

Ponsky • Rosen

Atlas of Surgical Techniques for the Upper Gastrointestinal Tract and Small Bowel



**SURGICAL
TECHNIQUES
ATLAS
SERIES**

SERIES EDITORS

Townsend • Evers

companion website >> with video

Atlas of Surgical Techniques for the Upper Gastrointestinal Tract and Small Bowel

A Volume in the Surgical Techniques Atlas Series

Editor

Michael J. Rosen, MD

Chief, Division of Gastrointestinal and General Surgery
Director, Case Comprehensive Hernia Center
Assistant Professor
Case Medical Center
University Hospitals of Cleveland
Cleveland, Ohio

Jeffrey R. Ponsky, MD

Chairman, Department of Surgery
Case Medical Center
University Hospitals of Cleveland
Cleveland, Ohio

Series Editors

Courtney M. Townsend, Jr., MD

Professor and John W. Harris Distinguished Chairman
Department of Surgery

The University of Texas Medical Branch
Galveston, Texas

B. Mark Evers, MD

Director, Lucille P. Markey Cancer Center
Professor and Vice-Chair for Research, UK Department of Surgery
Markey Cancer Center Director Chair
Physician-in-Chief, Oncology Service Line
University of Kentucky
Markey Cancer Center
Lexington, Kentucky

SAUNDERS



ELSEVIER

SAUNDERS
ELSEVIER

1600 John F. Kennedy Blvd.
Ste 1800
Philadelphia, PA 19103-2899

ATLAS OF SURGICAL TECHNIQUES FOR THE UPPER GASTROINTESTINAL
TRACT AND SMALL BOWEL

ISBN: 978-1-4160-5278-4

Copyright © 2010 by Saunders, an imprint of Elsevier Inc.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Permissions may be sought directly from Elsevier's Rights Department: phone: (+1) 215 239 3804 (US) or (+44) 1865 843830 (UK); fax: (+44) 1865 853333; e-mail: healthpermissions@elsevier.com. You may also complete your request on-line via the Elsevier website at <http://www.elsevier.com/permissions>.

Notice

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our knowledge, changes in practice, treatment and drug therapy may become necessary or appropriate. Readers are advised to check the most current information provided (i) on procedures featured or (ii) by the manufacturer of each product to be administered, to verify the recommended dose or formula, the method and duration of administration, and contraindications. It is the responsibility of the practitioner, relying on their own experience and knowledge of the patient, to make diagnoses, to determine dosages and the best treatment for each individual patient, and to take all appropriate safety precautions. To the fullest extent of the law, neither the Publisher nor the Authors assumes any liability for any injury and/or damage to persons or property arising out of or related to any use of the material contained in this book.

The Publisher

Library of Congress Cataloging-in-Publication Data

Atlas of surgical techniques for the upper gastrointestinal tract and small bowel / editors, Michael J. Rosen, Jeffrey R. Ponsky.—1st ed.

p. ; cm.—(Surgical techniques atlas series)

Includes bibliographical references.

ISBN 978-1-4160-5278-4 (hardcover : alk. paper)

1. Gastrointestinal system—Surgery—Atlases. 2. Intestine, Small—Surgery—Atlases. I. Rosen, Michael J. II. Ponsky, Jeffrey R. III. Series: Surgical techniques atlas series.

[DNLN: 1. Upper Gastrointestinal Tract—surgery—Atlases. 2. Gastrointestinal Diseases—surgery—Atlases. 3. Intestine, Small—surgery—Atlases. WI 17 A8796 2010]

RD540.A85 2010

617.4'300222—dc22

2009029395

Acquisitions Editor: Judith Fletcher
Developmental Editor: Sarah Myer
Publishing Services Manager: Jeff Patterson
Project Manager: Amy Rickles
Design Direction: Steven Stave

