries.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was awakened and taken to the *postanesthesia care unit/intensive care unit* in stable condition.

241 Endovascular Repair of Ruptured Abdominal Aortic Aneurysms

Manish Mehta

Indications

- Ruptured abdominal aortic aneurysm
- Ruptured aortoiliac aneurysm

Essential Steps

1. Once the diagnosis of ruptured abdominal aortic aneurysm (AAA) is made, patients need expeditious transfer from the emergency room (ER) to the operating room (OR) that is well equipped for both endovascular and open surgical repair.
2. All hemodynamically stable patients should undergo preoperative CTA. In patients with preexisting renal insufficiency, limited contrast or non-contrast thin axial CT images (0.625 mm) can be obtained. Standardized protocols should be developed to expedite patient transfer from the ER to the OR that are time sensitive and allow for CT in all patients with ruptured AAA.
3. In all hemodynamically unstable patients, when preoperative CT is prohibitive, if endovascular abdominal aortic aneurysm repair (EVAR) is attempted, intraoperative aortic neck measurements can be accessed by intravascular ultrasound, or routine arteriography. If angiography is used, one needs to oversize the stent grafts 20–30 %, to compensate for possible underestimation of the aortic neck diameter on angiography.
4. Patient positioning and prep should be ideal for both EVAR and possible conversion to open surgical repair; this includes a patient in supine position, left arm tucked, right arm out for arterial and venous access (at the discretion of anesthesiologist), and prep from above the xiphoid to mid-thigh level.
5. Femoral artery access via cutdown or percutaneous approach is up to the discretion of the individual surgeon/interventionalists. Most reports of ruptured EVAR are via femoral artery cutdown. We reserve percutaneous access for patients who are truly hemodynamically unstable, when general anesthesia induction might result in the loss of sympathetic tone and hemodynamic collapse.
6. In hemodynamically unstable patient, access the femoral artery; needle, floppy wire, guide catheter, stiff wire exchange, 12–18-Fr sheath placement, aortic occlusion balloon advancement to the supraceliac aorta, and inflation. Subsequent contralateral femoral access; appropriate sheath placement (18–24 Fr), angiography, and EVAR.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_241

7. In hemodynamically stable patients, access the femoral artery; needle, floppy wire, guide catheter, stiff wire exchange, 12–18-Fr sheath placement, angiography, and EVAR.
8. If aortic occlusion balloon is needed, advance a 30–40 cm, 12 Fr, or greater sheath up to the aortic neck, advance the occlusion balloon, and during the aortic occlusion balloon inflation, maintain forward traction on the femoral sheath and the aortic balloon catheter to support the balloon catheter and prevent occlusion balloon prolapse into the AAA.
9. During EVAR, identify appropriate proximal and distal landing zones, and in cases of aortoiliac aneurysms when internal iliac artery occlusion with stent graft extension to the external iliac artery is needed, get stent graft proximal fixation and seal before dealing with the internal iliac arteries.
10. During EVAR, prior to the deployment of the stent graft, if aortic occlusion balloon is needed to maintain hemodynamic stability, one needs to identify proximal landing zone, deflate and remove the occlusion balloon, deploy the stent graft, reposition the aortic occlusion balloon from within the ipsilateral main body up to the stent graft main body/aortic neck, and reestablish balloon inflation. This would allow time for further EVAR steps including contralateral gait cannulation, iliac stent graft extensions, or conversion of bifurcated stent graft into aortouniiliac devices.
11. In hemodynamically unstable patients, one could consider primary use of aortouniiliac stent grafts with the femoral bypass and contralateral common iliac occlusion.
12. Generally, management of ruptured EVAR revolved around the patient's hemodynamic status, and during the course of the procedure, the surgeon/interventionalists, the anesthesiologist, and the OR staff need to be in continuous communication regarding the patient's hemodynamic status. Furthermore, one should anticipate frequent use of aortic occlusion balloon as needed during the course of the procedure.
13. With few exceptions, highlighted above, the remainder of the ruptured EVAR procedure is similar to standard elective EVAR procedure.

Variations

- Similar to open surgical ruptured AAA repair, we do not anticoagulate the patient during ruptured EVAR and utilize frequent sheath flush techniques to limit thromboembolic complications.
- Management of variations during ruptured EVAR is dependent on the patient's hemodynamic status during presentation and during the course of the procedure as described above. Other variations to consider include the use of brachial access for occlusion balloon placement, which today is really of historic importance, and rarely needed; however, when needed, one needs to be familiar with these techniques.
- In cases when percutaneous access is obtained for ruptured EVAR, one has to decide on preclosure techniques versus percutaneous access and subsequent femoral cutdown and direct femoral artery repair. We have generally reserved the percutaneous access for hemodynamically unstable patients, and in such cases we have generally avoided preclose techniques to further expedite rupture EVAR and, subsequent to the completion of the procedure, perform femoral artery cut down and direct repair.

Complications

- Standard complications include cardiac, respiratory, and renal insufficiency, ischemic colitis, lower extremity thromboembolism, and ischemia. Certainly ongoing bleeding and hypotension should be evaluated by repeat CT scan and managed as indicated based on finding of the CT scan.
- Life-threatening complications include abdominal compartment syndrome. Risk factors for abdominal compartment syndrome include

(1) massive blood transfusion requirement, (2) the use of aortic occlusion balloon, and (3) coagulopathy in the perioperative period. One needs to assess for abdominal compartment syndrome frequently during the procedure and, in the presence of one or more of the above risk factors, should consider decompression laparotomy. Bladder pressure measurements can be useful for the diagnosis of abdominal compartment syndrome, and generally speaking, bladder pressures of greater than 35 mmHg should indicate one for the presence of abdominal compartment syndrome.

Dictation

Procedure Ruptured EVAR

Preoperative Diagnosis Ruptured abdominal aortic aneurysm

Postoperative Diagnosis Ruptured abdominal aortic aneurysm

Complications Abdominal compartment syndrome; free rupture; persistent endoleak; conversion to open repair

Patient Presentation Patient is an XX-year-old gentleman who presents with sudden onset of abdominal pain, back pain, and hypotension and has abdominal aortic pulsatility, and a CT scan indicates a ruptured abdominal aortic aneurysm. Appropriate risk benefits and alternatives were explained to the patient and family. They understand the procedure, and we are planning on endovascular abdominal aortic aneurysm repair, possible open surgical repair.

Procedure

1. Bilateral femoral artery cutdown
2. Introduction of bilateral catheters into aorta with interpretation
3. Endovascular aneurysm repair using two docking limb modular bifurcated stent graft with interpretation
4. Distal stent graft extension, right common iliac artery with interpretation
5. Additional distal stent graft extension left common iliac artery with an interpretation for endoleak

Completion arteriogram indicates adequate proximal distal fixation of the stent graft just below the lower most renal arteries and bilateral common iliac arteries. No type one or type three endoleak is noted. Both renal arteries and both internal iliac and external iliac arteries are well perfused and both limbs of the stent graft are widely patent.

Patient was prepped and draped in a routine fashion, bilateral femoral cutdowns were made, fascia was dissected, and femoral arteries were isolated.

A 19-gauge needle was used to puncture right common femoral artery. Bentson wire was advanced into the aorta with a Berenstein catheter which was exchanged for a stiff wire, over which an 18-Fr sheath was advanced and placed into the abdominal aortic aneurysm. Similarly, from the left a 19-gauge needle, Bentson wire, and Berenstein catheter were used to cannulate the abdominal aorta; Bentson wire was exchanged for a stiff wire, over which an 18-Fr sheath was advanced and placed into the abdominal aortic aneurysm. Marker flush catheter was advanced up to the juxtarenal aorta. Aortogram was done. Findings indicated abdominal aortic aneurysm with rupture, patent visceral vessels, patent bilateral renal arteries, and adequate infrarenal aortic neck for endovascular aneurysm repair, and aneurysm extends to the aortic bifurcation. Patent bilateral external, internal, and common iliac arteries.

Endovascular abdominal aortic aneurysm repair. Patient became hemodynamically unstable; therefore, from the right femoral approach over a stiff wire, an aortic occlusion balloon (you could use any of the occlusion balloons available in the USA, they are Reliant, Equalizer, Corda, and Q50) was used and placed up to the supraceliac level and inflated. Patient regained hemodynamic stability; from the left femoral approach, a stent graft was advanced and placed just below the lower most renal artery; and from the sheath that was used to support the balloon catheter from the right femoral artery, an arteriogram was done to mark the level of the aortic neck and the lower most renal artery. Prior to deployment of the stent graft, the occlusion balloon was deflated and removed, and the stent graft was deployed just below the lower most renal artery. From the ipsilateral stent graft side, the occlusion balloon was advanced and placed up to the aortic stent graft main body within the aortic neck, and the occlusion balloon was reinflated to maintain hemodynamic stability. From the contralateral side, the contralateral gait was cannulated using a guide catheter and a glide wire. Arteriogram and catheter manipulations were done to assess adequate cannulation of the gait.

Additional iliac stent graft extensions were advanced and placed proximally within the stent graft contralateral gait and distally in the common iliac artery and deployed. The occlusion balloon was deflated. Patient remained hemodynamically stable.

Bilateral pelvic arteriograms were done. Two additional distal stent graft extensions were needed in the right and left common iliac arteries. Two additional stent graft extensions were advanced on the right and left part proximally within the prior stent graft limbs, distally in the native right and left common iliac arteries, and deployed.

A compliant balloon was used to mold the proximal fixation site, and all stent grafts overlap sights and the common iliac landing zones. Completion arteriogram was done with a catheter at the juxtarenal aorta from within the stent graft, and findings indicated the following:

Adequate placement of the stent graft

Exclusion of the ruptured abdominal aortic aneurysm

Preservation of flow to both renal arteries, both internal iliac and external iliac arteries, and both limbs of the stent graft

During the entire procedure, the abdomen was assessed repeatedly for the development of abdominal compartment syndrome and bladder pressures were measured.

In case of no signs or symptoms of development of abdominal compartment syndrome: All catheters, wires, and sheaths were drawn back and removed. Bilateral femoral arteriotomies were closed primarily. Anterior and retrograde arterial flushes were done appropriately prior to the completion of closure. Good Doppler signal and pulses were noted on both arteriotomy closures. Complete hemostasis was obtained, and both groin incisions were closed in two layers. Dressings were applied.

In case of development of abdominal compartment syndrome or signs of development of abdominal compartment syndrome with abdominal distention, pulmonary compromise, elevated peak and plateau pressures, and sustained hypotension: Midline laparotomy was made, fascia was dissected, and the abdominal cavity was entered. The retroperitoneum was NOT explored. The abdominal cavity was left open with dressing placed to suction. Patient was resuscitated. Femoral sheaths were removed, bilateral femoral arteriotomies were closed, and anterior and retrograde arterial flushes were done appropriately. Good Doppler signal and pulses were noted after arteriotomy closures. Both groin incisions were closed in two layers. Dressings were applied, and patient tolerated the procedure well.

242 Open Repair/Ligation of Splenic Artery Aneurysm

Houssein Haidar Ahmad and Jamal J. Hoballah

Indications

- Asymptomatic splenic artery aneurysm in a childbearing-age female patient
- Asymptomatic splenic artery aneurysm and planned liver transplantation
- Asymptomatic splenic artery aneurysm greater than 2 cm
- Asymptomatic splenic artery false aneurysm and chronic pancreatitis
- Symptomatic splenic artery aneurysm

Essential Steps

1. Left subcostal or chevron incision.
2. Access to lesser sac through the gastrohepatic ligament.
3. Exposure of the celiac artery and its three branches: left gastric, splenic, and common hepatic arteries.
4. Oversewing of the splenic aneurysm after proximal and distal control.
5. Check the viability of the spleen.
6. Secure hemostasis.
7. Closure in layers.

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Note These Variations

- Endovascular treatment via embolization, stent graft placement or placement of flow dierting stens may be used depending on the anatomy of the splenic artery and the location of the aneurysm.
  The procedure may be approached through a midline or subcostal incision.
- Splenic artery aneurysms may be approached anteriorly or laterally.
- Anterior approach through the gastrocolic or gastrohepatic ligament provides good exposure for aneurysms in the proximal third. The lateral approach provides exposure to aneurysms in the mid- and distal part of the splenic artery.
- Access to the lesser sac through the gastrohepatic ligament allows excellent exposure for proximal control of the celiac, common hepatic, and origin of the splenic artery without disruption of any collaterals.
- The lateral retroperitoneal approach after medial visceral rotation allows exposure of most of the splenic artery.
- Open surgical approaches may include trans-aneurysmal arterial ligation, proximal and distal splenic artery ligation with or without resection of the aneurysm, and partial or total splenectomy/distal pancreatectomy with removal of the aneurysm for distal splenic aneurysms.
- Aneurysm resection with primary anastomosis is occasionally possible. Interposition graft insertion has been described but rarely indicated.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_242

Complications

- Post-embolization syndrome
- Splenic infarct
- Splenic abscess
- Pancreatic injury and leak

Template Operative Dictation

Preoperative Diagnosis Splenic artery aneurysm

Procedure Ligation of splenic artery aneurysm

Postoperative Diagnosis Splenic artery aneurysm

Indications This_____ -year-old male/female patient presenting with *symptomatic/asymptomatic splenic artery aneurysm*. Evaluation revealed a saccular/fusiform splenic aneurysm with/without other abnormalities. The patient was not a candidate for endovascular treatment. The risks and benefits of the surgical options were discussed with the patient, and *he/she* elected to proceed with surgical intervention.

Description of the Procedure Time-outs were performed using both preinduction and preincision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. With the patient in the supine position and after induction of general anesthesia, the abdomen was prepped and draped in the usual sterile fashion.

A left subcostal incision was then performed starting from the lateral edge of the right rectus muscle and extending toward the left subcostal region. The anterior rectus sheaths, the right and left rectus muscles, and the posterior rectus sheaths were divided, and the abdominal cavity was entered. A quick exploratory laparotomy was performed and revealed no pathology except for the splenic artery aneurysm.

Attention was then directed to the lesser omentum. The gastrohepatic ligament was divided, and the lesser sac was entered. The area of the common hepatic artery was identified, and the common hepatic artery was circumferentially dissected. The dissection was progressed proximally until the origin of the splenic artery was identified. Further dissection proximally revealed the celiac artery and the origin of the left gastric artery. The celiac artery was then circumferentially dissected and controlled. Attention was then carried to the origin of the splenic artery. The latter was sharply dissected. The dissection progressed distally toward the aneurysm. The overlying tissues were identified and divided. It was felt at this stage that the best would be to oversew the aneurysm rather than to construct a bypass. The splenic artery was clamped proximally, and the aneurysm was entered. The distal end was controlled with finger pressure and followed by an oversewing with a 2-0 Prolene suture. The proximal end was transected and oversewn with a running suture of 4-0 Prolene.

Thorough irrigation was then performed. The hemostasis was secured. The spleen was checked and was viable due to flow from the short gastrics.

The wound was then closed with №1-Prolene sutures en masse closure. Skin was approximated with 4/0 Monocryl in subcuticular fashion.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and transferred to the postanesthesia care unit in stable condition.

Replacement of Common Femoral Aneurysm with PTFE Graft

243

Jamal J. Hoballah

Indications

- Large asymptomatic femoral aneurysm
- Tissue loss
- Gangrene
- Rest pain
- Disabling claudication

Essential Steps

1. Expose the proximal common femoral artery.
2. Expose the superficial and profunda femoris arteries.
3. Anticoagulate.
4. Construct the proximal anastomosis.
5. Construct the distal anastomosis.
6. Check for hemostasis.
7. Wound closure.
8. Pulse reevaluation.

Note This Variation

- Occasionally, the femoral aneurysm extends beyond the femoral bifurcation. In this situation, the distal anastomosis is constructed to the superficial femoral artery, and the profunda femoris artery is reimplanted into the side of the graft.

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Complications

- Bleeding
- Gangrene
- Thrombosis of graft
- Infection
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis *Asymptomatic ___-cm femoral aneurysm/symptomatic ___-cm femoral aneurysm with right/left leg-disabling claudication. Right/left foot rest pain. Right/left foot/toe ulcerations/gangrene*

Procedure Replacement of *right/left* common femoral artery aneurysm with 8-mm *PTFE/Dacron* graft

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with an *asymptomatic ___-cm femoral aneurysm/symptomatic ___-cm femoral aneurysm with right/left leg-disabling claudication,*

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_243

right/left foot rest pain, and *right/left foot/toe ulcerations/gangrene*.

Preoperative evaluation revealed a *right/left* common femoral aneurysm with reconstitution of the profunda and superficial femoris arteries.

The risks and benefits of aneurysm replacement and nonoperative management were explained to the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure The procedure was performed under *general/spinal/epidural* anesthesia. The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

A *vertical/curvilinear* skin incision overlying the right common femoral artery pulse was made. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery aneurysm was then exposed. The dissection was extended proximally to the inguinal ligament, exposing the most distal part of the external iliac artery, which was sharply dissected circumferentially. Attention was then focused on the distal end of the aneurysm. The superficial femoral and profunda femoris arteries were exposed and circumferentially dissected. The external iliac, superficial femoral, and profunda femoris arteries were encircled with Silastic vessel loops. Minor branches of the common femoral artery were identified and spared.

The patient was given 75–100 U/kg of heparin intravenously, and, after allowing it to circulate for 3–5 min, vascular clamps were applied on the external iliac, superficial femoral, and profunda femoris arteries. The aneurysm was opened longitudinally, and the arteriotomy was extended proximally and distally. Toward the proximal neck of the aneurysm, the incision was Td off, transecting the posterior wall 1–2 cm distal to the vascular clamp. Similarly, toward the distal neck of the aneurysm, the arteriotomy was carried in a T shape, transecting the posterior wall 1–2 cm proximal to the origin of the superficial and profunda femoris arteries. An *8/10*-mm *PTFE/Dacron* graft was used to replace the aneurysm. An end-to-end proximal anastomosis was constructed between the graft and the transected distal end of the external iliac artery with a running *5-0/6-0 Prolene/Gore-Tex* suture. The anastomosis was then completed and checked for hemostasis, which was adequate/*revealed needle-hole bleeding that was controlled with the application of Gelfoam soaked with thrombin*. The graft was then transected to the appropriate length, and its distal end was spatulated to match the common femoral bifurcation. An end-to-end distal anastomosis was constructed with a running *5-0/6-0 Prolene/Gore-Tex* suture. Prior to the completion of the anastomosis, forward bleeding of the graft and back bleeding of the superficial and profunda femoris arteries were performed. The sutures were then tied and the clamps released. The suture lines and the wounds were then rechecked for hemostasis. There were good *Doppler signals/palpable pulses* in the foot and a good augmentation of the signal with compressing and releasing the PTFE graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

Ligation of Popliteal Aneurysm: Femoropopliteal/Tibial Reversed Vein Bypass

244

Jamal J. Hoballah

Indications

- Asymptomatic popliteal aneurysm
- Tissue loss
- Gangrene
- Rest pain
- Disabling claudication

Essential Steps

1. Expose the popliteal artery below the knee.
2. Expose the inflow femoral vessels.
3. Expose/harvest/reverse the greater saphenous vein (GSV).
4. Expose the popliteal artery above the knee through the GSV vein harvest incision.
5. Create graft tunnel.
6. Construct the proximal anastomosis.
7. Check graft for hemostasis.
8. Pass graft through the tunnel.
9. Ligate the proximal and distal necks of the aneurysm.
10. Construct the distal anastomosis.
11. Completion angiogram.
12. Wound closure.
13. Pulse reevaluation.