Printed in China

Last digit is the print number: 9 8 7 6 5 4 3 2 1

Working together to grow
libraries in developing countries

www.elsevier.com | www.bookaid.org | www.sabre.org

ELSEVIER

BOOK AID
International

Sabre Foundation

**Atlas of
Surgical Techniques for the
Upper Gastrointestinal Tract and
Small Bowel**

Forthcoming Volumes in the **Surgical Techniques Atlas Series**

Atlas of Endocrine Surgical Techniques

Edited by Quan-Yang Duh, MD, Orlo H. Clark, MD & Electron Kebebew, MD

Atlas of Breast Surgical Techniques

Edited by V. Suzanne Klimberg, MD

Atlas of Thoracic Surgical Techniques

Edited by Joseph B. Zwischenberger, MD

Atlas of Minimally Invasive Surgical Techniques

Edited by Stanley W. Ashley, MD and Ashley Haralson Vernon, MD

Atlas of Pediatric Surgical Techniques

Edited by Dai H. Chung, MD and Mike Kuang Sing Chen, MD

Atlas of Trauma/Emergency Surgical Techniques

Edited by William Cioffi, Jr., MD

Atlas of Surgical Techniques for Colon, Rectum, and Anus

Edited by James W. Fleshman, MD

Atlas of Surgical Techniques for the Hepatobiliary Tract and Pancreas

Edited by Reid B. Adams, MD

CONTRIBUTORS

Alfredo M. Carbonell, DO, FACS, FACOS
Assistant Professor of Clinical Surgery
Division of Minimal Access and Bariatric Surgery
Greenville Hospital System University Medical Center
University of South Carolina School of Medicine
Greenville, South Carolina

Bradley Champagne, MD
Assistant Professor
General Surgery, Division of Colorectal Surgery
Case Medical Center
Cleveland, Ohio

William S. Cobb IV, MD
Associate Professor
Department of Surgery
University of South Carolina School of Medicine
Greenville, South Carolina

Matthew O. Hubbard, MD
Dudley P. Allen Research Fellow
Resident in General Surgery
Department of Surgery
Case Western Reserve University
Case Medical Center
Cleveland, Ohio

Leena Khaitan, MD, MPH
Associate Professor of Surgery
Case Western Reserve University
Cleveland, Ohio
Director of Bariatrics and Minimally Invasive Surgery
Geauga Medical Center
Chardon, Ohio

Julian A. Kim, MD, FACS
Professor and Chief, Surgical Oncology
Department of Surgery
Case Western Reserve University Hospitals
Cleveland, Ohio

Philip A. Linden, MD, FACS, FCCP
Associate Professor of Surgery
Case Western Reserve University
Chief, Division of Thoracic and Esophageal Surgery
Case Medical Center
Cleveland, Ohio

Michael J. Rosen, MD
Chief, Division of Gastrointestinal and General
Surgery
Director, Case Comprehensive Hernia Center
Assistant Professor
Case Medical Center
University Hospitals of Cleveland
Cleveland, Ohio



FOREWORD

“A picture is worth a thousand words”

Anonymous

This atlas is for practicing surgeons, surgical residents, and medical students for their review and preparation for surgical procedures. New procedures are developed and old ones are replaced as technologic and pharmacologic advances occur. The topics presented are contemporaneous surgical procedures with step-by-step illustrations, preoperative and postoperative considerations, and pearls and pitfalls, taken from the personal experience and surgical practice of the authors. Their results have been validated in their surgical practices involving many patients. Operative surgery remains a manual art in which the knowledge, judgment, and technical skill of the surgeon come together for the benefit of the patient. A technically perfect operation is the key to this success. Speed in operation comes from having a plan and devoting sufficient time to completion of each step, in order, one time. The surgeon must be dedicated to spending the time to do it right the first time; if not, there will never be enough time to do it right at any other time. Use this atlas; study it for your patients.

“An amateur practices until he gets it right; a professional practices until she can’t get it wrong.”

Anonymous

Courtney M. Townsend, Jr., MD
B. Mark Evers, MD



PREFACE

Foregut surgery provides the general surgeon the unique ability to treat a multitude of gastrointestinal diseases, including functional disorders of the esophagus, malignancies, morbid obesity, gastroesophageal reflux disease, and peptic ulcer disease. The surgical approaches to these diseases have evolved over the last several years with the rapid influx of minimally invasive techniques. It is important to point out that many disorders of the foregut require complex medical workups and substantial preoperative decision algorithms, which are not covered in this atlas. The atlas of foregut surgery focuses on the technical aspects of gastrointestinal surgery. We have paid particular attention to the operative steps of the respective procedures. We hope to provide a strategy both for avoiding common pitfalls in the operating room and for dealing with technical challenges once they are encountered. In this textbook, both laparoscopic and open approaches are described in detail to allow the surgeon to be comfortable with both techniques and to provide patients with the best outcomes. While there are often many ways to complete a successful operation, this textbook gives examples of safe and effective strategies to dealing with these common problems by various experts in this field. We hope these chapters provide a useful guide to the practicing surgeon in the care of gastrointestinal diseases of the foregut.