Note These Variations

- Endovascular treatment with stent graft placement may be offered in select patients with appropriate anatomy.
- If the popliteal aneurysm is extremely large, causing significant venous compression, it may be accessed through a posterior approach with the patient in a prone position.
- The bypass can be constructed using a reversed (as described here), nonreversed, or in situ technique.
- The proximal anastomosis can be performed at various sites depending on the anatomy.
- The site of the distal anastomosis is dictated by the aneurysmal disease and degree of distal embolization. If the distal anastomosis is to the popliteal artery, it is usually performed in an end-to-end manner. Alternatively, the anastomosis is conducted in an end-to-side manner with ligation of the popliteal artery proximal to the anastomosis.

Complications

- Bleeding
- Gangrene

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_244

- Thrombosis of graft
- Infection
- Myocardial infarction

Template Operative Dictation

Preoperative Diagnosis *Asymptomatic* ___*-cm popliteal aneurysm/symptomatic* ___*-cm popliteal aneurysm* with *right/left leg-disabling claudication*, *right/left foot rest pain*, *and right/left foot/toe ulcerations/gangrene*

Procedure Ligation of *right/left* popliteal artery aneurysm; *femoropopliteal/tibial reversed/nonreversed/*in situ *bypass*

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with an *asymptomatic* ___*-cm popliteal aneurysm/a symptomatic* ___*-cm popliteal aneurysm with right/left leg-disabling claudication*, *right/left foot rest pain*, *and right/left foot/toe ulcerations/gangrene*.

Preoperative evaluation revealed a *right/left* popliteal aneurysm with *a patent popliteal artery and good tibial runoff/occluded* popliteal artery with reconstitution of the *anterior tibial/posterior tibial/peroneal artery*.

The risks and benefits of aneurysm ligation and bypass and nonoperative management were explained to the patient, who elected to undergo surgical intervention.

Description of Procedure The procedure was performed under *general/spinal/epidural* anesthesia. The patient was placed supine on the operating table. The arms were *tucked in/placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision.

A 10- to 12-cm longitudinal skin incision was performed 1–2 cm posteromedial and parallel to the tibia. The incision was deepened through the subcutaneous tissue, exposing the fascia. The fascia was incised and the popliteal space was entered. A self-retaining retractor was applied, retracting the gastrocnemius muscle posteriorly and laterally. The tendons of the semimembranosus and semitendinosus muscles were divided to further facilitate the exposure. The popliteal vessels were identified. A 2-cm segment of the most distal popliteal artery was sharply dissected.

Attention was then directed to the groin. A vertical curvilinear skin incision overlying the right common femoral artery was made extending down the upper medial thigh along the preoperatively mapped GSV. The incision was deepened through the subcutaneous tissues with electrocautery. The encountered lymphatics were ligated and divided. The common femoral artery was then exposed and sharply dissected circumferentially. The dissection was extended proximally to the inguinal ligament and distally to include the superficial femoral and profunda femoris arteries. The common femoral, superficial femoral, and profunda femoris arteries were encircled with silastic vessel loops. Minor branches of the common femoral artery were identified and spared.

The GSV was then identified. The vein was exposed from the saphenofemoral junction to the *mid/lower leg through one continuous incision/multiple incisions separated by skin bridges*. Dextran-heparin-papaverine solution was infused into the GSV through a blunt needle that was placed in a side branch in the most distal aspect of the vein. The GSV was harvested and its tributaries ligated with 3-0 silk ties.

The above-knee popliteal artery was then exposed through the bed of the harvested GSV. The skin incision above the knee was deepened through the subcutaneous tissue, exposing the adductor tendon anteriorly and the sartorius muscle posteriorly. The fascia between these two muscles was incised and the popliteal fossa entered. A self-retaining retractor was placed deeper in the wound and the popliteal artery was palpated and exposed. A 2-cm segment of the proximal popliteal artery was sharply dissected.

A tunnel was then created using a *Zepplin/Kelly weck/Gortex* tunneler. The tunnel was *subcutaneous/subfascial* parallel to the course of the GSV to the level of the exposed popliteal artery.

The patient was given 5,000 U of heparin intravenously. The GSV was transected at the saphenofemoral junction and its stump suture ligated with 2-0 silk sutures. The distal end was double ligated and transected.

The common femoral artery, profunda, and superficial femoral artery were clamped. A longitudinal arteriotomy in the common femoral artery was performed and extended with Potts scissors for 1 cm. The vein was then reversed, and its distal end was incised along its posterior wall/*incorporating a side branch creating a T-junction shape*. The proximal anastomosis was constructed between the spatulated vein and the femoral arteriotomy with a running *5-0/6-0* Prolene suture. Prior to completing the suture line, back-bleeding, forward-flushing, and irrigation of the anastomosis with heparinized solution were performed. The anastomosis was then completed and checked for hemostasis, which was adequate. The flow through the vein was checked and was pulsatile. The end of the vein was ligated with a 2-0 silk tie. The vein was rechecked for hemostasis. The vein was then passed distended through the tunnel, avoiding any twists. The popliteal artery was then suture ligated proximal and distal to the aneurysm using *2-0/3-0 silk/Prolene* sutures.

Attention was then focused on the construction of the distal anastomosis. A Yasargil clip was applied on the popliteal artery at the level of its trifurcation. The popliteal artery was transected distal to the ligature. The distal end was incised along its anterior surface for 1 cm. The vein was then transected at the appropriate length. An end-to-end anastomosis was then performed between the distal end of the vein bypass and the popliteal artery using *5-0/6-0* Prolene sutures.

Prior to the completion of the anastomosis, forward-bleeding of the graft and back-bleeding of the tibial arteries were performed. The sutures were then tied and the clamps released. A 20-gauge angiocatheter was then introduced into the vein graft near the proximal anastomosis and an intraoperative arteriogram was performed. This revealed a widely patent anastomosis and no evidence of filling defects or kinks. The angiocatheter was removed and its puncture site repaired with a 6-0 prolene suture. The suture lines and wounds were then rechecked for hemostasis. There were good *Doppler signals/palpable pulses* in the foot and a good augmentation of the signal with compressing and releasing the vein graft. The wounds were all irrigated with antibiotic solution. The subcutaneous tissue in the groin wound was closed in two layers of 3-0 Vicryl sutures. The fascia overlying the sartorius muscle and in the popliteal space was approximated with 3-0 Vicryl sutures. The skin was closed with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

245 Endovascular Treatment of Popliteal Artery Aneurysm

Jamal J. Hoballah

Indications

- Asymptomatic popliteal artery aneurysm greater than 2 cm in diameter in the presence of suitable anatomy
- Symptomatic popliteal artery aneurysm in the presence of suitable anatomy

Essential Steps

1. Preoperative evaluation by CT angiography to determine suitable anatomy (2 cm landing zones and preferably two tibial vessel runoff).
2. Antegrade percutaneous access of the ipsilateral common femoral artery or under local anesthesia expose the ipsilateral superficial femoral artery.
3. Place a 5-French sheath.
4. Obtain an angiogram to further document the suitable anatomy.
5. Exchange the 5-French sheath into an 8-French sheath.
6. Anticoagulate with intravenous heparin 75–100 IU/kg to keep ACT greater than 250 s.
7. Evaluate the landing zones if intravascular ultrasound (IVUS) is available.
8. Advance a glide wire into a tibial artery and then exchange into a stiff straight wire (260 cm).
9. Obtain another angiogram with the stiff wire through the aneurysm and reassess the anatomy.
10. Select the desired dimensions of the endoprosthesis (upsizing by 10 % and avoid excessive upsizing to prevent infolding of the graft).
11. Mark the desired landing zones distally and proximally on the screen and using bony landmarks or roadmap.
12. Introduce the endoprosthesis to the desired location.
13. Obtain another angiogram to reconfirm desired landing location.
14. Deploy the endoprosthesis.
15. Remove the delivery system.
16. Perform balloon angioplasty to mold/iron the endoprosthesis at the landing sites.
17. Completion angiogram to check for endoleak or the need for another extension.
18. Remove the sheath and close the puncture site with a closure device if performed percutaneously or with interrupted Prolene

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_245

sutures if performed using an open superficial femoral artery exposure.

Note These Variations

- Proper patient selection based on suitable anatomy is essential to the success of the procedure. If poor distal runoff or short landing zones, or presence of significant compression symptoms, an open repair is preferable especially if the patient is not a high medical risk for open procedure.
- Access to the femoral vessel may be performed percutaneously or through an open approach. Due to the large-sized sheath, an open exposure of the superficial femoral artery under local anesthesia allows easy access and closure of the puncture side. If a percutaneous approach is used, a closure device should be considered for closing the puncture side to avoid excessive manual compression that may occlude the endoprosthesis or cause groin complications.
- Various stent grafts and endoprostheses are available on the market.
- It is preferable to avoid using multiple endoprostheses. However, if there is significant discrepancy between the diameter of the distal landing zone and the proximal landing zone, two stents grafts may be needed. The distal endoprosthesis is first deployed. The second endoprosthesis is then docked inside the distal with a good 2- to 3-cm overlap.
- The patient is usually started on dual antiplatelet therapy with aspirin and clopidogrel prior to the procedure. Clopidogrel is usually maintained for 3 months postoperatively and aspirin indefinitely.

Complications

- Thrombosis of endoprosthesis
- Endoleak
- Distal embolization
- Bleeding
- Gangrene

Template Operative Dictation

Preoperative Diagnosis Asymptomatic ___-cm popliteal aneurysm/symptomatic ___-cm popliteal aneurysm with right/left leg-disabling claudication. Right/left foot rest pain. Right/left foot/toe ulcerations/gangrene

Procedure Endovascular repair of *right*/*left* popliteal artery aneurysm using a _____ *Viabahn*/*Fluency*/*other* endoprostheses

Postoperative diagnosis Same

Indications The patient is a ___-year-old male/female with an asymptomatic ___-cm popliteal aneurysm/a symptomatic ___-cm popliteal aneurysm with right/left leg-disabling claudication, right/left foot rest pain, right/left foot/toe ulcerations/gangrene.

Preoperative evaluation revealed a *right*/*left* popliteal aneurysm with *a patent popliteal artery and good tibial runoff* and reconstitution of the *anterior tibial*/*posterior tibial*/*peroneal artery*. The landing zones were deemed appropriate for endovascular treatment.

The risks and benefits of endovascular aneurysm repair and alternatives with bypass and nonoperative management were explained to the patient, who elected to undergo endovascular intervention.

Description of Procedure The procedure was performed under *local monitored* anesthesia. The patient was placed supine on the operating table. The arms were *tucked in*/*placed at 80°*. Normal bony prominences were padded. Time-outs were performed using both preinduction and preincision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The anesthesia team placed appropriate lines. A Foley catheter was placed under sterile technique. The patient's lower abdomen and both lower extremities were circumferentially prepped and draped in the usual sterile fashion. Preoperative antibiotics were administered prior to skin incision. The patient has been on dual antiplatelet therapy with aspirin and clopidogrel.

Alternative 1: Using a Seldinger technique and under ultrasound guidance, *the common femoral artery was punctured in an antegrade manner. The wire was advanced into the superficial femoral artery. The micropuncture sheath was then exchanged into a size 5-French sheath*.

Alternative 2: *The skin over the course of the proximal superficial femoral artery was infiltrated with 1% lidocaine. A 7-cm longitudinal incision was performed over the upper thigh and deepened through the subcutaneous tissue and fat. The superficial femoral artery was identified along the lower border of the sartorius muscle and was dissected for a 5-cm segment. Using Seldinger technique, a 5-French sheath was inserted*.

Angiography through the sheath was performed delineating the location of the aneurysm and its proximal and distal landing zones. The anatomy appeared to be appropriate for endovascular graft treatment. The patient was given 75–100 IU of heparin intravenously to keep the activated clotting time (ACT) greater than 250 s. The 5-French sheath was exchanged for a size 8-French sheath. *The intravascular ultrasound IVUS was introduced, and the landing zones were evaluated and confirmed to be appropriate*. The superficial femoral artery/popliteal artery diameter was measured proximal and distal to the aneurysm. A glide wire was then introduced and manipulated through the aneurysm and advanced to the tibial arteries. The wire was then exchanged to an 260-cm Amplatz/straight tip stiff wire. A repeat angiogram was then performed with the stiff wire in place. The proximal and distal landing zones were marked using a *Glow 'N Tell tape*/*erasable marker on the screen*/*bony landmarks*. The appropriate size stent graft was selected. A size ____mm × ____cm *Viabahn*/*Fluency* graft was then introduced over the wire to the area of the aneurysm. The stent graft was then placed at the appropriate location. After an additional angiogram was performed to further confirm the appropriate position, the stent graft was deployed. The delivery system was then removed. A size ____mm × ____cm balloon was then used to mold each landing zone to maximize the apposition of the graft against the arterial wall. The balloon was then removed. An angiography was then performed and revealed proper placement with no evidence of any type I endoleak. There was no need for any additional extension limbs.

Alternative 1: *The sheath was then removed and a closure device* (*Perclose) was used to close the puncture side*.

Alternative 2: *The sheath was removed, and the puncture hole in the superficial femoral artery was closed with interrupted 5-0 Prolene sutures. The wound was then closed with 3-0 absorbable sutures* (*Vicryl*) *for the subcutaneous tissue and 4-0 absorbable subcuticular sutures* (*Monocryl*) *for the skin*.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the recovery room in good condition with excellent distal pulses and no complications.

Part XXII

Vascular Surgery: Venous Disorders

Stripping of the Greater Saphenous Vein and Stab Avulsion of Branch Varicosities

246

Michael S. Connors III and Samuel R. Money

Indications

- Pain
- Fatigue
- Bleeding
- Ulcerations
- Cosmesis

Essential Steps

1. Mark the varicose veins preoperatively with the patient upright.
2. Incise the skin over the saphenofemoral junction.
3. Identify and ligate the greater saphenous vein at the saphenofemoral junction.
4. Ligate all branches draining into the greater saphenous vein at the saphenofemoral junction.
5. Incise over the greater saphenous vein *at/below* the *knee/ankle*.
6. Pass vein stripper from the greater saphenous vein from below *knee/ankle* to the groin.
7. Pull stripper from the groin, avulsing the greater saphenous vein.
8. Incise the skin over the marked varicose vein tributaries.
9. Identify the varicose vein, and avulse in both proximal and distal directions with a *hemostat/crochet* hook.
10. Assess hemostasis, close the wound, and then wrap the lower extremity with cotton gauze followed by an Ace bandage (start at foot and wrap proximal to the most cephalic incision site).

Note These Variations

- Endovascular laser or radiofrequency ablation, Cyanoacrylate have replaced stripping of the greater saphenous veins in many practices and will be described in Chap. 247, endovenous ablation of varicose veins.
- Stripping of the greater saphenous vein from the ankle to the groin is associated with saphenous nerve injury because of the adherence of the saphenous nerve to the vein in the lower leg. This can be avoided by stripping the vein from just below the knee to the groin.
- If the greater saphenous vein is not varicosed and the saphenofemoral junction is competent, the greater saphenous vein is not stripped, and only stab avulsion of the branch varicosities is performed.

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© Springer Science+Business Media, LLC 2017
J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_246

Complications

- Infection
- Bleeding
- Saphenous nerve injury

Template Operative Dictation

Preoperative Diagnosis Varicose veins of the *right/left* lower extremity

Procedure *Right/left* lower extremity greater saphenous vein stripping and stab avulsion of varicose veins

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with a history of varicose veins involving the *right/left* lower extremity. The patient has been complaining of pain, fatigue, bleeding, and ulcerations and is nonresponsive to compression therapy. *The veins are being excised for cosmetic purposes*. Preoperative lower extremity duplex revealed no DVT and *competent/incompetent* saphenofemoral junction.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

After the induction of *general/epidural/spinal* anesthesia, the patient was positioned supine with both legs elevated. The patient was sterilely prepped and draped in the usual fashion from the tip of the toe up to the umbilicus. A primary incision was made in the *right/left* inguinal crease overlying the saphenofemoral junction. This was identified as being 1 cm medial and 1 cm inferior to the femoral artery pulse. The subcutaneous tissue was divided with electrocautery. The greater saphenous vein was identified and traced proximally toward the saphenofemoral junction. Multiple (ordinarily five) venous tributaries were divided with 3-0 silk ligatures. The greater saphenous vein was doubly ligated at its origin with a 2-0 silk ligature. The distal ligature was not tied; however, it was left in position.

[Choose One:]

If stripping to knee level: *A second incision was made a few centimeters below the knee. The subcutaneous tissue was divided and the saphenous vein identified and then circled proximally and distally with 3-0 silk ties. This time the distal ligature was secured and the proximal ligature left in position*.

If stripping to ankle level: *A second incision was made at the ankle/approximately one fingerbreadth anterior and superior to the medial malleolus. The subcutaneous tissue was divided and the saphenous vein identified and then circled proximally and distally with 3-0 silk ties. This time the distal ligature was secured and the proximal ligature left in position. Care was taken to avoid injury to the saphenous nerve* (*which lies in close proximity to the vein at this position*).

A small transverse venotomy was created with a #11 blade. The stripping wire was inserted and passed proximally toward the groin without difficulty. The greater saphenous vein was then divided completely at the groin, allowing the vein-stripping wire to exit. Prior to removal the stripping wire was secured at both ends with the 2-0 silk ties that had been left in position. The greater saphenous vein was then stripped from distal to proximal with pressure being exerted as the vein was stripped. At this point, hemostasis was controlled by elevation and pressure. Small incisions, approximately 2–4 mm, were created over the preoperative marked areas using a #11 blade. A *small crochet hook/or mosquito hemostat* was used to avulse these veins. The veins were pulled both proximally and distally. After hemostasis was obtained, the wounds were irrigated copiously. The wound in the groin was closed in multiple layers with 3-0 absorbable sutures followed by a running 4-0 subcuticular stitch. The wounds where the stab avulsions occurred were closed with steri-strips. The wound at the *ankle/below-knee* incision was closed with a 4-0 *absorbable suture/steri-strips*.

All wounds were sterilely dressed with gauze and then a doubly applied 4-in. Ace bandage was placed on the lower leg beginning at the head of the metatarsals. This was concluded by a 6-in. Ace bandage on the upper leg. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Endovenous Ablation of Varicose Veins

247

Dale Maharaj, Kathleen J. Ozsvath,
and R. Clement Darling III

Indication

- As for the conventional saphenofemoral or sapheno-popliteal ligations, particularly in the redo patient with previous groin dissection. Particularly useful in patients with lower calf perforators with skin changes and in obese patients

Complications

- Hemorrhage
- Bruising
- Phlebitis
- Deep venous thrombosis
- Paresthesia
- Skin burns

Advantages

- No incisions, minimal scaring, and less chance of surgical site infection
- Can be done under local anesthesia
- Can be done with active ulcer
- Can ambulate right away

Essential Steps

1. Preoperative ultrasound vein mapping and marking of the vein to be ablated, including the saphenofemoral (SFJ) or sapheno-popliteal junctions (SPJ) and perforators.
2. Prevention of vasospasm when performing the percutaneous access.
3. Trendelenberg position when accessing and reverse Trendelenburg when ablating.
4. Ensure that fiber tip is exposed, and not within the sheath when ablating.
5. Ensure that the tip of the laser is distal to the first tributaries at the saphenofemoral junction.
6. Aim for a laser energy delivery of 90 J/cm.
7. Apply compression after procedure and ambulate immediately.