Michael Rosen, MD

CONTENTS

Section I Esophagus

- CHAPTER 1 TRI-INCISIONAL ESOPHAGECTOMY 1
Philip A. Linden, MD, FACS, FCCP, and Matthew O. Hubbard, MD
- CHAPTER 2 IVOR LEWIS ESOPHAGECTOMY 15
Philip A. Linden, MD, FACS, FCCP
- CHAPTER 3 LEFT THORACOABDOMINAL 21
Philip A. Linden, MD, FACS, FCCP
- CHAPTER 4 TRANSHIATAL 27
Philip A. Linden, MD, FACS, FCCP, and Matthew O. Hubbard, MD
- CHAPTER 5 MINIMALLY INVASIVE ESOPHAGECTOMY 33
Philip A. Linden, MD, FACS, FCCP

Section II Hiatal Hernia Surgery

- CHAPTER 6 NISSEN FUNDOPLICATION 40
Michael J. Rosen, MD
- CHAPTER 7 PARAESOPHAGEAL HERNIA REPAIR 52
Michael J. Rosen, MD
- CHAPTER 8 HELLER MYOTOMY 65
Michael J. Rosen, MD

Section III Stomach

- CHAPTER 9 TRUNCAL VAGOTOMY 72
Alfredo M. Carbonell, DO, FACS, FACOS
- CHAPTER 10 SELECTIVE VAGOTOMY 78
Alfredo M. Carbonell, DO, FACS, FACOS
- CHAPTER 11 HIGHLY SELECTIVE VAGOTOMY 82
Alfredo M. Carbonell, DO, FACS, FACOS
- CHAPTER 12 HEINEKE-MIKULICZ PYLOROPLASTY 87
William S. Cobb IV, MD
- CHAPTER 13 FINNEY PYLOROPLASTY 97
William S. Cobb IV, MD
- CHAPTER 14 JABOULAY PYLOROPLASTY 104
William S. Cobb IV, MD
- CHAPTER 15 ANTRECTOMY 110
William S. Cobb IV, MD
- CHAPTER 16 SURGICAL TREATMENT OF POSTGASTRECTOMY SYNDROMES 127
Alfredo M. Carbonell, DO, FACS, FACOS
- CHAPTER 17 LAPAROSCOPIC GASTRIC ULCER SURGERY 137
William S. Cobb IV, MD

Section IV Gastric Cancer Surgery

- CHAPTER 18 SUBTOTAL GASTRECTOMY: BILLROTH I AND II 145
Julian A. Kim, MD, FACS
- CHAPTER 19 TOTAL GASTRECTOMY 153
Julian A. Kim, MD, FACS

Section V Morbid Obesity Surgery

- CHAPTER 20 ROUX-EN-Y GASTRIC BYPASS 161
Leena Khaitan, MD, MPH
- CHAPTER 21 GASTRIC BAND 177
Leena Khaitan, MD, MPH
- CHAPTER 22 GASTRIC SLEEVE 187
Leena Khaitan, MD, MPH

Section VI Small Intestine Surgery

- CHAPTER 23 SMALL BOWEL RESECTION AND ANASTOMOSIS 194
Bradley Champagne, MD
- CHAPTER 24 JEJUNOSTOMY TUBE 206
Bradley Champagne, MD
- CHAPTER 25 STRICTUROPLASTY FOR CROHN'S DISEASE 213
Bradley Champagne, MD
- CHAPTER 26 LAPAROSCOPY FOR CROHN'S DISEASE 218
Bradley Champagne, MD
- CHAPTER 27 MECKEL DIVERTICULECTOMY 224
Bradley Champagne, MD
- CHAPTER 28 INTUSSCEPTION REDUCTION 228
Bradley Champagne, MD
- CHAPTER 29 SMALL BOWEL OBSTRUCTION 231
Bradley Champagne, MD
- INDEX 237

TRI-INCISIONAL ESOPHAGECTOMY

Philip A. Linden, MD, FACS, FCCP, and Matthew O. Hubbard, MD

Step 1: Surgical Anatomy

- ◆ The normal stomach will reach the neck when placed in situ in virtually every patient. If a patient has had prior gastric surgery, then it may not reach the neck.
- ◆ The upper and mid esophagus are most easily accessed via right-side thoracotomy, as the esophagus deviates to the right and there is no intervening aortic arch.
- ◆ The azygous vein crosses the esophagus at approximately the junction of the first third and second third of the esophagus. If the azygous vein is unusually large, it should be preserved. The azygous is infrequently a continuation of an interrupted inferior vena cava.
- ◆ The left recurrent nerve loops around the aortic arch and ascends in the tracheoesophageal groove in the chest. The right recurrent nerve loops around the right subclavian artery and ascends in the tracheoesophageal groove. Both nerves are best avoided by keeping dissection inside the vagus nerves above the level of the azygous vein.

Step 2: Preoperative Considerations

- ◆ A mechanical bowel prep is wise if there is a possibility of requiring a colon interposition instead of a gastric conduit.
- ◆ Preoperative intravenous antibiotics are administered. Although many prefer broad spectrum IV antibiotics, there is no data to show that these are superior to preoperative antibiotics directed only at gram-positive organisms.
- ◆ All patients undergoing esophagectomy are at high risk of deep vein thrombosis and pulmonary embolism, and they should receive perioperative subcutaneous heparin and sequential compression devices.
- ◆ Patients with limited exercise capacity and risk factors for coronary artery disease (CAD) should undergo cardiac testing prior to operation. Patients with a recent change in cardiac symptoms, change in their EKG, possible aortic stenosis, or signs or symptoms of heart failure should also undergo cardiac evaluation.

- ◆ Many factors, including location of tumor, extent of dysplasia, surgeon experience, lung and cardiac function, and patient anatomy factor into the route and method of esophagectomy.
- ◆ Patients with bulky mid-esophageal tumors, especially those who have undergone neoadjuvant chemoradiation, are best treated with a transthoracic approach.
- ◆ Patients with very poor pulmonary function (i.e., FEV₁ <40% predicted) may be better served with a thoracoscopic dissection or transhiatal approach.
- ◆ Bronchoscopy with full visualization of the membranous trachea and left main bronchus should be performed by the surgeon for all tumors of the mid and upper esophagus.
- ◆ Esophagogastroduodenoscopy must be performed by the surgeon prior to incision.
- ◆ A thoracic-level epidural is very useful in managing perioperative pain and minimizing the incidence of pulmonary complications after a thoracotomy.
- ◆ The advantages of the tri-incisional esophagectomy include: the complete removal of the esophagus; safe dissection of bulky tumors in the chest under direct vision; and an anastomosis out of the chest.
- ◆ Disadvantages include the need for a chest incision, and the higher incidence of recurrent nerve injury with a neck anastomosis.
- ◆ Patients with tumors at or above the level of the carina generally require a tri-incisional approach with an anastomosis in the neck.

Step 3: Operative Steps

1. Right Thoracotomy

- ◆ The patient is placed in the left lateral decubitus position with an approximate 30-degree forward tilt.
- ◆ An abbreviated right posterolateral thoracotomy is performed, starting beneath the tip of the scapula and extending posteriorly 10 cm—typically just long enough to allow introduction of the surgeon's hand.
- ◆ The latissimus is divided and the serratus muscle is spared and retracted anteriorly. Entry into the chest is on top of the sixth rib, in the fifth interspace. A 2-cm-long portion of the posterior sixth rib is removed to facilitate spreading of the ribs. The lung is retracted anteriorly and the inferior pulmonary ligament is divided with cautery.
- ◆ Starting at a region in the esophagus away from the tumor, the pleura is incised just anterior to the azygous vein. Posterior dissection is performed with a large, blunt right-angle or Harken #1 clamp. Medially, the pleural reflection is taken off the pericardium and dissection proceeds posteriorly. Dissection continues with cautery until a finger can encircle the esophagus, followed by a Penrose drain. All tissue lateral to the pericardium is included in the specimen. (Figure 1-1)
- ◆ For tumors at the GE junction, one may choose first to perform dissection in a cranial direction. To the right of the esophagus, all tissue medial to the azygous vein is included in the specimen—branches from the aorta are clipped on the aortic side, and cauterized on the esophageal side. All tissue is dissected off the pericardium and included in the specimen. The Penrose drain is used to distract the specimen away from surrounding tissue.
- ◆ On the left, the esophagus is dissected off the pericardium, and then away from the left main bronchus. On the right and posteriorly the esophagus is dissected off the aorta, clipping all large branches.
- ◆ The anterior vagus nerve is divided at this level, and dissection proceeds in between the vagus nerve and esophagus. (Figure 1-2)
- ◆ The posterior (left) vagus nerve is also identified and dissected away from the esophagus.