Note These Variations

Endovascular ablation may be performed using Radiofr equency ablation. Cyanoacrylate can

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_247

also be used as a glue to occlude the vein without having to use tumescent anesthesia.

Operative Note

Preoperative Diagnosis Rt/Lt, saphenofemoral incompetence; sapheno-popliteal incompetence; perforator incompetence

Procedure Rt/Lt, endovenous ablation under local anesthesia

Postoperative Diagnosis Same

Indications ___-year-old man/woman

Painful varicose veins/ankle edema/stasis dermatitis/non-healing ulcer

Duplex scan revealed reflux at the saphenofemoral, sapheno-popliteal, or perforator incompetence

Description of the Procedure Vein mapping was performed with the patient standing. Attention was paid to marking the SFJ/SPJ/perforators.

The patient was placed in the reverse Trendelenburg position.

The Rt/Lt lower limb was prepped and draped in a standard surgical fashion.

Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Under ultrasound guidance, the GSV/SSV was accessed using a 14G, 70-mm percutaneous entry needle, and the intravascular position was confirmed by "flashback."

The ultrasound transducer was placed at the SFJ and a 035″ J-guidewire was inserted into the vessel utilizing the standard Seldinger technique and directed to the common femoral vein via the GSV.

The catheter sheath assembly was fed over the guidewire into the vessel and positioned under ultrasound guidance just distal to the first tributary at the SFJ (e.g., 2 cm from the SFJ).

The laser fiber tip was advanced into the sheath up to the first "site mark."

The sheath was then withdrawn to the second "site mark."

The patient was placed in the Trendelenburg position and suction applied to the three-way stopcock using a 20-ml syringe.

Tumescent anesthesia was administered in the perivenous space with 500 ml of saline containing 50 ml of 1 % lidocaine (with 10 ml of sodium bicarbonate) via direct visualization with ultrasound.

The sheath positioning was confirmed under ultrasound, with the fiber tip located approximately 1–2 cm below the saphenofemoral junction.

Laser safety goggles were used.

The fiber was attached to the laser consol and the aiming beam confirmed the position of the laser fiber tip.

The laser was set in the continuous mode at 14 W (or lower depending on area to be ablated).

The sheath and fiber were withdrawn at the rate of 1–2 mm/s for the first 5–10 cm of the vessel and then 2–3 mm/s for the remainder of the treated segment.

Confirmatory ultrasound was then performed documenting a successfully ablated vein and no deep venous thrombosis.

The limb was wrapped with an ace bandage, and a class II compression hose was placed on the patient. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was ambulated immediately (if no general anesthesia/conscious sedation was used).

For perforator ablation (**pathologic perforator associated with CEAP>4**): Under duplex guidance, a 21G venous access needle was inserted into the perforator.

A 10 cm × 4 F introducer sheath was directed into the subfascial plane over an 0.018″ guidewire.

A 400 μm optical fiber was then inserted into the sheath, and the tip was directed to 1 cm from the deep vein and perforator junction.

Tumescent local anesthesia was injected into the perforator perivenous area.

The laser was set in continuous mode at 5 W and the perforator was ablated.

248 Femorofemoral Vein Bypass (Palma Procedure)

Munier M.S. Nazzal

Indications

- Persistent isolated unilateral iliac/common femoral vein occlusion in patients with severe venous insufficiency unresponsive to conservative therapy
- Evidence of hemodynamic or venographic stable occlusion over 1 year
- Venous claudication unresponsive to conservative therapy in active patients
- Patient with progressive swelling of the leg secondary to external compression that is not relieved by conservative therapy

Essential Steps

1. Bilateral vertical groin incision to expose the femoral veins
2. Exposure of the contralateral greater saphenous vein down to the knee
3. Dissection of the contralateral greater saphenous vein at the saphenofemoral junction, preserving all tributaries
4. One hundred eighty degrees exposure of the anterior wall of the ipsilateral common femoral vein
5. Suprapubic tunnel formation
6. Check the tunneled saphenous vein for twisting or kinking
7. Heparinization of the patient
8. End-to-side anastomosis of the saphenous vein to the common femoral vein
9. Closure of the groin and thigh incisions in layers

Note This Variation

- Femorofemoral venous bypasses can also be constructed using prosthetic conduits with adjunctive arteriovenous fistulae. Endovascular recannalization is gaining popularity as a means for reestablishing flow through the iliac venous system without having to construct a cross over femorofemoral venous bypass.

Complications

- Thrombosis
- Wound complications
- Lymph leak

Template Operative Dictation

Preoperative Diagnosis *Left/right* lower-extremity *swelling/claudication/venous ulcer* with iliofemoral vein occlusion

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_248

Procedure Cross-femoral venous bypass (Palma procedure)

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* who presented with *swelling/claudication/venous ulcer* for about ___ years, not responding to conservative therapy.

Description of Procedure The patient was placed in a supine position. Time-out was performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed *under general/epidural/spinal* anesthesia. The abdomen and both lower extremities were prepped and draped in the usual fashion.

A vertical incision was made in the contralateral groin. The saphenofemoral junction was exposed. All tributaries of the greater saphenous vein at the junction were isolated and preserved.

The greater saphenous vein was exposed from the groin down to the knee using small interrupted incisions. The affected groin was incised vertically down to the femoral veins. The common femoral vein and deep femoral vein were exposed.

The anterior surface of the common femoral vein was dissected, exposing the anterior 180° of the vein.

Patency of the common femoral vein was confirmed by palpation and Doppler flow.

A suprapubic subcutaneous tunnel was made between the two groin incisions using a tunneler that was left in place.

Length of the saphenous vein needed for bypass was confirmed.

Hemostasis was secured.

The saphenous vein was isolated and dissected out of the thigh. The distal transected saphenous vein was ligated with silk 0-0. The saphenous vein was distended carefully with heparinized solution to check for leaks.

The patient was heparinized (100 U/kg bolus) intravenously.

The saphenous vein was passed distended through the tunnel with care to avoid any twisting or kinking.

A U-shaped vascular clamp was applied to the recipient common femoral vein. A vertical venotomy was made using a #11 blade and extended with Potts scissors. An anastomosis was constructed between the end of the saphenous vein and the side of the common femoral vein using 6-0 Prolene. A duplex scan was obtained to confirm patency of the saphenous graft and the femoral vein.

Hemostasis was secured.

Wounds in the donor thigh were closed in two layers. A closed suction drain was left in both groin incisions. The vertical groin incisions were closed in three layers: the fascia and subcutaneous layers with Vicryl 3-0 continuously and the skin with staples. Dressings were applied. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, recovered from anesthesia, and was taken to the postanesthesia care unit in stable condition.

249 Venous Thrombectomy for Iliofemoral DVT Using Mechanical Devices and Lysis

Chad Laurich

Indication

- Acute iliofemoral DVT with symptoms <14 days, good functional status, life expectancy, and >1 year who have a low risk of bleeding

Essential Steps

1. Define the extent of thrombus preoperatively via duplex or CT.
2. Prevent PE with systemic anticoagulation if not contraindicated, vena cava filter or balloon occlusion during thrombectomy, positive end expiratory pressure during thrombectomy.
3. Access femoral/popliteal vein percutaneously.
4. Cross thrombus with wire and perform mechanical, pharmacomechanical, or catheter-directed thrombolysis directly to the area of thrombus.
5. If catheter-directed thrombolysis performed, plan repeat venography within 24 h.
6. Perform completion venography to ensure adequate results and evaluate for venous outflow stenosis.

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Note These Variations

- Access may be from the popliteal vein with the patient prone if thrombus extends to the femoropopliteal venous segment.
- Angioplasty/stenting may be necessary if underlying iliac stenosis identified.
- For free floating IVC thrombus, a removable vena cava filter (Denali, C. R. Bard, New Providence, NJ; Option ELITE, Argon Medical, Plano, TX) may be placed or occlusive balloon (CODA, Cook Incorporated, Bloomington, IN or Reliant, Medtronic, Fridley, MN) placed from the contralateral side for use during mechanical thrombolysis to prevent emboli.
- Multiple thrombolysis devises/catheters are available including, but not limited to, the AngioJet (Boston Scientific, Marlborough, MA) and EKOS EkoSonic Endovascular System (BTG International, London, United Kingdom) system.
- Thrombolytic agent may be infused through both the thrombolysis catheter and the sheath.
- Venous outflow stenosis must be treated with angioplasty/stenting if found after thrombolysis.

Complications

- Bleeding
- Non-resolution of thrombus

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_249

- Embolization
- Recurrence

Template Operative Dictation

Preoperative Diagnosis Acute iliofemoral DVT

Procedure Venous thrombectomy with mechanical device *with*/*without* lysis

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male*/*female* presenting with *right*/*left* lower extremity swelling and pain. Preoperative duplex evaluation is consistent with *right*/*left* iliofemoral DVT. The patient has been informed of the risks and benefits of venous thrombectomy and thrombolysis and wishes to undergo the procedure.

Description of Procedure The patient was brought to the procedure suite and placed in *supine*/*prone* (for isolated popliteal vein access) position. Prophylactic antibiotics were administered. Time-outs were performed using both pre-induction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The patient was fully anticoagulated and maintained on an unfractionated heparin drip *or was administered a therapeutic* (1 mg/kg) *does of low molecular weight heparin*. The *right*/*left* groin and leg were prepped and draped in the usual sterile fashion. Monitored anesthesia care was provided, and local anesthetic (1 % Lidocaine) was infiltrated into the skin and subcutaneous tissues around the *femoral vein*/*popliteal vein*/*posterior tibial vein*.

Percutaneous access was achieved in the *femoral vein*/*popliteal vein*/*posterior tibial vein* with a micropuncture kit using ultrasound and fluoroscopic guidance. A 5-mm nick was made in the skin with an 11 blade and a 6-Fr sheath was placed using Seldinger technique. Venography was performed and the area of thrombus confirmed. An angled Glidewire and straight Glide catheter were used to cross the area of occlusion. The Glidewire was exchanged for a Benson wire (Amplatz wire or stiff Glidewire may be used as well) and the 6-Fr AngioJet catheter was placed.

A removable IVC filter sheath was passed from a contralateral percutaneous access site and venography performed in the IVC to confirm location of the renal veins, *IVC sizing*, *and absence of IVC thrombus. The filter was deployed and a short sheath exchanged at the access site*. (*Alternatively*, *a balloon catheter could be placed from a contralateral access site and inflated in the IVC above the thrombus to protect against embolization*.)

For pulse spray technique: After access, the AngioJet catheter was used to pulse inject 5–20 mg rt-PA and allowed to dwell for 30 min. Rheolytic thrombectomy was then performed via the AngioJet. The 6-Fr catheter was left in place and secured with a 2-0 silk stitch for planned venography with repeat treatment, if necessary, within 24 h.

Multiple passes of the AngioJet were performed. Venography revealed removal of a significant portion of clot. A ___ cm multi-side hole thrombolysis catheter was then placed across the area of thrombus and rt-PA infusion was initiated at a rate of 0.5 mg/h. The catheter was secured to the skin with a 2-0 silk stitch and a dressing applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

250 Endovenous Recanalization for Chronic Occlusion or Stenosis, May-Thurner Syndrome

Chad Laurich

Indication

- Chronic stenosis or obstruction of the femoroiliocaval venous outflow tract.

Essential Steps

1. Access the femoral vein with ultrasound guidance.
2. Perform venography and/or intravascular ultrasound to define the severity and length of stenosis.
3. The full area of disease must be defined and treated with stenting.
4. Predilation is performed; serial dilatations may be necessary in occluded segments.
5. Large-diameter stents are used (14–24 mm; WALLSTENT, Boston Scientific, Marlborough, MA) in the common and external iliac veins.
6. Post-stent dilatation is performed with appropriately sized (14–24 mm) balloons.
7. Completion venography/intravascular ultrasound evaluation confirms successful results.

Note These Variations

- Patients may present with iliofemoral DVT and require pharmacomechanical lytic therapy and/or catheter-directed lytic therapy prior to intervention with angioplasty and stenting.
- Intravascular ultrasound or venography may be used exclusively for the procedure, but intravascular ultrasound is considered more sensitive and its use highly encouraged.
- The popliteal vein may be used for access, if necessary.
- Serial dilations may be necessary for initial catheter placement.
- For proximal common iliac lesions, it is necessary to extend the stent into the inferior vena cava to prevent recurrent stenosis.
- For chronic occlusions, multiple maneuvers with soft and stiff wires supported by guide catheters may be necessary to cross the occlusion.
- If a long-segment stenosis is present, it is acceptable to extend the stents across the inguinal ligament to the common femoral vein (to just above the greater saphenous, circumflex, and profunda vein tributaries).

Complications

- Bleeding
- Early thrombotic events
- Late recurrence

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_250

Template Operative Dictation

Preoperative Diagnosis Chronic obstruction of the left iliofemoral venous outflow tract

Procedure Intravascular ultrasound evaluation with venography and endovenous balloon angioplasty/stenting of left iliac veins

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *female/male* who presents with *previous DVT and/or lower extremity swelling and pain* that is refractory to conservative management. Evaluation with IVUS and venography with possible balloon angioplasty and stenting is indicated. The patient has been informed of the risks and benefits of the procedure and wishes to proceed.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The patient was brought to the endovascular suite and placed in supine position, and *conscious sedation or monitored anesthesia care with local anesthetic was provided*. Prophylactic antibiotics were administered. The *right/left* groin and leg were prepped and draped in the usual sterile fashion.

The *left* femoral vein was accessed distal to the obstruction with a micropuncture kit using ultrasound guidance. An 8- to 12-Fr sheath was then placed using Seldinger technique. 5,000 units of unfractionated heparin was given intravenously. Venography was performed with multiple oblique projections (0, 45, and 60°), and an area of stenosis was visualized in the common iliac vein with numerous pelvic collaterals. An angled Glidewire and straight-glide catheter were used to cross the femoral and iliac veins into the inferior vena cava. Intravascular ultrasound was performed and confirmed the findings with greater than 50 % stenosis in the common iliac vein, with the extension of stenosis into the proximal external iliac vein.

Balloon angioplasty was performed with a 14–24 mm balloon over a stiffened Glidewire to predilate the stenosis. A self-expanding 14–24 mm bare metal stent was placed across the stenosis, extending from the external iliac vein to the inferior vena cava. *If two stents are necessary due to the length of involvement*: A 14–24 mm stent was placed distally in the external iliac artery, and a 14–24 mm stent was placed proximally in the common iliac vein with extension into the inferior vena cava and sufficient overlap of the stents to prevent separation. Balloon angioplasty was performed inside the stent(s) with a 14–24 mm balloon, and the proximal end was overexpanded slightly to "flare" it in the inferior vena cava.

Completion venography and evaluation with intravascular ultrasound revealed widely patent iliac veins with decreased flow through collaterals. All catheters and wires were removed and the sheath was removed after the activated clotting time was <180 s. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well with no apparent complications and was taken to the postanesthesia care unit in stable condition.

251 Inferior Vena Cava Filters

F. Ezequiel Parodi and Murray L. Shames

Indications

Absolute

- Deep venous thrombosis or documented thromboembolism in a patient who has a contraindication to anticoagulation
- Recurrent thromboembolism despite adequate anticoagulation
- Complications of anticoagulation that required discontinuation of therapy
- Immediately after pulmonary embolectomy
- Failure of another form of caval interruption, demonstrated by recurrent pulmonary thromboembolism

Relative

- A large free-floating iliofemoral thrombus demonstrated on venography in a high-risk patient
- A propagating iliofemoral thrombus despite adequate anticoagulation
- Chronic pulmonary embolism in a patient with pulmonary hypertension and cor pulmonale
- A patient who has occlusion of more than 50 % of the pulmonary vascular bed and would not tolerate additional thromboembolism
- Presence of recurrent septic embolism
- Patient at high risk for DVT/PE with contraindications for prophylactic anticoagulation

Essential Steps

Femoral Approach

1. Local anesthesia over the femoral vein (right usually used).
2. Percutaneous puncture of the common femoral vein with Seldinger needle.
3. Place guide wire into the vena cava under fluoroscopic guidance.
4. Sequential dilation of the tract.
5. Place marker pigtail catheter in the inferior vena cava.
6. Venogram to identify the renal veins and assess the diameter of the vena cava.
7. Place provided sheath into the vena cava to the level of the lowest (left) renal vein.
8. Insert filter into sheath, with tip of filter to be distal to the lowest renal vein.
9. Withdraw sheath to expose filter.
10. Deploy filter under continuous fluoroscopy.
11. Completion venogram.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_251

12. Remove sheath, and hold pressure on the puncture site for 10–15 min to obtain hemostasis.

Jugular Approach

1. Local anesthesia over the internal jugular vein (usually right).
2. Percutaneous puncture of the internal jugular vein with Seldinger needle.
3. Place guide wire into the vena cava under fluoroscopic guidance.
4. Sequential dilation of the tract.
5. Place marker pigtail catheter in the inferior vena cava.
6. Venogram to identify the renal veins and assess the diameter of the vena cava.
7. Place provided sheath into the vena cava to the level of the lowest (left) renal vein.
8. Insert filter into sheath, with top of filter to be distal to the lowest renal vein.
9. Withdraw sheath to expose filter.
10. Deploy filter under continuous fluoroscopy.
11. Completion venogram.
12. Remove sheath, and hold pressure on the puncture site for 10–15 min to obtain hemostasis.

Note This Variation

- The procedure may be performed through a femoral or jugular approach, using various filters. Retrievable filters are also available and used when the need for an IVC filter is temporary.

Complications

- Vena cava perforation
- Filter misplacement (cephalad to the renal veins, in an iliac vein tilt)
- Acute or late filter thrombosis
- Access site bleeding/hematoma

Template Operative Dictation

Preoperative Diagnosis Recurrent pulmonary embolus

Procedure Vena cava filter placement (*jugular/femoral* approach)

Postoperative Diagnosis Recurrent pulmonary embolus

Indications The patient is a ___-year-old *male/female* with recurrent pulmonary emboli despite *adequate anticoagulation/significant DVT* and contraindications for anticoagulation. The patient has been informed of the risks and benefits of inferior vena cava filter placement and has agreed to the procedure.