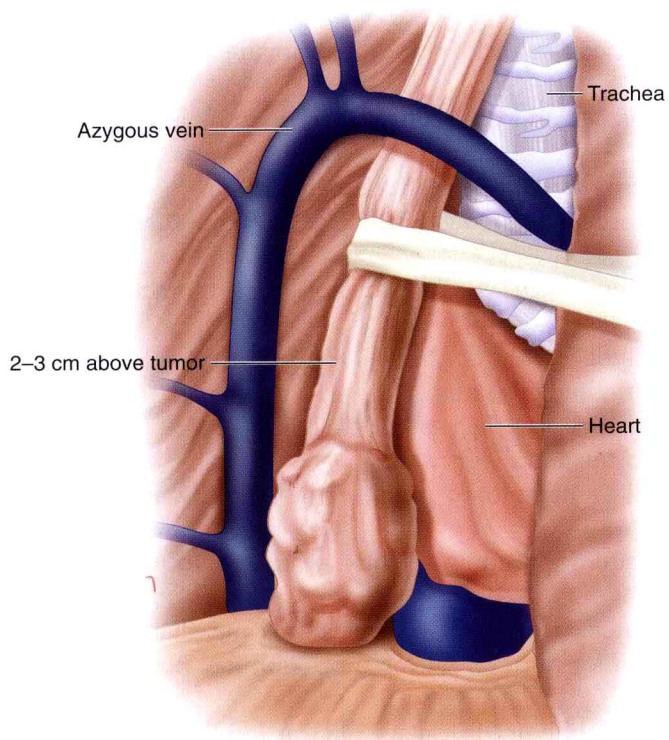


Figure 1-1

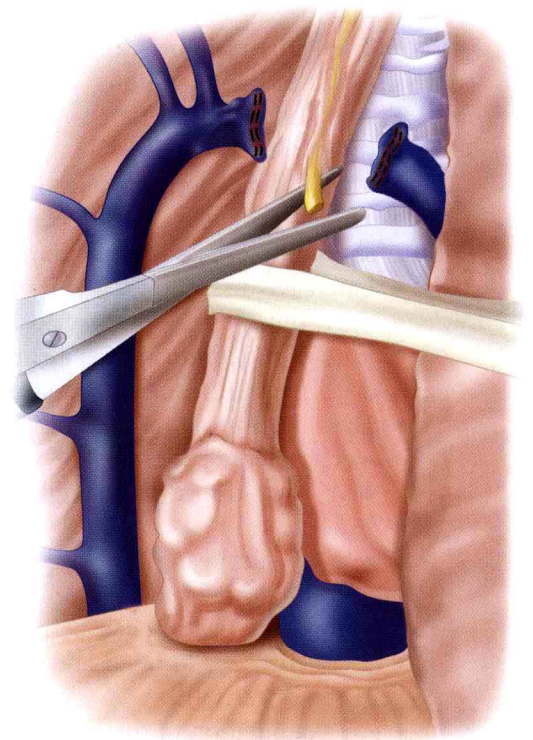


Figure 1-2

- ◆ The azygous vein is divided with an endovascular 2.5-mm stapler.
- ◆ Using low cautery settings, the esophagus is dissected away from the carina and trachea. Some of the dissection may be done using blunt finger dissection.
- ◆ The apical portion of mediastinal pleura is preserved in order to minimize the risk of contamination from a cervical leak.
- ◆ Dissection at the thoracic inlet is performed bluntly with the fingertip, preserving the apical pleura.
- ◆ The Penrose drain is knotted and placed along the cervical spine for retrieval during the cervical phase of the operation.
- ◆ Another Penrose drain is placed around the esophagus, and dissection proceeds in a caudal direction.
- ◆ Medial dissection removes the esophagus and periesophageal tissue off the pericardium.
- ◆ The esophagus is dissected laterally away from the aorta and azygous vein. Large arterial feeders should be clipped on the aortic side.
- ◆ Extensive dissection to the right and posterior to the esophagus enters the region of the thoracic duct, but must be performed for bulky tumors.
- ◆ For GE-junction tumors, a rim of diaphragm is included in the specimen. The rim is elevated away from intraabdominal structures using a large right-angle clamp.
- ◆ Mass ligation of the thoracic duct is performed at the level of the esophageal hiatus.
 - ▲ The pleura overlying the vertebral body lateral to the aorta is incised.
 - ▲ A blunt-tipped right-angle is used to encircle all tissue anterior to the vertebral body and aorta.
 - ▲ A #1 silk ligature is used to tie the tissue; take care not to tie too tightly, which could tear through the duct. (Figure 1-3)
 - ▲ A suture ligature can be performed, but there may be a higher risk of lacerating the duct.
- ◆ The Penrose is knotted and placed into the abdomen for retrieval during the abdominal phase of the operation.
- ◆ An examination of the esophageal bed is made for bleeding or for leakage of clear fluid, which may be an indication of a thoracic duct tear in the unfed patient.
- ◆ A 28 straight chest tube is placed to the right apex with an additional hole cut to drain fluid from the right pleural base.
- ◆ The chest is closed with #1 or #2 Vicryl paracostal sutures.
- ◆ Latissimus is reapproximated with a running 0 Vicryl suture.
- ◆ The subdermal layer is closed with a running 2-0 Vicryl suture.
- ◆ The subcuticular layer is closed with a running 3-0 monocryl or Vicryl suture.