Description of Procedure Text

[Choose One:]

If femoral approach: The patient was placed on the operating table in a supine position. The *right/left* groin was prepped and draped in the standard fashion. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Using 1 % lidocaine, the area overlying the common femoral vein was anesthetized. (Intravenous sedation was administered by the anesthesia staff if needed.) The common femoral vein was punctured with the Seldinger needle and a guide wire placed into the vena cava to the level of the second lumbar vertebrae under fluoroscopic guidance. A pigtail catheter was placed into the vena cava over a guide wire. Contrast venography was performed, and there was no thrombus within the vena cava or iliac veins. The vena cava is ___ mm in diameter. The renal vein and iliac vein confluence is identified and marked on the screen. The tract was serially dilated over the guide wire and the provided sheath placed into the vena cava under fluoroscopy. The sheath was flushed with heparin solution. The device was inserted over the wire into the sheath and positioned below the lowest renal vein. The sheath was withdrawn, exposing the filter. With continuous fluoroscopic imaging, the filter was deployed in the infrarenal vena cava. Completion venogram shows good filter position within the vena cava without thrombus formation. The device and sheath were removed and 15 min of pressure applied to the puncture site for hemostasis. Dressings were applied.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

If jugular approach: The patient was placed on the operating table in a supine position. The right neck was prepped and draped in the standard fashion. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Using 1 % lidocaine, the area overlying the internal jugular vein was anesthetized. Intravenous sedation was administered by the anesthesia staff. The internal jugular vein was punctured with the Seldinger needle and a guide wire placed into the vena cava to the level of the second lumbar vertebrae under fluoroscopic guidance. A pigtail catheter was placed into the vena cava over a guide wire. Contrast venography was performed, and there was no thrombus within the vena cava or iliac veins. The vena cava is ___mm in diameter. The renal vein and iliac vein confluence was identified and marked on the screen to identify the renal veins and assess the diameter of the vena cava. The tract was serially dilated over a guide wire and the provided sheath placed into the vena cava under fluoroscopy. The sheath was flushed with heparin solution. The device was inserted over the wire into the sheath and positioned distal to the lowest renal vein. The sheath was withdrawn, exposing the filter. With continuous fluoroscopic imaging, the filter was deployed in the infrarenal vena cava. Completion venogram shows good filter position within the vena cava without thrombus formation. The device and sheath were removed and 15 min of pressure applied to the puncture site for hemostasis. Dressings were applied. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Radiology Supervision and Interpretation

1. ***Venogram***: Venogram, no intraluminal thrombus noted.
2. ***Completion venogram***: Interval placement of inferior vena caval filter device caudad to renal veins. Device is in good position, no evidence of tilt or adherent thrombus.

Part XXIII

Vascular Surgery: Creation of Arteriovenous Fistulae for Dialysis

Radiocephalic Arteriovenous Fistula for Hemodialysis

252

Christopher Bunch

Indication

- End-stage renal disease requiring hemodialysis or Long term need for plasmapheresis

Essential Steps

1. Evaluate the cephalic vein with duplex scan unless good quality and continuity to the upper arm are clearly established by physical exam.
2. Allen test.
3. Regional/local anesthesia.
4. Intra-operative ultrasound was then performed to map the veins of the arm. The vein chosen, was compressible, thin walled, and ___ mm in diameter, and chosen for venous outflow given those characteristics.
5. *Transverse incision overlying the artery and vein/longitudinal incision between the artery and vein*.
6. Develop skin flaps.
7. Identify and mobilize 2 cm of the radial artery.
8. Identify and mobilize the vein local or systemic anticoagulation initiated.
9. Obtain proximal and distal control.
10. Longitudinal arteriotomy.
11. *End-to-side/side-to-side* anastomosis to the vein.
12. Check for thrill, distal pulse.
13. Check hemostasis.
14. Close the incision.

Note These Variations

- Skin incision is tailored depending on the location of the vein relative to the artery.
- The anastomosis may be performed in a side-to-side or end-to-side configuration.

Complications

- Failure to achieve sufficient arterialization of venous network
- Steal syndrome
- Bleeding
- Occlusion
- Infection

Template Operative Dictation

Preoperative Diagnosis End-stage renal disease requiring chronic hemodialysis

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_252

Procedure *Left/right* wrist arteriovenous fistula for hemodialysis

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* developed end-stage renal disease due to ___, requiring *(anticipated)* need for chronic hemodialysis. Arteriovenous fistula was chosen to provide access. Risks and benefits were explained to the patient, and *he/she* elected to undergo the procedure.

Description of Procedure The patient was brought to the operating room and placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Following induction of *regional* anesthesia, the patient's right arm was prepped and draped in the usual sterile fashion. A *transverse/longitudinal* incision was made adjacent to the radial artery and cephalic vein in the wrist. The cephalic vein was identified. This measured approximately ___ mm in diameter. It was dissected at a large branch point. *Several small tributaries were ligated with 4-0 silk*. The vein was mobilized and secured with Silastic loops. Next, the radial artery was identified and dissected. The artery measured approximately ___ mm in diameter and was without significant atherosclerotic disease. The artery was mobilized proximally and distally for a 2-cm segment, *and several small tributaries were ligated with 4-0 silk and divided*. The vein was brought adjacent to the artery and appeared to lie comfortably without tension or kinking.

The artery was controlled proximally and distally with Silastic loops, and an anterolateral arteriotomy was made using a #11 blade scalpel. The artery was then locally heparinized.

[Choose One:]
If end-to-side configuration*: The distal vein was ligated and the vein divided with proximal control. The end of the vein was then opened and spatulated.*

If side-to-side configuration*: A similar length venotomy was made on the corresponding portion of the cephalic vein. The vein was flushed and pressurized with a heparin / papaverine saline solution with outflow compression.*

The arteriovenous anastomosis was then performed using a running 7-0 Prolene suture. Following completion of the anastomosis, vascular control appeared excellent. Excellent flow was established through the fistula, and a strong distal pulse was palpable within the radial artery.

Hemostasis was achieved with electrocautery and 4-0 silk ties. The wound was irrigated, and the subcutaneous tissues were reapproximated using interrupted 3-0 monocryl sutures. The skin was closed with *3-0 nylon vertical mattress sutures/a subcuticular closure/other*. A dry sterile dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

253 Creation of Brachiocephalic Fistula

Christopher Bunch

Indication

- End-stage/impending end-stage renal disease
- Need for long term plasmaphoresis

Essential Steps

1. Intra-operative ultrasound to assess vein quality.
2. Skin incision over the antecubital fossa.
3. Expose and circumferentially dissect the cephalic vein.
4. Expose and circumferentially dissect the brachial artery.
5. Anticoagulate with IV heparin or locally inject heparin in artery and vein when clamping.
6. Transect the vein.
7. Construct the anastomosis.
8. Check for thrill and distal radial and ulnar pulses.

Note These Variations

A proximal radial to cephalic fistula may be performed. In that situation the brachial artery bifurcation is exposed and dissected and the anstomois is constructed to the proximal radial artery just distal toits origin. Such configuration may be associated wih lower incidence of steal syndrome.

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Complications

- Infection
- Bleeding
- Thrombosis of fistula
- Finger/hand ischemia
- Nerve injury
- Steal syndrome
- Ischemic monomelic neuropathy

Template Operative Dictation

Preoperative Diagnosis End-stage renal artery disease

Procedure Creation of brachiocephalic arteriovenous fistula

Postoperative Diagnosis Same.

Indications The patient is a ___-year-old *male/female with an end-stage/impending end-stage renal artery disease*. The risks of the procedure were discussed with the patient and *he/she* elected to undergo surgical intervention.

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Description of Procedure The patient was positioned supine with the arm outstretched to near 90°. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *local/axillary block/general anesthesia*. The right upper extremity was prepped and draped in the usual sterile fashion. Intra-operative ultrasound was then performed to map the veins of the arm. The vein chosen, was compressible, thin walled, and ___mm in diameter, and chosen for venous outflow given those characteristics.

The skin over the antecubital fossa was infiltrated with 0.5% lidocaine.

A 6-cm transverse skin incision was then performed over the antecubital fossa. The cephalic vein was identified and encircled with a vessel loop. The vein was dissected for a segment of 5 cm. The dissection was carried as distally as possible through that incision.

Attention was then directed to the brachial artery. The tendinous aponeurosis of the biceps muscle was incised. The location of the brachial artery was identified by palpation. The soft tissue over the brachial artery was then incised, and the brachial artery was identified and encircled with a vessel loop.

The patient was given 3,000 U of heparin intravenously.

The cephalic vein was then ligated at its most distal end. Yasargil clips were applied on the brachial artery and a 6-mm incision in the anterior wall of the brachial artery was performed. The cephalic vein was then gently curved and allowed to lie over the arteriotomy. The end of the vein was spatulated to match the size of the arteriotomy.

The anastomosis was then performed using a *5-0/6-0* Prolene running suture. At the completion of the suture line, the brachial artery was forward-flushed and then allowed to backbleed. The cephalic vein was also allowed to backbleed. The anastomosis was irrigated with heparinized solution. The sutures were then tied and the suture line evaluated for hemostasis, which was adequate.

There was evidence of an excellent thrill in the cephalic vein. There was evidence of strong palpable pulses in the brachial, radial, and ulnar arteries at the wrist. There was no evidence of any kinks.

The wound was then irrigated with antibiotic solution.

The subcutaneous tissue was closed with 3-0 Monocryl and the skin closed with 4-0 subcuticular monocryl sutures. Sterile surgical glue sealed the incision. There was evidence of an excellent thrill in the cephalic vein after wound closure. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

254 Creation of Brachiobasilic Fistula: Basilic Vein Transposition

Mazen M. Hashisho

Indication

- End-stage/impending end-stage renal disease

Essential Steps

1. Skin incision over medial aspect of the upper arm from the antecubital fossa to the axilla.
2. Expose and circumferentially dissect the basilic vein and ligate its branches.
3. Expose and circumferentially dissect the brachial artery at the antecubital fossa.
4. Create a subcutaneous tunnel from the axilla to the antecubital fossa.
5. Anticoagulate with IV heparin.
6. Transect the vein at the antecubital fossa.
7. Pass the vein distended in the tunnel.
8. Construct the anastomosis.
9. Check for thrill and distal radial and ulnar pulses.
10. Close the wounds.

Note This Variation

- When the basilica vein is smaller than 4 mm, the procedure may be performed in two stages.

First, brachiobasilic fistula is created at the elbow. The vein is then transposed or superficialized when it grows or matures usually 6 weeks later.

Complications

- Infection
- Bleeding
- Thrombosis of fistula
- Finger/hand ischemia
- Nerve injury
- Steal syndrome

Template Operative Dictation

Preoperative Diagnosis End-stage renal artery disease

Procedure Creation of brachiobasilic arteriovenous fistula

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female with an end-stage/impending end-stage renal artery disease*. The cephalic vein was unavailable. The risks of the procedure were discussed with the patient and *he/she* elected to undergo surgical intervention.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_254

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *axillary block/general anesthesia*. The patient was positioned supine with the arm outstretched to near 90°. The right upper extremity was prepped and draped in the usual sterile fashion.

A longitudinal skin incision was performed in the upper arm over the previously mapped basilic vein. The incision was deepened down through the subcutaneous tissue and fat, and the basilic vein was identified at the level of the antecubital fossa. The basilic vein was encircled with a vessel loop. The vein was then dissected proximally all the way up to the axilla, and its branches were isolated, ligated, and divided. The overlying nerve branches were preserved. The basilic vein was dissected free from the antecubital fossa to the axilla.

Attention was then directed to the brachial artery in the antecubital fossa. The brachial artery was palpated and the soft tissue overlying it was incised. The brachial artery was exposed and encircled with a vessel loop. A 2-cm segment of the brachial artery was then circumferentially dissected.

A curved tunneler was then used to create a tunnel along the anterior aspect of the upper arm from the axillary fossa to the antecubital area in a position that will facilitate venipuncture.

The patient was given 3,000 U of heparin intravenously.

The basilic vein was then ligated as distally as possible in the antecubital fossa and divided. The basilic vein was then introduced in the tunnel in a distended form, avoiding any kinks or twists.

Yasargil clips were then applied on the brachial artery, and a 6-mm incision was then performed in its anterior wall. The end of the basilic vein was then spatulated to match the size of the arteriotomy.

An anastomosis was then created between the end of the vein and the arteriotomy using a *5-0/6-0* Prolene running suture. At the completion of the procedure, the basilic vein was allowed to backbleed, and the brachial artery was forward-flushed and backbled. The anastomosis was irrigated with heparinized saline. The sutures were tied and the suture line was checked for hemostasis, which was adequate.

There was an excellent thrill in the vein, and the vein was readily palpable under the skin. Hemostasis was then ensured. There was evidence of an excellent pulse in the radial and ulnar arteries at the wrist. The wounds were irrigated and then closed with 3-0 Vicryl for the subcutaneous tissue.

The skin was closed with 4-0 Monocryl subcuticular sutures.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

PTFE Forearm Graft for Hemodialysis

255

Mazen M. Hashisho

Indications

- End-stage renal disease requiring hemodialysis
- Inability to construct primary arteriovenous fistula

Essential Steps

1. Map the vein and artery.
2. *Regional/local* anesthesia.
3. *Transverse incision overlying the artery and vein/longitudinal incision between the artery and vein*.
4. Develop flaps.
5. Identify the artery and mobilize.
6. Ligate the small tributaries if necessary.
7. Obtain proximal and distal control with Silastic loops.
8. Identify the vein and mobilize.
9. Similarly ligate the small tributaries, and obtain proximal and distal control.
10. Create a 2-cm transverse skin incision in the distal forearm.
11. Create skin flap and a pocket for the loop part of the graft.
12. Create a tunnel, and pass the graft in the tunnel.
13. Longitudinal arteriotomy.
14. Anastomose spatulated end of the graft to the side of the artery.
15. Anastomose spatulated end of the graft to *side/end* of the vein.
16. Check for thrill, distal pulse.
17. Check hemostasis.
18. Close the incision.

Note These Variations

- Size and type of graft vary.
- Location on forearm varies.
- May perform the arterial or venous anastomosis first.
- The venous anastomosis may be performed using a side-to-side or end-to-side configuration.

Complications

- Steal syndrome
- Bleeding
- Occlusion
- Infection

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_255

Template Operative Dictation

Preoperative Diagnosis End-stage renal disease requiring chronic hemodialysis

Procedure Creation of *left*/*right* forearm loop hemodialysis PTFE graft

Postoperative Diagnosis Same

Indications This ___-year-old *male*/*female* developed end-stage renal disease due to ___, *requiring*/*anticipating* need for chronic hemodialysis. Because of *inadequate veins*/*previous surgery*/*other*, PTFE graft from *brachial*/*other* artery to *basilic*/*cephalic*/*other* vein was chosen.

Description of Procedure The patient was brought to the operating room and placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Following induction of *regional* anesthesia, the patient's *left*/*right* arm was prepped and draped in the usual sterile fashion. A transverse incision was made (*specify location or locations*).

The brachial artery was identified, gently dissected, and encircled with Silastic loops. A second incision was then made over the *cephalic*/*basilic* vein and the vein similarly dissected and encircled. A 2-cm transverse skin incision in the distal forearm was performed.

A skin flap was developed, creating a pocket for the loop part of the graft.

The tunneling device was then passed between these incisions. A ___ (*specify type*, *length*, *and caliber*) graft was passed through the tunnel, taking care to avoid kinking or twists. The graft was irrigated with heparinized saline solution.

Proximal and distal arterial control was then obtained, and an anterior arteriotomy was made. The artery was irrigated with heparinized saline solution. An end PTFE to side artery anastomosis was then performed, using a running 6-0 Prolene suture. Upon the completion of the anastomosis, two *Bulldog*/*Fogarty* clamps were placed on the PTFE graft just distal to the anastomosis, and vascular control of the artery was released to reestablish flow to the hand.

Attention was directed to the vein. Proximal and distal control was obtained, and an anterolateral venotomy was made. The vein was then irrigated with heparinized saline solution. The end of the PTFE graft was then cut in a beveled fashion at the appropriate length. An end PTFE graft to side vein anastomosis was then performed, using a running, 6-0 Prolene suture. Following the completion of the anastomosis, vascular control was released, and flow was established through the graft. *Papaverine was injected into the adventitia*/*the native vessels*.

There was an excellent distal pulse in the artery and a strong thrill in the vein. Hemostasis was achieved and the wound irrigated. The subcutaneous tissues were reapproximated using interrupted 3-0 Vicryl sutures. The skin was reapproximated using *3-0 nylon in a vertical mattress fashion*/*subcuticular suture*/*other*.

A dry sterile pressure dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Creation of Upper-Arm Prosthetic Arteriovenous Grafts

256

Christopher Bunch

Indications

- End-stage/impending end-stage renal disease
- Inability to construct a native autogenous fistula
- Long term need for plasmaphoresis

Essential Steps

1. Intraoperative ultrasound assessment of vein quality.
2. Skin incision over medial aspect of the upper arm at the axilla.
3. Expose and circumferentially dissect the outflow (Axillary, Basilic, Cephalic) vein.
4. Skin incision over the antecubital fossa.
5. Expose and circumferentially dissect the brachial artery.
6. Create a subcutaneous tunnel from the axilla to the antecubital fossa.
7. Anticoagulate with IV heparin or local heparinization of vessels.
8. Construct an end-to-side anastomosis between the graft and the brachial artery.
9. Pass the graft in the tunnel.
10. Construct the anastomosis between the graft and the outflow vein.
11. Check for thrill and distal radial and ulnar pulses.
12. Close the wound.

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Complications

- Infection
- Bleeding
- Thrombosis of fistula
- Steal syndrome
- Ischemic monomelic neuropathy
- Nerve injury

Template Operative Dictation

Preoperative Diagnosis End-stage renal artery disease

Procedure Creation of brachiobasilic arteriovenous fistula

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female with an end-stage/impending end-stage renal artery disease*. The cephalic vein was unavailable. The risks of the procedure were discussed with the patient and *he/she* elected to undergo surgical intervention.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_256

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *axillary block/general anesthesia*. The patient was positioned supine with the arm outstretched to near 90°. The upper extremity was prepped and draped in the usual sterile fashion. Intra-operative ultrasound was performed to confirm the quality of the outflow vein.

A 5-cm skin incision was then performed over the medial aspect of the upper arm toward the axilla. The incision was deepened down through the subcutaneous tissue and fat. The basilic vein was identified and circumferentially dissected and encircled with a vessel loop. A 4-cm segment of the basilic vein was circumferentially dissected.

A 3-cm longitudinal incision was then performed over the antecubital fossa. The aponeurosis of the biceps muscle was incised, and the brachial artery was palpated and its location determined. The soft tissues over the brachial artery were incised, and the brachial artery was circumferentially dissected and encircled with a vessel loop. A 3-cm segment of the brachial artery was circumferentially dissected.

A curved tunneler was then used to create a superficial subcutaneous tunnel connecting the incision in the antecubital fossa to the incision in the axilla. The tunnel was created in the anterior aspect of the upper arm to facilitate puncture for dialysis.

The patient was given 3,000 U of heparin intravenously or locally heparinized.

Yasargil clips were then applied on the brachial artery, and a 9-mm incision was performed in the anterior wall of the brachial artery. The end of a 6-mm PTFE graft was spatulated to match the size of the arteriotomy. An anastomosis was then performed between the end of the PTFE graft and the arteriotomy using a 6-0 Prolene running suture. Forward- and back-bleeding from the brachial artery was performed. The anastomosis was then irrigated with heparinized saline. The sutures were tied and the anastomosis was checked for hemostasis, which was adequate. Flow was allowed to resume through the brachial artery. The PTFE graft was then introduced in the tunnel distended, avoiding any kinks or twists.

Attention was then directed toward the basilic vein. The basilic vein was then controlled with Yasargil clips, and a 1-cm incision was then created in the vein. The PTFE graft was measured to length and was transected in an oblique fashion to match the size of the venotomy. An anastomosis was then created between the end of the PTFE graft and the venotomy using a 6-0 Prolene running suture. At the completion of the anastomosis, backbleeding from the venous side and forwardbleeding from the graft were performed. The sutures were tied and the anastomosis checked for hemostasis, which was adequate. Flow was allowed in the arteriovenous graft.

There was evidence of excellent thrill in the basilic vein and Doppler signals. There was also evidence of palpable pulses in the radial and ulnar arteries at the wrist. The suture lines were checked again for hemostasis, which was adequate. Hemostasis in the soft tissues was secured and the wound was then closed using 3-0 Monocryl for subcutaneous tissue and 4-0 Monocryl subcuticular sutures for the skin. A sterile dressing was applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition.

257 Placement of a Hemodialysis Reliable Outflow (HeRO) Graft in the Upper Extremity

Joseph J. Naoum

Indications

- End-stage renal disease
- Current or future hemodialysis catheter dependency
- Unsuitable peripheral superficial veins for arteriovenous fistula (AVF) or graft (AVG) creation
- Central venous stenosis with compromised outflow

Essential Steps

1. Skin incision over medial aspect of the upper arm at the axilla or antecubital fossa.
2. Expose and circumferentially dissect the *proximal* (*axillary incision*) *or distal* (*antecubital fossa incision*) brachial artery.
3. Ultrasound-guided access of the internal jugular (IJ) vein.
4. Vascular sheath placement into the vein.
5. Venogram.
6. Placement of a wire in the central venous system and down into the inferior vena cava.
7. Pre-dilatation or balloon angioplasty of any existent central venous stenosis.
8. Exchange for a Stiff wire.
9. Creation of a subcutaneous pocket.
10. Incision at the delto-pectoral groove.
11. Incision on the upper arm to assist in tunneling.
12. Tunneling of the arterial graft component.
13. Intravenous anticoagulation.
14. Assembly of HeRO catheter portion.
15. Serial dilatation of the venous tract.
16. Placement of a 20 Fr Introducer/sheath.
17. Introduction of the venous outflow component catheter and peal-away sheath removal.
18. Tunneling of the outflow catheter component into the delto-pectoral groove.
19. Establish catheter tip position and cut the venous outflow component as necessary.
20. Assembly of the arterial graft component connector to the outflow component catheter.
21. Construct an end-to-side anastomosis between the graft and the brachial artery.
22. Check for thrill and distal pulses and perfusion.
23. Achieve hemostasis.
24. Close the incisions.

Complications

- Infection
- Bleeding
- Graft thrombosis

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_257

- Seroma
- Air embolus
- Finger/hand ischemia or steal syndrome
- Nerve injury
- Trauma or injury to central venous vasculature
- Among others

Template Operative Dictation

Preoperative Diagnosis End-stage renal disease on hemodialysis with (*catheter dependency/nonavailable AVF or AVG option/central venous outflow stenosis*)

Procedure
1. Ultrasound-guided access to the (*right/left*) jugular vein
2. Jugular vein and central venogram
3. Balloon angioplasty of the *IJ/superior vena cava* (*SVC*) stenosis
4. Creation of permanent access using the HeRO graft from the (*right/left*) brachial artery at the (*antecubital fossa/axilla*) into the IJ vein
5. Fluoroscopic guidance for venous outflow component placement/positioning

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with end-stage renal disease on hemodialysis with (*catheter dependency/nonavailable AVF or AVG option/central venous outflow stenosis*). The risks of the procedure including infection, bleeding, graft thrombosis, seroma formation, air embolus, steal syndrome, nerve injury, and trauma to the central vasculature among others were explained to the patient, questions were answered, and *he/she* consented to undergo surgical intervention and HeRO graft placement.

Description of Procedure The procedure was performed under *right/left upper extremity nerve block/general anesthesia*. The patient was positioned supine with the arm outstretched to near 90°. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The *right/left* upper extremity, chest, and neck were prepped and draped in the usual sterile fashion.

A 3–5-cm skin incision was then performed over the medial aspect of the upper arm toward the *axilla/antecubital fossa* using a #15 blade. The incision was carried down through the subcutaneous tissue and fat. The brachial artery was palpated and its location determined. The soft tissues over the brachial artery were incised, and the brachial artery was isolated and circumferentially dissected and encircled proximally and distally with a vessel loop. Careful attention was placed not to injure the underlying nerves.

Ultrasound-guided access of the *right/left* IJ was achieved with a 4 Fr micropuncture kit with an etched needle. A 1-cm incision was made with an #11 blade. A venogram was performed that demonstrated *a patent central venous outflow target system/the following stenosis* __________ ________________________. The micropuncture kit was exchanged for a 7 Fr sheath, and a stiff Glyde wire was advanced down into the inferior vena cava for support. *Angioplasty of the central venous stenosis located in the IJ/SVC was performed with a ______ size balloon*. The wire was exchanged through a catheter for a stiff Amplatz wire. The neck incision was dissected with forceps to create an adequate pocket to accommodate the venous outflow component of the HeRO graft. The HeRO graft components were prepared on the back table.

A 3–5-cm incision was made in the delto-pectoral groove and another incision midway between the delto-pectoral groove and the brachial artery incision. The arterial graft component was tunneled and placed in the subcutaneous tissues from the brachial artery incision to the delto-pectoral groove. *The patient was given ____units of heparin for anticoagulation*.

The 7 Fr sheath was removed and serial dilatation of the venous tract was performed over the wire initially with a 12 and 16 Fr dilator and under fluoroscopic guidance. A 20 Fr dilator and with peal-away sheath was placed. The dilator was removed and *the hemostatic plug was quickly applied/manual occlusion achieved*.

The venous outflow component already fitted with the 10 Fr introducer was advanced over the wire through the 20 Fr peal-away sheath under fluoroscopic guidance and into the central venous system. The 20 Fr peal-away sheath was removed while keeping forward tension on the venous outflow component. The 10 Fr introducer was removed along with the wire and the venous outflow component was clamped. Careful attention to avoid an air embolus was performed during these steps.

A heavy clamp was tunneled from the delto-pectoral groove to the overlying IJ incision. The venous outflow component was secured with the clamp and pulled into the delto-pectoral area. Fluoroscopy was used to adjust the venous outflow component catheter tip position to correspond to the mid to upper right atrium. The venous outflow component was then cut with a heavy scissor in a straight manner and connected to the arterial graft component connector.

Proximal and distal control of the brachial artery was achieved, and an arteriotomy performed with an #11 blade and extended with Potts scissors. The artery was irrigated with heparinized solution. The graft was cut in an oblique manner to match the size of the arteriotomy, and an end-to-side anastomosis was performed using 5-*0*/*6-0* Prolene. Before completing the anastomosis, forward- and backbleeding from the brachial artery was performed. The venous outflow component was also allowed to backbleed. The anastomosis was then irrigated with heparinized saline. The anastomosis was completed, sutures were tied, and the anastomosis was checked for hemostasis. Flow was allowed to resume through the brachial artery and allowed in the HeRO graft.

There was evidence of a palpable thrill over the graft *and Doppler signals were present*. There was also evidence of *palpable pulses*/*signals* in the *radial and*/*or ulnar* arteries at the wrist. *The heparin was reversed with _ mg of protamine*. Once adequate hemostasis was achieved, the incisions were closed using 3-0 *Vicryl*/*PDS* for the subcutaneous tissues and 4-0 Monocryl subcuticular sutures for the skin. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition with a patent HeRO.

Estimated blood loss
Intravenous fluid given
Specimens removed

Ultrasound-Guided Placement of an Internal Jugular Tunneled Cuffed Dialysis Catheter

258

Hiba Ezzeddine and Jamal J. Hoballah

Indications

- Hemodialysis for:
  - Chronic renal failure
  - Acute kidney injury with expected need for dialysis for more than 2–3 weeks

Essential Steps

1. Confirm patient identification and indication for surgery. Review the anatomy of the neck and check the veins by ultrasound and review the history and relevant lab studies to avoid any preventable complications.
2. Position the patient in a way to stand comfortably at the head of the bed at the side of the planned insertion (you might need to position the bed horizontally with the anesthesia at the side opposite to your insertion site).
3. Prepare the X-ray machine and monitor. The X-ray machine should advance easily over the neck and chest area from the side opposite your insertion at the head level. The monitor should be facing you at the level of the feet.
4. Prep and drape the neck and chest area at the side of your insertion.
5. Use the ultrasound probe to identify the vein again. Puncture the vein using a micropuncture needle as close to the clavicle as possible.
6. Once venous blood returns, advance the micropuncture wire. Confirm the presence of the micropuncture wire in the vein by ultrasound.
7. Remove the needle over the wire and insert the sheath over the wire.
8. Unlock the sheath and remove the inner piece with the wire. At this point make sure the tunneled catheter has been opened for you and the guidewire is ready on your field.
9. Thread the wire through the sheath. Confirm the position of the guidewire under fluoroscopy.
10. Using a 15 blade make an incision vertically along the wire and create a space/pocket for the curvature of your catheter.
11. Make a small incision over the chest at the exit site.
12. Apply local anesthesia through the tunnel and over the clavicle.
13. Attach the catheter to the tunneler.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_258

14. Tunnel the catheter from the exit site incision and out through the neck incision near the wire.
15. Pass the dilators sequentially over the wire followed by the peel-away sheath.
16. The wire is removed along with the lock system.
17. The catheter is threaded into the sheath while it is peeled to the outside.
18. Under fluoroscopy confirm the position of the catheter with no kinks along its curvature.
19. Close the neck incision. Secure the catheter at its exit site.
20. Flush the catheter and prime it with pure heparin as specified on its ports.

Complications

- Pneumothorax
- Hemothorax
- Neck hematoma
- Arterial puncture, canalization, or injury
- Vein laceration
- Venous air embolus
- Cardiac arrhythmias

Template Operative Dictation

Preoperative Diagnosis This ___-year-old *male/female* requires a tunneled dialysis catheter because she will be requiring long-term hemodialysis for *chronic/acute renal failure*. (*More detailed underlying medical condition can be added as well.*)

Procedure Ultrasound-guided left/right internal jugular tunneled dialysis catheter insertion

Post-operative Diagnosis As above

Description of Procedure The patient was placed in supine position with the neck turned to the contralateral side. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The vein was checked using the ultrasound and confirmed to be patent and compressible and had nonpulsatile blood flow. The ultrasound was placed opposite the site of insertion facing us. The X-ray machine was conveniently positioned on the contralateral side of the head and made sure to easily pass forward over the neck and chest at the site of insertion. The monitor was positioned at the feet in front of us. A dose of antibiotics (*specify the antibiotics and dose*) was given to the patient. The *right/left* neck and chest were prepped and draped using topical antiseptic and full body barrier precautions. The micropuncture kit was flushed and tested prior to use. The skin and subcutaneous tissues at the prick site over the vein were anesthetized with __ ml of __% lidocaine.

Using the micropuncture needle, the vein was pricked under ultrasound guidance. Once good venous flow was ensured, the micropuncture wire was advanced through the needle. The wire advanced with no resistance or difficulty. The needle was then replaced with the micropuncture sheath. The tunneled catheter kit was opened at this point; it was flushed with heparinized saline and tested. The locking system and wire were removed. Venous flow was observed through the sheath. The guidewire was advanced through the sheath. The advancement occurred smoothly with no resistance encountered. The position of the wire was confirmed under fluoroscopy to be in the *ventricle/IVC*. A *vertical/horizontal* incision along the wire and sheath was made using 15 blade. It was deepened using electrocautery. A pocket was created for the curvature of the catheter.

A small nick was made along the chest (at the exit site of the catheter). Local anesthetic with __ ml of ___ % lidocaine was applied along the tunnel and above the clavicle. The catheter was attached to the tunneler and passed from the exit site out through the neck incision near the wire. Sequential dilators were passed over the wire followed by the peel-away sheath. The locking system was removed along with the wire. The catheter was then threaded through the sheath, while the assistant peeled it to the outside. It was made sure that the curve of the catheter rested smoothly in the pocket. Fluoroscopy was done to confirm good position of the catheter with its tip at the junction of the SVC and right atrium with no kinking along its curve.

The neck incision was closed using ___ sutures. The catheter was secured to the chest with two ___ sutures.

The two ports of the catheter were checked for good flow and flushed with heparinized saline. The ports were then primed with pure heparin (1,000 units/ml) with the volume indicated on each port.

A dry clean dressing was applied.

The patient tolerated the procedure well and a post procedure chest X-ray was ordered.

Distal Revascularization and Interval Ligation (DRIL)

259

Simon Roh

Indication

- Ischemic steal syndrome related to a functioning dialysis access graft or fistula.

Essential Steps

1. Exposure of fistula
2. Exposure of the outflow artery for the construction of the distal bypass anastomosis 1–2 cm distal to the access anastomosis
3. Exposure of the inflow artery for the construction of the proximal bypass anastomosis at greater than or equal to 7 cm from the access anastomosis
4. Harvesting an appropriate length greater saphenous vein
5. Creation of a tunnel from the proximal anastomosis to the site of the fistula
6. Anticoagulation with IV heparan sulfate at 50 UI/kg
7. Construction of the proximal anastomosis
8. Passing the graft in the tunnel
9. Construction of the distal anastomosis
10. Ligation of artery distal to the access anastomosis
11. Check for flow using ultrasound Doppler
12. Closure

Note These Variations

- DRIL may be performed for various upper extremity AV fistulas as well as lower extremity AV fistulas although very rarely needed for distal radiocephalic fistulae.
- DRIL was designed to overcome the limitations of fistula plication, a technique whereby the lumen of the first few centimeters of the fistula is narrowed to increase the outflow resistance in the fistula.
- The site of the proximal anastomosis in the inflow vessel may be exposed by extending the incision at the level of the fistula proximally for 7 cm or by creating a new incision 7–10 cm proximal to the level of the fistula.

Complications

- Vascular injury (dissection, thrombosis, perforation, and embolization)
- Distal limb ischemia (embolization and thrombosis)
- Damage to surrounding neurovascular structures

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_259

Template Operative Dictation

Preoperative Diagnosis *Right/left* upper extremity ischemic steal syndrome related to a functioning arteriovenous fistula

Procedure Distal revascularization with interval ligation of *radial/brachial* artery

Postoperative Diagnosis *Right/left* upper extremity ischemic steal syndrome related to a functioning arteriovenous fistula.

Indications This ___-year-old *male/female* patient was found to have a *right/left* upper extremity ischemic steal syndrome related to a functioning *right/left radial/brachial cephalic/basilic/axillary* arteriovenous fistula.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. The *right/left* arm was stretched out in a 90° fashion, prepped with povidone–iodine solution, and draped in the standard fashion. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. General anesthesia was induced along with endotracheal intubation.

The area over the arteriovenous fistula was palpated, and an incision was made providing sufficient exposure of the fistula. The incision was deepened down to the access vessels using electrocautery. Hemostasis was achieved. The *radial/brachial cephalic/basilic/axillary* arteriovenous fistula was identified and was found to have good flow with ultrasound Doppler. *The radial/brachial* artery was exposed for a 2 cm distance distal to the fistula for creation of the distal anastomosis.

The incision was extended proximally for 10 cm/A 4 cm, and skin incision was then performed 10 cm proximal to the site of the fistula. The radial/brachial artery was exposed 7–10 cm proximal to the fistula site and dissected circumferentially in preparation for the proximal anastomosis of the bypass. Attention was then directed to the upper thigh where the greater saphenous vein was previously mapped. The greater saphenous vein was harvested for an appropriate 12 cm segment. A subfascial tunnel was then created from the level of the proximal radial/brachial artery. The patient was anticoagulated with intravenous heparin at 50 UI/kg. The proximal radial/brachial artery was then clamped and a 1 cm arteriotomy was created. The vein was reversed and its end was spatulated to match the arteriotomy. An end-to-side anastomosis was then constructed using 5-0 Prolene suture. The vein was then passed distended in the tunnel. The point for the distal bypass anastomosis was identified 1–2 cm distal to the arteriovenous fistula on the *radial/brachial* artery. Vascular/Yasargil clamps were placed on the distal *radial/brachial* artery. A longitudinal arteriotomy was made over the *radial/brachial* artery, and a side-to-end anastomosis was constructed with the distal end of a saphenous vein graft. A 2-0 silk suture was used to ligate the *radial/brachial* artery between the access anastomosis and distal bypass anastomosis.

Yasargil clamps were removed and ultrasound Doppler was used to verify good flow through the fistula and bypass graft. Hemostasis was checked. The subcutaneous tissues were approximated with multiple interrupted 3-0 Vicryl sutures, and the skin was closed with 4-0 Monocryl in a running subcuticular fashion.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition. There were no complications.

Notes

Anatomic Requirements

Steal syndrome resulting from functional arteriovenous fistula

Necessary Equipment

Yasargil clamps
11 and 15 blade knives
Debakey forceps
Electrocautery
Sutures
Greater saphenous vein graft

260 Revision Using Distal Inflow (RUDI)

Simon Roh

Indication

- Ischemic steal syndrome related to a functioning dialysis access graft or fistula

Essential Steps

1. Exposure of the fistula
2. Exposure of the artery distal to the fistula and identification of its bifurcation
3. Exposure of one of the bifurcation arteries which will serve as the new distal inflow of the fistula and preparing it for the construction of the proximal bypass anastomosis
4. Harvesting an appropriate length greater saphenous vein
5. Anticoagulation with IV heparan sulfate at 50 UI/kg
6. Construction of the proximal anastomosis
7. Ligate/transect the fistula at its origin
8. Construction of the distal anastomosis
9. Check for flow using ultrasound Doppler
10. Closure

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Note These Variations

- Revision using distal inflow (RUDI) may be performed using either the radial or ulnar artery as the source for distal inflow.
- The distal anastomosis may be constructed using end-to-end or end-to-side configuration.

Complications

- Vascular injury (dissection, thrombosis, perforation, embolization)
- Distal limb ischemia (embolization, thrombosis)
- Damage to surrounding neurovascular structures

Template Operative Dictation

Preoperative Diagnosis *Right*/*left* upper extremity ischemic steal syndrome related to a functioning arteriovenous fistula

Procedure RUDI from *radial*/*ulnar* artery

Postoperative Diagnosis *Right*/*left* upper extremity ischemic steal syndrome related to a functioning arteriovenous fistula

Indications This ___-year-old *male*/*female* patient was found to have a *right*/*left* upper extremity

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_260

ischemic steal syndrome related to a functioning *right/left radial/brachial cephalic/basilic/axillary* arteriovenous fistula.

Details of Operation The patient was brought to the operating room and placed on the operating table in the supine position. The *right/left* arm was stretched out in a 90° fashion and prepped and draped in the usual sterile fashion.

Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

General anesthesia was induced along with endotracheal intubation.

The area over the arteriovenous fistula was palpated, and an incision was made providing sufficient exposure of the fistula. Incision was deepened down to the access vessels using electrocautery. Hemostasis was achieved. The *radial/brachial cephalic/basilic/axillary* arteriovenous fistula was identified and was found to have good flow with ultrasound Doppler.

The brachial artery distal to the fistula was exposed to its bifurcation. The radial/ulnar artery was selected as the new distal inflow site. A 2 cm segment of the radial/ulnar artery was further dissected and prepared for the creation of the proximal anastomosis. The distance between the fistula and the new inflow site was approximately 4–5 cm necessitating a vein segment to connect the fistula to the new distal inflow. A 5 cm segment of right/left greater saphenous vein was harvested from the thigh. The patient was administered heparan sulfate 50 UI/kg intravenously. Yasargil/Bulldog clamps/vessel loops were applied on the radial/ulnar artery. A 6 mm arteriotomy was created. An end-to-side anastomosis was created between the harvested vein and the radial/ulnar artery. The anastomosis was checked for hemostasis which was adequate. A 2-0 silk tie was used to ligate the arteriovenous fistula at its origin. Yasargil clamps were applied on the fistula. A 6–10 mm incision was performed in the fistula distal to the ligature/*the harvested vein segment was measured to the appropriate length, and an end-to-side anastomosis was then created between the harvested vein and the fistula*/(*alternative*) *an end to side. The fistula was transected distal to the ligature. An end-to-end anastomosis was created between the vein and the fistula*

The Yasargil clamps were removed, and ultrasound Doppler was used to verify good flow through the distal inflow graft and fistula, as well as the distal portions of the *radial/ulnar* artery and the palmar arch. Hemostasis was checked. The subcutaneous tissues were approximated with multiple interrupted 3-0 Vicryl sutures, and the skin was closed with 4-0 Monocryl in a running subcuticular fashion.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was transferred to the postanesthesia care unit in stable condition. There were no complications.

Notes

Anatomic Requirements

Steal syndrome resulting from functional arteriovenous fistula

Proximalization of the Arterial Inflow for Treatment of Steal Syndrome

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Mohammad Rachad Wehbe and Jamal J. Hoballah

Indication

Ischemic steal syndrome related to a functioning dialysis fistula

Essential Steps

1. Exposure of the fistula.
2. Exposure of afferent fistula vein.
3. Exposure of the proximal artery in the upper arm (12–15 cm proximal to the fistula site).
4. Creation of a tunnel from the proximal artery access to the site of the fistula.
5. Passing the graft in the tunnel.
6. Anticoagulation with IV heparin sulfate at 50 UI/kg.
7. Construction of the proximal anastomosis.
8. Ligation *and possible division* of the fistula.
9. Construction of the distal anastomosis (graft form the proximal artery site to the exposed vein).
10. Check for flow using ultrasound Doppler.
11. Wound closure.

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Note These Variations

The distal anastomosis may be performed using an end-to-side or end-to-end configuration depending on how the graft lies over the vein.

The graft used may be a 6 mm straight or 4-7 mm tapered ePTFE; *alternatively a saphenous vein segment may also be used if available and of good caliber*.

Complications

Vascular injury (dissection, thrombosis, and embolization)
Distal limb ischemia (embolization and thrombosis)
Damage to surrounding neurovascular structures
Infection

Template Operative Dictation

Preoperative Diagnosis *Right/left* upper extremity ischemic steal syndrome related to a functioning arteriovenous fistula

Operation *Proximalization of the arterial inflow to a brachiocephalic AVF*

Postoperative Diagnosis *Right/left* upper extremity ischemic steal syndrome related to a functioning arteriovenous fistula

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_261

Indications This ___-year-old *male/female* patient presented with a *right/left* upper extremity ischemic steal syndrome (*pain*, *finger ulcerations/gangrene*) related to a functioning *right/left radial/brachial cephalic/basilic* arteriovenous fistula.

Description of Procedure The patient was brought to the operating room and placed on the operating table in the supine position.

Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

Regional/general anesthesia was induced.

The *right/left* arm was stretched out in a 90° fashion, prepped with povidone-iodine solution and draped in the standard fashion.

The area over the arteriovenous fistula (brachiocephalic AVF) was palpated over the antecubital area, and an incision was made providing sufficient exposure of the fistula. The incision was deepened down to the access vessels using electrocautery.

Hemostasis was achieved. The brachiocephalic arteriovenous fistula was identified and was found to have good flow with ultrasound Doppler. Both the cephalic vein and the brachial artery at the level of the anastomosis were dissected for a 4 cm length. The cephalic vein was encircled with Silastic vessel loops. Attention was then directed proximally where a 4 cm longitudinal incision was made at the proximal upper arm medially. The incision was deepened until the proximal brachial artery was identified. It was dissected circumferentially and encircled with Silastic vessel loops.

The tunneling device was then passed between these two incisions. An ePTFE graft (4–7) mm/6 mm was passed through the tunnel taking care to avoid kinking or twists. The graft was irrigated with heparinized saline solution.

The patient was given 3,000 U of heparin intravenously. Proximal and distal arterial control was then obtained of the proximal brachial artery, and an anterior arteriotomy measuring 6 mm was made. The artery was irrigated with heparinized saline solution. An end PTFE to side artery (proximal brachial artery) anastomosis was then performed, using a running 6-0 Prolene suture. Upon the completion of the anastomosis, the PTFE graft was clamped just distal to the anastomosis, and vascular control of the artery was released to reestablish flow to the hand. Attention was directed to the cephalic vein at the antecubital area. Proximal and distal control was obtained, and a 10 mm venotomy was made. The vein was then irrigated with heparinized saline solution. The end of the PTFE graft was then cut in a beveled fashion at the appropriate length. An *end PTFE graft to side vein/end-to-end* anastomosis was then performed, using a running 6-0 Prolene suture. Following the completion of the anastomosis, vascular control was released, and flow was established through the graft.

There was an excellent distal pulse in the artery and a strong thrill in the vein. Hemostasis was achieved and the wound irrigated.

The subcutaneous tissues were reapproximated using interrupted 3-0 Vicryl sutures. The skin was reapproximated using *3-0 nylon in a vertical mattress fashion/subcuticular suture/other*.

A dry sterile pressure dressing was applied. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

262 Pharmacologic/Mechanical Lytic Therapy for Occluded Dialysis Access

Eanas S. Yassa

Indication

- Acute occlusion of dialysis access graft or fistula

Essential Steps

1. Determine if dialysis access is via PTFE graft or autogenous fistula. If graft, determine if loop configuration.
2. Rule out any signs of infection at potential percutaneous access site.
3. Confirm the patient is physiologically appropriate for percutaneous mechanical or pharmacologic thrombectomy.
4. Examine access for pseudoaneurysms.
5. Secure antegrade access via the arterial limb of dialysis graft/fistula.
6. Venogram – note location of any stenoses.
7. Anticoagulate with IV heparin sulfate (2,000–5,000 units typically).
8. Exchange angiogram catheter for 6- or 7-French sheath (usually, though different devices call for differing sheath sizes).
9. Advance a 0.035 in steerable guidewire to occlusion site.
10. Remove thrombus with device of choice, brought into position over guidewire.
11. Exchange thrombectomy device over guidewire for angioplasty balloon.
12. Treat noted venous stenoses.
13. Insertion of a second vascular access via micropuncture kit, retrograde from the venous limb toward the arterial anastomosis.
14. Exchange micropuncture sheath for 6- or 7-French working sheath.
15. Dislodge any arterial plugs (an organized densely packed collection of red blood cells and fibrin plug).
16. Remove sheaths and obtain hemostasis.

Note These Variations

- Diagnostic venogram may reveal a severe proximal venous stenosis that may preclude removal of thrombus and will need to be treated prior to thrombus removal – mechanical thrombectomy techniques include:
  - Balloon thromboaspiration – use of a Fogarty-type balloon to coax thrombus toward sheath through which thrombus is subsequently aspirated
  - Amplatz mechanical thrombectomy device (Microvena Corp, White Bear Lake, MN)
  - Hydrolyser catheter (Cordis Endovascular, Warren, NJ)

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_262

  - Possis AngioJet (Possis, Minneapolis, MN)
  - Oasis catheter (Boston Scientific, Natick, MA)
  - Gelbfish Endovac (Neovascular Technologies, Brooklyn, NY)
  - Trerotola device (Arrow International, Reading, PA)
  - AKonya Eliminator Plus (IDev Technologies, Houston, TX)
- If occlusion is unable to be adequately treated by thrombectomy device, usually secondary to inability to recannulate lumen using guidewire, recombinant tissue plasminogen activator (tPA) can be administered directly at thrombus site for later maceration using angioplasty balloon, or sheath can be left in place and tPA instilled at site of occlusion.
- If mechanical thrombectomy is not an option, tPA can be injected into the graft and allowed to act for 30 min prior to starting the procedure, which can then be supplemented by pulse spray injection of tPA inside the occluded graft.

Complications

- Venous/arterial endothelial injury and dissection
- Vessel rupture with balloon dilatation
- Embolization of small fragments into the distal arterial circulation *or* into central venous circulation
- Excessive blood loss from inattention to appropriate manual pressure with sheath exchanges or prolonged activation of aspiration arm on mechanical thrombectomy devices

Contraindications

- Local infection at access site
- Immature fistulae or one never having previously been used for dialysis access
- Large pseudoaneurysms at the cannulation sites
- Patient physiology unable to tolerate possibility of embolism of small thrombus particles to the lungs, i.e., significant left or right heart failure, pulmonary hypertension, and presence of right-to-left shunt
- *Relative contraindication*: Significant clot burden (suggested as >100 cc)

Template Operative Dictation

Preoperative Diagnosis Occluded dialysis access *graft/fistula*

Procedure Percutaneous *mechanical/pharmaco mechanical/pharmacologic* thrombectomy or thrombolysis

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* patient was found to have an acutely occluded dialysis access *graft/fistula*. Preoperative ultrasound confirmed absence of flow, and the patient is a good candidate for attempt at percutaneous repair.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *regional/local* anesthesia. The patient was positioned on the hybrid table in a supine position with affected extremity extended on an arm board/*exposed for imaging*. A prophylactic intravenous antibiotic for coverage of skin flora was administered. The extremity was prepped and draped in the standard sterile fashion.

A percutaneous access site was selected *for loop configuration grafts; access is obtained at the apex of the loop pointing toward the venous anastomosis; for autogenous fistulae, the access is in the fistula just distal to the anastomosis*. Access is obtained via micropuncture kit. Once access is confirmed, a guidewire is advanced beyond the occlusion, and an angiographic catheter is exchanged for the micropuncture sheath over a guidewire. A venogram to include the central venous circulation is obtained. Location of the thrombus and any other significant stenoses are noted. *If venous outflow cannot be traversed or recannulated and/or no other obstruction explains fistula failure*, *the procedure is aborted, or tPA therapy is initiated*.

IV heparin is administered for therapeutic anticoagulation. Over a wire, the angiographic catheter is exchanged for a working sheath (typically 6–8 French depending upon device to be used). The mechanical thrombectomy device is advanced to the level of the thrombosis. The device is activated. Care is taken to monitor blood loss if there is a suction or evacuator port. Once the thrombus has been removed, attention is turned toward treatment of underlying venous stenosis. A repeat angiogram is performed to verify any stenoses previously obscured by presence of thrombus. An angioplasty balloon is selected to be 10–20 % greater in the diameter than adjacent vessel diameter. The balloon is advanced to the site of stenosis and inflated to approximately 20 atm using a 1/2 strength contrast mixture to observe dilatation under fluoroscopy.

A second micropuncture is made to access the arterial limb of the anastomosis. *In a loop configuration graft, the arterial stick is also at the apex with sheaths oriented in a* "*crossing*" *fashion*; *in an autogenous fistula, the site of access is at the venous limb and directed retrograde*. Attention is then turned toward dislodgement of the arterial plug. A Fogarty (or other compliant balloon) is advanced under fluoroscopic guidance beyond the arterial anastomosis. It is partially inflated and pulled across the anastomosis, while the degree of inflation is continually adjusted. Once dislodged, the arterial plug is allowed to pass into venous circulation (*in situations of compromised pulmonary reserve*, *the plug can attempt to be aspirated through the sheath in the same manner as the venous thrombus. In these situations*, *it may also be prudent to delay treatment of venous stenoses until after the arterial plug is retrieved*).

Completion fistulagram is performed via the antegrade sheath. Return of palpable thrill is documented. The sheaths are withdrawn. Access site hemostasis is obtained by *manual pressure* (*if autogenous fistula*)/*by placement of superficial figure-of-eight/purse-string stitch of nonabsorbable monofilament* (*typically 3-0 or 4-0 PDS*) *in the skin overlying the access site but not incorporating the underlying PTFE graft*. Sterile dressing is applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The drapes were drawn at the patient, and the patient was transferred to the postanesthesia recovery unit in stable condition after tolerating the procedure well.

Part XXIV

Vascular Surgery: Sympathectomy

Supraclavicular Cervical Sympathectomy

263

Mario Martinasevic

Indications

- Hyperhidrosis
- Posttraumatic pain (frostbite)
- Raynaud's syndrome
- Nonhealing finger ulcerations with nonreconstructable vessels

Essential Steps

1. General anesthesia with a double-lumen endotracheal tithe
2. Barber chair position
3. Transverse skin incision two fingerbreadths above the clavicle starting at the lateral border of the sternocleidomastoid muscle
4. Scalene fat pad mobilized
5. Anterior scalene muscle and the phrenic nerve identified
6. Anterior scalene muscle divided
7. Transverse process of the sixth cervical vertebra identified
8. The nerve roots of the brachial plexus identified and protected
9. The middle scalene muscle identified and divided from its attachments to the first rib
10. The pleura bluntly dissected away
11. The thoracic sympathetic chain identified and its level determined by counting down from the first rib at the apex of the thoracic cavity
12. A segment of thoracic sympathetic chain from T2 to the T4 ganglion excised
13. Hemostasis and closure

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Note This Variation

- Cervical sympathectomy can also be performed under thoracoscopic guidance.

Complications

- Chylous fistula
- Phrenic nerve injury
- Horner's syndrome
- Pneumothorax

Template Operative Dictation

Preoperative Diagnosis *Hyperhidrosis/causalgia/Raynaud's syndrome/finger ulceration*

Procedure *Right/left/bilateral* cervical sympathectomy

Postoperative Diagnosis Same

© Springer Science+Business Media, LLC 2017
J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_263

Indications The patient is a ____-year-old *male/female with right/left/bilateral upper extremity hyperhidrosis/causalgia/nonreconstruc table ischemia*. The risks and benefits of cervical sympathectomy were discussed with the patient, who elected to undergo surgical intervention.

Description of Procedure The patient was placed in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under general anesthesia with a double-lumen endotracheal tube (which is preferred). The neck was extended and rotated to the *right/left*. The neck, chest, and *right/left* arm were all prepped and draped in a sterile fashion. A transverse skin incision was made two fingerbreadths above the clavicle starting at the lateral border of the sternocleidomastoid muscle. This was carried down through the platysma muscle. The scalene fat pad was exposed and the cutaneous nerves divided. The scalene fat pad was then retracted laterally. The anterior scalene muscle was then exposed. The phrenic nerve was identified and retracted. The anterior scalene muscle was then divided from its attachments to the first rib. The muscle was retracted superiorly, and the dissection was carried down to the level of the transverse process of the sixth cervical vertebra. The nerve roots of the brachial plexus were identified. The middle scalene muscle was identified and divided from its attachments to the first rib. The nerve roots were protected during this procedure at all times. The pleura was bluntly dissected away, avoiding any penetration into the pleural space. The thoracic sympathetic chain was then identified and its level determined by counting down from the first rib at the apex of the thoracic cavity. The sympathetic chain was encircled with a Silastic loop. A segment of thoracic sympathetic chain from T2 to the T4 ganglion was excised. The stellate ganglion was preserved. The wound was inspected for hemostasis. The fat pad was placed overlying the brachial plexus nerve roots. The platysma was closed with 3-0 Vicryl. The skin was closed with subcuticular sutures.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, was extubated, and was taken to the postanesthesia care unit in stable condition.

Thoracoscopic Sympathectomy

264

Pierre Sfeir

Indications

- Upper limb hyperhidrosis
- Raynaud disease
- Reflex sympathetic dystrophy
- Angina pectoris

Essential Steps

1. Preoperative CXR.
2. Double-lumen endotracheal intubation.
3. Lateral decubitus position.
4. Appropriate operating table flexion.
5. Axillary sandbag.
6. Make 1-cm skin incision in the mid-axillary line over the fourth intercostals space.
7. Insert 10-mm trocar followed by a thoracoscope.
8. Insert 5-mm port under vision along the third intercostal space and anterior axillary line.
9. Insert another 5-mm port along the third intercostal space and the posterior axillary line.
10. Identify the main sympathetic chain.
11. Identify important collateral fibers.
12. Identify and preserve the stellate ganglion.
13. Ablate or resect appropriate levels.
14. Hemostasis.
15. Chest drainage.
16. Wound closure.

Note These Variations

- Chest drainage is optional.
- Excision and interruption of the sympathetic chain are both acceptable options.

Complications

- Thermal injury to the stellate ganglion resulting in Horner's syndrome
- Bleeding from posterior thoracic wall veins
- Injury to intercostals or intercostobrachial nerves

Template Operative Dictation

Preoperative Diagnosis Palmar hyperhidrosis

Procedure Thoracoscopic sympathectomy

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* presenting with incapacitating palmar hyperhidrosis that was resistant to all conservative measures.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_264

The procedure along with its risks and alternatives was described to the patient in details.

Description of Procedure The patient was taken to the operating room and the side of the surgery was verified. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

In the supine position, general endotracheal anesthesia with a double-lumen tube was induced. The patient was then put in the *left/right* lateral decubitus position with appropriate flexion of the table to maximize the intercostal spaces. The chest was then scrubbed and draped in the usual fashion. The lung was deflated and the table was tilted forward to enhance exposure of the posterior chest wall by letting the deflated lung naturally fall downward. A 1-cm skin incision was made in the mid-axillary line over the fourth intercostal space. With blunt dissection, the pleural space was entered over the rib. A 10-mm trocar was then introduced followed by the thoracoscope. A second 5-mm port was then inserted under vision along the third intercostal space and anterior axillary line. A third port was introduced at the same level along the posterior axillary line. Quick exploration of the chest cavity did not reveal any gross abnormality. The fat pad on the neck of the first rib, overlying the stellate ganglion, was identified along with the upper thoracic sympathetic chain beneath the parietal pleura. The latter was then incised and the nerve dissected and elevated with a hook at the neck of the third rib. All communicating rami were divided up to the level of the second rib. Above the second ganglion, the chain was clipped and divided. Electrocautery was not used to avoid injury to the stellate ganglion by the transmitted current. Distally, the nerve was transected below the third ganglion. The specimen was sent to pathology. Hemostasis was secured. A 20-F chest tube was left along the chest apex through the 1-cm incision. The trocars were then removed and the lung reinflated. The wounds were closed with subcuticular fine absorbable monofilament. Steri-strips were applied.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, was extubated on the table, and was transferred to the postanesthesia care unit in stable condition.

Lumbar Sympathectomy

265

Mario Martinasevic

Indications

- Causalgia
- Posttraumatic pain (frostbite)
- Hyperhidrosis
- Vasospastic disorder
- Combine with arterial reconstruction
- Nonhealing ulcers in inoperable arterial occlusive disease

Essential Steps

1. General anesthesia
2. Supine position
3. Skin incision from the edge of the rectus toward the midpoint between the lower costal margin and the *anterior/superior* iliac spine
4. The external oblique incised and spread
5. The internal oblique aponeurosis incised and spread
6. The transversalis fascia incised and the peritoneum swept medially to expose the psoas muscle
7. The ureter identified and retracted medially and protected
8. The inferior vena cava dissected away from the psoas muscle and retracted medially (only on the right side)
9. The sympathetic chain was exposed and retracted on a nerve hook
10. A segment of lumbar sympathetic chain from the L2 to L3 ganglion excised
11. Hemostasis and closure

Complications

- Postsympathectomy neuralgia
- Retrograde ejaculation (if bilateral may be as high as 50 %)

Template Operative Dictation

Preoperative Diagnosis *Causalgia/hyperhidrosis/nonhealing foot ulcers*

Procedure *Right/left/bilateral* lumbar sympathectomy

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *male/female with right/left/bilateral causalgia hyperhidrosis/ischemic leg*. The risks and benefits of lumbar sympathectomy were discussed with the patient and *he/she* elected to undergo surgical intervention.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_265

Description of Procedure The patient was placed in the supine position. Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *general/spinal/endotracheal anesthesia*. The abdomen was prepped and draped in the usual sterile fashion.

An 8- to 10-cm skin incision was made from the edge of the rectus toward the midpoint between the lower costal margin and the anterior superior iliac spine. The incision was carried through the subcutaneous tissue. The external oblique was incised and spread. The internal oblique aponeurosis was incised and spread in the direction of its fibers. The transversalis fascia was incised and the peritoneum was swept medially to expose the psoas muscle. The ureter was identified and retracted medially and kept out of harm's way. The inferior vena cava was dissected away from the psoas muscle and retracted medially with minimal dissection (only on the right side). The sympathetic chain was exposed and retracted with a nerve hook. The nerve was dissected proximally and distally, exposing a ganglion at approximately the L2–L3 level. A 2.5-cm section of the nerve was clipped proximally and distally with metal clips. The nerve specimen was resected and sent to pathology, which confirmed it to be a nerve and ganglion. Hemostasis was secured. The incision was closed by approximating the transversalis muscle and the internal oblique with #1 PDS and the external oblique with 0 Prolene. The skin was approximated with staples.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well, was extubated, and was taken to the postanesthesia care unit in stable condition.

Part XXV

Vascular Surgery: Amputations

Above-Knee Amputation

266

Maen S. Aboul Hosn

Indications

- Nonhealing below-knee amputation
- Ischemic leg with nonreconstructable occlusive disease
- Ischemic leg in a nonambulatory patient with knee contracture
- Trauma
- Life-threatening infections
- Phlegmasia

Essential Steps

1. Outline with a marking pen the anterior and posterior skin flaps. (The flaps are usually equal in size, with a fish mouth pattern.)
2. Incise the skin and subcutaneous tissues down to the fascia.
3. Ligate and divide the greater saphenous vein on the medial aspect of the thigh.
4. Divide the fascia and the muscles at the same level as the skin flaps.
5. Locate the superficial femoral/proximal popliteal artery and vein on the deep posteromedial aspect of the thigh. Suture ligate the artery and vein individually.
6. Locate the sciatic nerve posterior to the femoral/popliteal vessels.
7. Pull, ligate, and divide the sciatic nerve.
8. Make a circular incision in the periosteum of the femur and free the periosteum proximally.
9. Divide the femur with a saw at least 5 cm proximal to the level of the soft-tissue transaction.
10. File any sharp bony edges.
11. Close the periosteum over the transected femur.
12. Approximate the deep investing fascia of the anterior and posterior muscles flaps with interrupted absorbable sutures.
13. Close the skin with interrupted nonabsorbable sutures/staples.

Note This Variation

- A circular incision can be performed and the skin edges are trimmed during closure to avoid any dog ears.

Complications

- Infection
- Nonhealing of amputation site
- Bleeding
- Phantom pain

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_266

Template Operative Dictation

Preoperative Diagnosis *Ischemic/gangrenous/trauma* with severe soft-tissue injury to the *right/left* leg

Procedure Above-knee amputation

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *male/female* with *nonhealing below-knee amputation/ischemic leg with nonreconstructable occlusive disease/ischemic leg in a nonambulatory patient/trauma/life-threatening leg infection/phlegmasia*. The risks of surgical intervention were discussed with the patient and *he/she* elected to undergo surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general/spinal/epidural/sciatic nerve block* anesthesia. The patient was placed supine. The *right/left* lower extremity was prepped and draped in the usual sterile fashion. An occlusive dressing was applied to the leg tip to the level of the knee.

Anterior and posterior skin flaps were outlined with a marking pen 5–10 cm proximal to the knee joint.

The skin incision was then performed and deepened through the subcutaneous tissue until the muscular fascia was identified. The greater saphenous vein was identified, ligated with 2-0 silk ties, and divided.

The muscle groups over the anterior and medial thighs were divided with electrocautery at the same level of the skin incision. The neurovascular bundle was identified on the medial aspect of the thigh. The popliteal artery and veins were isolated and suture ligated with a 2-0 silk ligature. The sciatic nerve was pulled, ligated with a 2-0 silk tie, and divided. The posterior thigh muscles were then divided with electrocautery. Once the muscle groups were circumferentially divided, the periosteum was incised and elevated approximately 5 cm proximally off the femur. The femur was divided with an *electric/Gigli* saw. The proximal end of the transected femur was smoothed with a file. The amputation stump was irrigated copiously with antibiotic solution. Hemostasis was secured. The periosteum was closed with a running 3-0 Vicryl suture over the transected femur. The fascia of the thigh muscles was closed with interrupted 3-0 Vicryl sutures. The skin was approximated with interrupted 3-0 *nylon sutures/skin staples* and dressed with 4 × 4 gauze, Kerlix, and an Ace bandage.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

267 Below-Knee Amputation

Maen S. Aboul Hosn

Indications

- Nonhealing transmetatarsal amputation
- Ischemic foot with nonreconstructable occlusive disease
- Ischemic foot in a nonambulatory patient
- Trauma
- Life-threatening foot infections

Essential Steps

1. Outline, with a marking pen, the skin incisions. (The anterior skin incision is made 10–12 cm below the tibial tuberosity and extends medially and laterally toward the edges of the gastrocnemius muscle. The posterior skin incision creates a posterior flap that extends 10–12 cm distal to the anterior incision.)
2. Incise the skin and subcutaneous tissues down to the fascia.
3. Ligate and divide the greater and short saphenous veins on the medial and posterior aspects of the leg, respectively.
4. Divide the fascia and the muscles at the same level of the anterior skin incision.
5. Divide the muscles in the anterior and lateral compartments.
6. Ligate the anterior tibial vessels.
7. Divide the interosseous membrane.
8. Incise the tibial periosteum at the same level of the skin and muscle division.
9. Strip the tibial periosteum proximally for 2 cm.
10. Divide the tibia with an anterior bevel.
11. Expose and transect the fibula with a bone cutter or Gigli saw 2 cm proximal to the tibial division.
12. Transect the soleus obliquely and the gastrocnemius muscle at the same level as the posterior flap.
13. Ligate and oversew any bleeding soleal veins and posterior tibial and peroneal vessels.
14. File any sharp bony edges.
15. Approximate the fascia of the anterior and posterior muscles flaps with interrupted absorbable sutures.
16. Close the skin with interrupted nonabsorbable sutures/staples.

Note This Variation

- Various types of flap coverage may be used to construct a below-knee amputation. The technique described herein utilizes a longer posterior flap and is the most commonly used.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_267

Complications

- Infection
- Nonhealing of amputation site
- Bleeding
- Phantom pain

Template Operative Dictation

Preoperative Diagnosis *Ischemic/gangrenous/trauma with severe soft-tissue injury to the right/left lot*

Procedure Below-knee amputation

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *male/female* with *nonhealing transmetatarsal amputation/ischemic foot with nonreconstructable occlusive disease/ischemic foot in a nonambulatory patient/trauma/life-threatening foot infection*. The risks of surgical intervention were discussed with the patient and *he/she* elected to undergo surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *general/spinal/epidural/sciatic nerve block* anesthesia. The patient was placed supine. The *right/left* lower extremity was prepped and draped in the usual sterile fashion. An occlusive dressing was applied to the foot up to the level of the ankle.

Anterior and posterior skin incisions were outlined with a marking pen. The anterior skin incision was made 12 cm below the tibial tuberosity and extended medially and laterally toward the edges of the gastrocnemius muscle. The skin incision was then extended distally on either side parallel to the tibia for 12–15 cm, creating a posterior flap. The skin and subcutaneous tissues were incised down to the fascia. The greater and short saphenous veins on the medial and posterior aspects of the leg, respectively, were ligated and divided. The fascia and the muscles were then divided with the electrocautery at the same level of the anterior skin incision. The muscles in the anterior and lateral compartment were divided, exposing the anterior tibial vessels, which were ligated and divided. The interosseous membrane was then incised. The tibial periosteum was incised circumferentially with the electrocautery at the same level of the skin and muscle division. Using a periosteal elevator, the tibial periosteum was stripped proximally for 2 cm. The tibia was then transected with a *Gigli/electric* saw 2 cm proximal to the skin incision with an anterior bevel. The fibula was then exposed, dissected circumferentially, and transected with a *bone cutter/Gigli* saw 2 cm proximal to the tibial division. The amputation was then completed with an amputation knife, transecting the soleus muscle obliquely and the gastrocnemius muscle at the same level as the posterior flap. Bleeding soleal veins and posterior tibial and peroneal vessels were clamped and oversewn with 2-0 silk sutures. Sharp bony edges were then filed, eliminating any bony prominences over the anterior aspect of the tibia. The fascia of the anterior and posterior muscle flaps were approximated with interrupted absorbable sutures. The skin was approximated with *interrupted 3-0 nylon sutures/skin staples* and dressed with 4 × 4 gauze, Kerlix, and an Ace bandage.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

268 Transmetatarsal Foot Amputation

Jamal J. Hoballah

Indications

- Multiple-toe gangrene/chronic osteomyelitis of metatarsal heads

Essential Steps

1. Noninvasive vascular testing suggests transmetatarsal amputation is likely to heal.
2. Mark the skin and the shape of the desired plantar flap.
3. Perform a transverse skin incision over the level of the midmetatarsal bones.
4. Deepen the incision to the bone.
5. Elevate the periosteum 1.5 cm proximal to the level of the skin incision.
6. Divide the bone.
7. Bend the divided bones and create the plantar flap.
8. Secure hemostasis.
9. Irrigate the wound.
10. Close the skin without tension.

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Note These Variations

- Depending on the extent of tissue loss, a transmetatarsal amputation can be an open amputation which will be closed later with a skin graft, delayed primary closure, or a closed amputation as described in this chapter.

Complications

- Nonhealing amputation site
- Infection

Template Operative Dictation

Preoperative Diagnosis *Multiple-toe gangrene/infection of metatarsal heads*

Procedure Transmetatarsal forefoot amputation

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female with multiple gangrenous/infected toes*. Noninvasive testing with toe pressure and transcutaneous oxygen tension suggested good skin perfusion. The risks and benefits of surgical intervention were discussed with the patient and *he/she* elected to undergo the procedure.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_268

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *regional/general anesthesia*. The *right/left foot* was prepped and draped in a sterile fashion. A skin incision was then performed at the level of the midmetatarsal level and then extended on the sides of the foot and the plantar aspect of the foot at the level of the metatarsophalangeal joints. The incision was deepened to the level of the bone. The periosteum was then elevated with a periosteal elevator. The bone was then transected at the midmetatarsal level, 1.5 cm proximal to the level of the skin incision. The divided bones were then reflected up and the amputation completed at the level of the plantar flap. Hemostasis was then secured and the wound was irrigated with saline solution. The skin was then closed with interrupted sutures of 4-0 nylon.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Transmetatarsal (Ray) Toe Amputation

269

Jamal J. Hoballah

Indication

- Toe gangrene/chronic osteomyelitis extending to the metatarsophalangeal joint or metatarsal head.

Essential Steps

1. Noninvasive vascular testing suggesting healing of toe amputation is likely.
2. Perform the skin incision (shape varies between toes; refer to variations).
3. Divide all attached tendons.
4. Elevate the periosteum to the level of the amputation.
5. Divide the bone.
6. Close the skin without tension.

Note This Variation

- For the first and fifth toes, an elliptical incision at a 30° angle to the longitudinal axis of the toe is made. For the second, third, and fourth toes, a circular incision is made at the metatarsophalangeal level and then extended on the dorsal aspect of the foot along the axis of the metatarsal bone.

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Complications

- Nonhealing amputation site
- Infection

Template Operative Dictation

Preoperative Diagnosis *Toe gangrene/infection*

Procedure Toe amputation

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with a *gangrenous/infected* toe extending to the proximal phalanx. Noninvasive testing with toe pressure and transcutaneous oxygen tension suggested good skin perfusion. The risks and benefits of surgical intervention were discussed with the patient and *he/she* elected to undergo the procedure.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklist to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *regional/general* anesthesia. The *right/left foot* was prepped and draped in a sterile fashion. *An elliptical skin incision was then performed at the level of the metatarsophalangeal joint at 30° to the longitudinal axis of the*

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DOI 10.1007/978-3-319-44797-1_269

metatarsal bone. A circular incision was performed at the metatarsophalangeal level and extended on the dorsal aspect of the foot along the metatarsal bone. The incision was deepened to the level of the bone, dividing all tendinous attachments. The periosteum overlying the metatarsal bone was then elevated with a periosteal elevator. The bone was then transected at the *distal/mid/proximal* metatarsal level, 1.5–2 cm proximal to the level of the skin incision. Hemostasis was then secured and the wound was irrigated. The skin was then closed with interrupted sutures of 4-0 nylon.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

270 Transphalangeal Toe Amputation

Jamal J. Hoballah

Indication

- Toe gangrene/chronic osteomyelitis

Essential Steps

1. Noninvasive vascular testing suggesting healing of toe amputation is likely.
2. Perform an elliptical skin incision perpendicular to the axis of the toe.
3. Elevate the periosteum to the level of the amputation.
4. Divide the bone.
5. Close the skin without tension.

Complications

- Nonhealing amputation site
- Infection

Template Operative Dictation

Preoperative Diagnosis *Toe gangrene/infection*

Procedure Toe amputation

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Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with a *gangrenous/infected* toe. Noninvasive testing with toe pressure and transcutaneous oxygen tension suggested good skin perfusion. The risks and benefits of surgical intervention were discussed with the patient, and *he/she* elected to undergo the procedure.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was performed under *regional/general* anesthesia. The *right/left foot* was prepped and draped in a sterile fashion. A skin incision was then performed at the level of the mid-proximal phalynx. The incision was deepened to the level of the bone. The periosteum was then elevated with a periosteal elevator. The bone was then transected at the proximal phalangeal level, 1.5 cm proximal to the level of the skin incision. Hemostasis was then secured and the wound was irrigated. The skin was then closed with interrupted sutures of 4-0 nylon.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_270

Part XXVI

Vascular Surgery: Miscellaneous Procedures

271 Supraclavicular Resection of Cervical Rib/First Thoracic Rib

Ismail Mohamad Khalil

Indication

- Neurogenic pain/axillary vein compression/axillary artery compression

Essential Steps

1. Patient in supine position, head of bed elevated 30°. The head and neck are turned to the opposite side.
2. The upper extremity and shoulder are prepped into the field to allow maneuvering the extremity for residual compression after scalenectomy and rib resection.
3. Incision starts 1–2 cm above and parallel to the clavicle. Start medially at the lateral border of clavicular head of sternocleidomastoid muscle and extending laterally parallel to the clavicle for 6–7 cm.
4. The incision is carried through the platysma muscle to expose the scalene fat pad.
5. Mobilization of the scalene fat pad begins at the lateral border of the internal jugular vein. The use of bipolar cautery is helpful at this stage to control bleeding veins.
6. The fat pad is freed medially, inferiorly, and superiorly then retracted laterally on its pedicle to expose the underlying roots of the brachial plexus. It is then held out in position with a suture and kept moist during the procedure. (The thoracic duct joins the left internal jugular vein at the base of the neck medially. Meticulous dissection in this region is obligatory to avoid injury to the duct.)
7. The phrenic nerve is clearly visualized within the investing fascia of the scalene anterior muscle.
8. The anterior scalene insertion on the first rib is clearly visualized. It is resected taking special effort to avoid any tension on the phrenic nerve.
9. The omohyoid muscle is seen traversing the field and can be divided.
10. The C5 and C6 roots and the brachial plexus and subclavian artery are observed at the lateral border of the edge of the anterior scalene.
11. The cervical rib and any cartilaginous or fibrous extensions to the first rib or other structures in the thoracic inlet are seen inferior to the subclavian artery.
12. The artery and roots are dissected carefully, avoiding any tension on the nerves.
13. Free the rib, circumferentially starting at its tip in the thoracic inlet, then proceeding posteriorly along its course toward the cervical spine.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_271

14. Resect the rib as far as you can and excise any additional remnants with a bone rongeur.
15. Release any adhesions around the artery and nerve roots.
16. For exposure of the first rib, the above steps are followed. Attention should be paid to avoid injuring the pleura when the inferior border of the rib is being freed. Similarly, the long thoracic nerve should be clearly visualized and protected when the scalene minimus insertion is mobilized.
17. At this stage the rib can be freed, circumferentially, from all facial and periosteal attachments and then resected.
18. The ipsilateral extremity can be manipulated at this stage to ensure that the vessels and roots are not compressed by any residual osseous or facial bands.

Note These Variations

- An infraclavicular approach may also be needed to allow further excision of the first rib and additional exposure of the subclavian vein.
- If any repair is required on the subclavian vein and superior vena cava, the supraclavicular exposure can be extended to provide adequate exposure.
- After resecting the first rib, the supraclavicular incision is extended medially to the sternal notch. The incision is then continued along the midline of the manubrium sterni and then carried laterally into the first rib space (which has been removed). The manubrium is slit for that short segment. The clavicle is kept attached to the segment of the manubrium, and the whole trapdoor is lifted in one unit exposing the superior mediastinum including the major vessels. This allows control of the axillary-subclavian vein as well as the superior vena cava for any bypass or patching of a narrowed segment of the vein.

Complications

- Injury to the phrenic, long thoracic, intercostal, and brachial plexus nerves
- Injury to the axillary vein or artery
- Injury to the thoracic duct
- Pneumothorax
- Incomplete rib resection
- Recurrent symptoms

Template Operative Dictation

Preoperative Diagnosis Right/left thoracic outlet syndrome

Procedure Supraclavicular resection right/left cervical or thoracic rib

Postoperative Diagnosis Same

Indications The patient is a ____-year-old male/female with symptoms suggestive of thoracic outlet syndrome with neurogenic/venous or arterial compression. The risks and benefits of supraclavicular rib resection were discussed with the patient, and he/she elected to undergo surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After induction of general anesthesia, the patient was placed in the supine position, with the head elevated 30° and tilted to the opposite side of the surgery. The entire ipsilateral extremity is scrubbed and draped in the field to allow full range of motion during the procedure. A transverse incision, 1–2 cm above the clavicle, was made starting medially at the lateral border of the clavicular head of the sternocleidomastoid and extended parallel to the clavicle for a distance of 6–8 cm. The incision was deepened through the platysma muscle which was divided. The scalene fat pad was visualized. Using a bipolar cautery, the fat pad was mobilized from its medial attachment, starting at the lateral border of the internal jugular, as well as superiorly and inferiorly. It was retracted laterally on a pedicle, attached to the drapes with a silk suture, and covered with moist gauze. The scalene anterior muscle came clearly into view with the phrenic nerve traversing its anterior belly. Laterally the brachial plexus roots and the subclavian artery were visualized. The middle scalene formed the lateral border. The cervical rib lied beneath the nerve roots and subclavian artery and was lifting the roots and artery upward. The area was inspected for fibrous or cartilaginous attachments between the rib and adjacent structures. The rib reached to and attached to the first rib with osseous and cartilaginous extensions. Soft tissue surrounding the cervical rib along with its fascia was carefully peeled away, circumferentially, with a small periosteum elevator as far back toward the cervical spine as possible. The rib was excised and any remnants removed with a fine rongeur. Soft tissue bands or adhesions to the artery or root were gently removed. The nerve roots were carefully protected from unnecessary mobilization or manipulation. The first rib was then removed. It was readily palpated in the base of the wound using the scalene attachment as a guide. Attachments of the middle scalene and scalene minimus were resected as well, after carefully guarding the long thoracic nerve. The fascia surround the rib was carefully peeled away circumferentially avoiding injury to the pleura underneath. To excise the rib adequately, it was necessary to divide the intercostal muscles between the first and second ribs. Similarly, medially the subclavious muscle is carefully resected after carefully protecting the subclavian vein. The neurovascular bundle was completely freed.

After resecting the rib and securing hemostasis, the wound was irrigated with saline. There was no evidence of lymph leak or leaks in the pleura. The wound was closed using 3-0 Vicryl for the subcutaneous tissue and 4-0 monocryl for the skin. The wound was covered with a sterile dressing.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

272 Transaxillary First Rib Resection

William J. Sharp

Indication

- Neurogenic pain/axillary vein compression/axillary artery compression

Essential Steps

1. Patient in straight lateral position.
2. Transverse skin incision below the axillary hairline.
3. Deepen the incision straight down to the rib cage.
4. Create an axillary tunnel.
5. Identify the first rib and incise its overlying fascia.
6. Gently push the axillary artery, vein, and brachial plexus toward the roof of the axillary tunnel.
7. Hook the attachment of the anterior scalene muscle to the first rib and divide it.
8. Identify and divide the attachment of the subclavius muscle tendon to the first rib.
9. Divide the intercostal muscles between the first and second ribs.
10. Free the first rib circumferentially from any muscular attachments.
11. Transect the rib anteriorly and posteriorly.
12. Excise additional rib remnants with a bone rongeur.
13. Check for pneumothorax.
14. Close the wound.

Note This Variation

- First rib resection can be performed through supra- and infraclavicular incisions or through a transaxillary approach as described in this chapter.

Complications

- Injury to axillary vein or artery
- Nerve injury: Brachial plexus, intercostobrachial nerve, and long thoracic nerve
- Recurrent symptoms
- Pneumothorax
- Incomplete rib resection

Template Operative Dictation

Preoperative Diagnosis *Right/left* thoracic outlet syndrome

Procedure Transaxillary *right/left* first rib resection

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_272

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* with symptoms suggestive of thoracic outlet syndrome with *neurogenic/venous arterial compression*. The risks and benefits of transaxillary first rib resection were discussed with the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. After the induction of general anesthesia, the patient was turned and placed in a straight lateral position with the *right/left* side up. The patient was supported with a beanbag and the contralateral axilla was padded and protected. The entire *right/left* upper extremity and upper chest were prepped and draped in the usual fashion. An assistant was holding the forearm in a double wristlock and elevating the upper extremity from the thorax. A transverse skin incision was made from the anterior edge of the latissimus dorsi muscle to the posterior edge of the pectoralis major muscle over the level of the third rib just below the axillary hairline. The incision was deepened down to the rib cage without angulating up into the axillary fat. The intercostobrachial nerves were identified and were spared and preserved. No accessory intercostobrachial nerves were identified. An axillary tunnel was then created. The first rib was identified. The fascia overlying the first rib was incised, and then using a combination of blunt and sharp dissection, the subclavian artery, vein, and brachial plexus were peeled off from the attachments to the top of the rib and pushed upward toward the roof of the axillary tunnel. Attention was then directed toward dividing the muscular attachments on the first rib. The anterior scalene muscle was identified, hooked with a right angle clamp, and then divided while protecting the subclavian artery and vein. The tendon of the subclavius muscle was identified and divided without any injury to the subclavian vein. The intercostal muscles between the first and second ribs were carefully released using a periosteal elevator. A raspatory was also used to free any additional attachments off the first rib superiorly and inferiorly. The intercostal space was then opened and the Sibson's fascia and remnants of the scalene muscles were incised. The first rib was completely freed circumferentially of all attachments from the transverse process of the vertebra posteriorly to the costal cartilage anteriorly, and a rib shears was used to transect the rib on both sides. Once the major portion of the rib was removed, the remaining stumps were palpated and shortened using a rongeur. Thorough irrigation was then performed. There was no evidence of any holes in the pleura. The neurovascular bundle was completely freed. The wound was then closed using 3-0 Vicryl for the subcutaneous tissue and 4-0 monocryl for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Surgical Repair of Femoral Pseudoaneurysm

273

Gregory A. Carlson

Indications

- Expanding hematoma following percutaneous femoral puncture
- Persistent pseudoaneurysm following percutaneous femoral puncture

Essential Steps

1. Local/general anesthesia.
2. Longitudinal incision over the pseudoaneurysm.
3. Proximal control if easily achievable.
4. Enter pseudoaneurysm and evacuate hematoma.
5. Finger control of bleeding site.
6. Proximal and distal control if arterial wall injury is complex.
7. Repair the femoral artery or any associated arterio-venous fistula.

Complications

- Recurrent hematoma
- Nerve injury
- Leg ischemia

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Template Operative Dictation

Preoperative Diagnosis Femoral pseudo aneurysm

Procedure Repair of femoral artery and evacuation of groin hematoma

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* who recently underwent a percutaneous femoral puncture for *angiography/cardiac catheterization*. The patient now has a *large/expanding* groin hematoma, *with hypotension and evidence of significant blood loss. The skin overlying the hematoma is tense and appears compromised*. A pseudoaneurysm has been identified on ultrasound. The risks and benefits of surgical intervention were discussed with the patient, and *he/she* elected to undergo surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *local/general* anesthesia. The patient was placed in a supine position. The *right/left* lower extremity was prepped and draped in a sterile fashion.

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_273

A longitudinal skin incision was then performed over the hematoma. The hematoma was then entered and the blood clot evacuated. The bleeding point was then controlled with finger pressure. The common femoral artery was then dissected around the injury site proximally and distally for a 3-cm segment. Vascular clamps were then applied on the femoral artery proximal and distal to the puncture site. Back- and forward bleeding were performed. There was no evidence of any intraluminal clots. The lumen was then irrigated with heparinized saline.

Two interrupted 5-0 Prolene sutures were then used to close the arterial wall defect.

The limb was reperfused and hemostasis was secured. The pedal pulses were evaluated by Doppler examination and revealed excellent flow.

A JP drain was placed in the wound and exteriorized through a separate stab incision. The wound was then irrigated and closed with 3-0 Vicryl for subcutaneous tissue and staples for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Ultrasound-Guided Percutaneous Obliteration of Common Femoral Artery Pseudoaneurysm with Thrombin Injection

274

Jamal J. Hoballah

Indication

- Persistent large pseudoaneurysm following percutaneous femoral puncture

Essential Steps

1. Local anesthesia
2. Duplex identification of the pseudoaneurysm
3. Introduction of the needle into the pseudoaneurysm
4. Injection of microairbubbles to further verify the needle tip position
5. Incremental thrombin injection until no flow is seen in the pseudoaneurysm

Note This Variation

- Femoral pseudoaneurysms following percutaneous arterial punctures can be left alone (if small), compressed under ultrasound guidance or injected with thrombin as described in this chapter.

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Complications

- Persistent pseudoaneurysm
- Leg ischemia
- Femoral artery thrombosis or distal embolization
- Nerve injury

Template Operative Dictation

Preoperative Diagnosis Tender *right/left* femoral pseudoaneurysm

Procedure Thrombin injection of *right/left* femoral pseudoaneurysm

Postoperative Diagnosis Same

Indications The patient is a ____-year-old *male/female* who recently underwent a percutaneous femoral puncture for *diagnostic angiography/cardiac catheterization*. Duplex ultrasonography revealed a large pseudoaneurysm measuring ____cm. *Ultrasound compression of the pseudoaneurysm was unsuccessful*. The risks and benefits of intervention were discussed with the patient, and *he/she* elected to undergo intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_274

safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. The procedure was done under local anesthesia. The patient was placed supine. The *right/left* groin was prepped and draped in the usual sterile fashion. The duplex probe was placed in the lateral aspect of the left common femoral artery pseudoaneurysm, revealing a ____-cm pseudoaneurysm with an identifiable neck communicating with the left common femoral artery.

The skin was infiltrated with 1 % lidocaine. A 20-gauge spinal needle was introduced into the pseudoaneurysm under ultrasound guidance. The needle tip was visualized penetrating the pseudoaneurysm capsule. A few microbubbles of air were injected through the needle to further confirm its position within the pseudoaneurysm.

The injection solution consisted of thrombin 5,000 U mixed with 5 cc of normal saline. Thrombin was injected at increments of 500 U per injection.

The first injection produced a near obliteration of the pseudoaneurysm. After waiting approximately 2 min, there was some persistent flow within the pseudoaneurysm. Additional increments of 500 U of thrombin were injected, which successfully obliterated the pseudoaneurysm completely. Duplex investigation revealed no evidence of blood flow into the pseudoaneurysm. The needle was removed. The patient had no change in the quality of the pedal pulses following the procedure.

There were no complications.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

Surgical Repair of Femoral Arteriovenous Fistula

275

Gregory A. Carlson

Indication

- Persistent arteriovenous fistula following percutaneous femoral puncture, with *distal ischemia/heart failure*

Essential Steps

1. Local/general anesthesia.
2. Longitudinal incision over the femoral artery.
3. Proximal arterial control.
4. Distal arterial control.
5. Circumferentially dissect and mobilize the femoral artery.
6. Finger control of bleeding site from venous hole.
7. Repair venous wall defect.
8. Repair arterial wall defect.

Complications

- Nerve injury
- Leg ischemia
- Venous thrombosis

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Template Operative Dictation

Preoperative Diagnosis Femoral arteriovenous fistula

Procedure Division of arteriovenous fistula and repair of femoral artery and vein

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* who recently underwent a percutaneous femoral puncture for *diagnostic angiography/cardiac catheterization*. Duplex evaluation revealed the presence of an arteriovenous fistula. The patient had *evidence/no evidence* of *leg swelling and distal ischemia/congestive heart failure*. The risks and benefits of surgical intervention were discussed with the patient, who elected to undergo surgical intervention.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under *local/general* anesthesia.

The patient was place in a supine position. The *right/left* lower extremity was prepped and draped in a sterile fashion.

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DOI 10.1007/978-3-319-44797-1_275

A longitudinal skin incision was then performed over the common femoral artery. The incision was deepened through the subcutaneous tissue and the femoral sheath entered. The common femoral artery was identified at the level of the inguinal ligament and circumferentially dissected and encircled with a vessel loop. The superficial femoral artery was circumferentially dissected and encircled with a vessel loop. The dissection of the superficial femoral artery was extended proximally. The profunda femoris artery was identified and encircled with a vessel loop.

The patient was given 5,000 U of heparin intravenously. The common femoral, superficial femoral, and profunda femoris arteries were then controlled with atraumatic vascular clamps. As the femoral artery was skeletonized, the fistula was encountered. The femoral artery was separated from the femoral vein. The hole in the femoral vein was controlled with the *forceps/finger pressure* and oversewn with a 5-0 Prolene suture. Interrupted 5-0 Prolene sutures were used to close the hole in the femoral artery. Flow was then resumed into the lower extremity.

Doppler evaluation revealed no evidence of any bruits or fistulae with good arterial signals in the foot.

The wound was then irrigated and closed with 3-0 Vicryl for subcutaneous tissue and staples for the skin.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient tolerated the procedure well and was taken to the postanesthesia care unit in stable condition.

276 Four-Quadrant Fasciotomy

Jamal J. Hoballah

Indication

- Status post lower-extremity revascularization with compartmental hypertension

Essential Steps

1. Longitudinal incision from the upper leg to the ankle 3 cm lateral to the tibia.
2. Skin flaps over the anterior and lateral compartments are created.
3. Longitudinal incision in the fascia of the anterior compartment.
4. Longitudinal incision in the fascia of the lateral compartment.
5. Longitudinal incision from the upper leg to the ankle 3 cm medial to the tibia.
6. The superficial fascia is incised.
7. The soleus muscle is incised longitudinally until the posterior fascia in identified and incised.

Note This Variation

- A four-quadrant fasciotomy can also be performed completely through a lateral approach. This approach will require excision of a large segment of the fibula. The deep and superficial posterior compartments are decompressed through the fibular bed.

Complications

- Nerve injury
- Bleeding

Template Operative Dictation

Preoperative Diagnosis Compartmental hypertension of the lower extremity

Procedure Four-quadrant fasciotomy

Postoperative Diagnosis Same

Indications The patient is a ___-year-old *male/female* who is status post *right/left* lower-extremity revascularization for acute ischemia. Postoperatively, the patient was noted to have pain with increasing leg swelling. Compartment pressures were obtained and were elevated greater than 35 mmHg.

Description of Procedure Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient,

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_276

procedure, site, and additional critical information prior to beginning the procedure.

The procedure was performed under general anesthesia. The patient was placed supine. The *right/left* lower extremity was prepped and draped in the usual sterile fashion.

A longitudinal incision was then performed over the lateral aspect of the leg 3 cm lateral and parallel to the tibia. The incision was deepened through the subcutaneous tissue until the fascia was identified. Skin flaps were created on either side of the incision to expose the anterior and lateral compartments. The fascia overlying the anterior compartment was then incised, and the incision carried along the entire length of the skin incision. The same was performed over the lateral compartment. The underlying muscles were released and appeared to bulge through the fascial incisions.

Attention was then turned to the medial compartment. A medial skin incision was then performed a few centimeters below the knee and extending down to 5 cm above the ankle. The incision was deepened down to the subcutaneous tissue until the fascia was identified. The superficial fascia was then divided, releasing the superficial posterior compartment. The soleus muscle was then incised with electrocautery until its posterior fascia was identified. The posterior fascia was then incised with the electrocautery along most of the length of the incision, freeing the deep posterior compartment.

Thorough irrigation was then performed and hemostasis was secured. The wounds were then covered with Vaseline Xeroform gauze. He/she had excellent signals in the foot.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was taken to the postanesthesia care unit in stable condition.

277 Split-Thickness Skin Graft

Jamal J. Hoballah

Indication

- Open wound, primary closure not possible

Essential Steps

1. Prepare the open wound and debride any non-granulating areas.
2. Identify the donor site.
3. Harvest the skin using the dermatome.
4. Mesh the skin graft.
5. Apply the skin graft over the wound and trim the edges.
6. Staple the skin graft.
7. Apply an occlusive immobilizing dressing.

Complications

- Failure of the skin graft to take
- Donor site infection

Template Operative Dictation

Preoperative Diagnosis Open wound (specify location)

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Procedure Split-thickness skin graft from *thigh/abdomen* to open wound (specify location)

Postoperative Diagnosis Same

Indications This is a ___-year-old *male/female* with an open wound over ___. The wound has a good granulation base and is not amenable to primary closure. A split-thickness skin graft was recommended. The risks and benefits of the procedure were explained to the patient, who agreed to proceed with the surgical procedure.

Description of Procedure The patient was placed in a supine position. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure.

General/regional anesthesia was induced. The *lower abdomen/upper thigh* and the wound area were prepped and draped in the usual sterile manner. The wound was then prepared and the granulation tissue gently scraped using a #10 blade. Using an electric dermatome a skin segment measuring ___ cm × ___ cm was harvested. The skin graft was then meshed at 1:1.5 ratio. The skin graft was then applied over the wound and the excessive skin trimmed. The skin was then stabilized to the wound using staples. The skin graft was then covered with a porous Vaseline

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_277

gauze dressing. A cotton ball dressing was applied over the Vaseline gauze and secured using *tie over silk sutures/Ace bandages*. A Tegaderm dressing was applied over the donor site.

A debriefing checklist was completed to share information critical to postoperative care of the patient.

The patient was taken to the postanesthesia care unit in stable condition.

Temporal Artery Biopsy

278

Jean Salem and Jamal J. Hoballah

Indication

- Tissue diagnosis to rule out giant cell/temporal arteritis

Essential Steps

1. Incise the skin and subcutaneous tissue over the temporal artery.
2. Identify and dissect the temporal artery located in the superficial layers of the superficial temporal fascia.
3. Suture/ligate the proximal and distal portions of the isolated artery.
4. Remove the ligated vessel.
5. Secure hemostasis.
6. Close the wound.

Note These Variations

- Biopsy is done on the side of most pain and/or tenderness. If there is no difference, the most easily palpable artery is chosen.
- The artery is usually mapped out by palpation. Rarely Doppler ultrasound is needed to locate the artery. Duplex may reveal a thickened artery with a halo sign.
- Temporal artery biopsy may be contraindicated in the presence of internal carotid occlusion as it may play an important collateral role.

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Complications

- Wound infection
- Hematoma formation
- Incisional alopecia
- Injury to the branches of the auriculotemporal or facial nerves

Template Operative Dictation

Preoperative Diagnosis Temporal arteritis

Procedure Temporal artery biopsy

Postoperative Diagnosis Same

Indications This ___-year-old *male/female* has *new-onset headache/jaw claudication/loss of visual acuity and diplopia/erythrocyte sedimentation rate greater than 50 mm/h* with *right/left* temporal artery *tenderness to palpation/reduced pulsation*. The patient has been informed that a temporal artery biopsy is required to confirm the

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J.J. Hoballah et al. (eds.), *Operative Dictations in General and Vascular Surgery*,
DOI 10.1007/978-3-319-44797-1_278

diagnosis of temporal arteritis before starting steroid therapy. The risks of the procedure were explained to the patient who elected to proceed with the biopsy.

Description of Procedure The patient was placed in the supine position with the head turned so the operative side is up. The *right/left* temporal area was prepped and draped in the usual sterile fashion. Time-outs were performed using both preinduction and pre-incision safety checklists to verify correct patient, procedure, site, and additional critical information prior to beginning the procedure. Local anesthetics (1 % lidocaine) without epinephrine to minimize arterial spasm were injected using a 27-gauge needle. A 3.5-cm incision was made directly over the artery through the skin and subcutaneous tissue using a #15 blade scalpel. The temporal artery was identified in the superficial layers of the superficial temporal fascia. Blunt dissection with a hemostat was performed parallel to the vessel to avoid tearing it. Electrocautery was used for hemostasis. The dissection proceeded beneath the vessel so that a hemostat was passed below it. After the vessel was isolated, 4-0 silk sutures were passed around the proximal and distal portions of the isolated artery and tied. Branches of the main artery were also ligated. The vessel was then transected. After ensuring hemostasis, the subcutaneous tissues were closed using interrupted 5-0 Vicryl sutures. The skin was closed with a running subcuticular 6-0 Vicryl sutures. Steri-Strips were applied over the wound and covered with sterile dressings.

The patient tolerated the procedure well. A debriefing checklist was completed to share information critical to postoperative care of the patient.

The specimen was spread over an applicator stick and submitted in saline solution to the pathologist.

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DOI 10.1007/978-3-319-44797-1

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