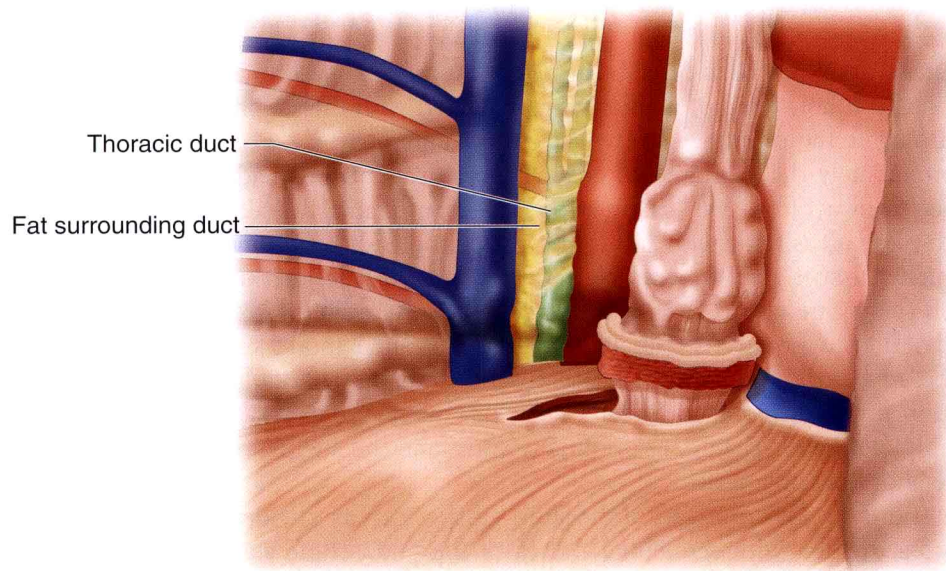


Figure 1-3

2. Laparotomy

- ◆ A midline upper laparotomy is performed from the base of the xiphoid process to 2 cm above the umbilicus. If the xiphoid process is excessively large, it can be excised.
- ◆ The omentum, liver, and serosal surfaces of the abdomen are explored for metastatic disease. If preoperative suspicion of abdominal metastatic disease is high, as in patients with celiac adenopathy, minimal response to neoadjuvant therapy, or signet cell pathology, a laparoscopy should be performed as the initial step. The right gastroepiploic artery is palpated—the pulse should be strong.
- ◆ An upper hand retractor is placed at about the level of the nipples. A Balfour retractor is used in addition to the upper hand retractor. Alternatively an Omni-type retractor can be used as the sole retractor. The patient is placed in a reverse Trendelenburg position.
- ◆ The attachments between the left lobe of the liver and the diaphragm are divided, taking care not to injure the left hepatic vein. The left lobe of the liver can be folded downward and retracted if the lobe is thin, taking care not to lacerate the surface of the liver. If the left lobe of the liver is thick, then it should be elevated anteriorly.
- ◆ Cautery is used to enter and divide the clear areas of the gastrohepatic ligament. An ultrasonic scalpel can be used for thicker areas of the ligament. Dissection proceeds up to the right crus.
- ◆ If a Penrose drain has been placed during the thoracic phase of the operation, it is now located and grasped. If not, a rim of diaphragm is included with the esophagus at the hiatus, with care to suture ligate the phrenic vein, which crosses anteriorly.
- ◆ At approximately the midpoint of greater curvature, entry is made into the lesser sac, several centimeters away from the gastroepiploic artery. Cranial dissection proceeds with cautery through clear areas, and with ultrasonic scalpel or with clamping and ligation through areas with thicker tissue. The surgeon to the patient's right side grasps the greater curvature of the stomach (with care not to compress or manipulate the right gastroepiploic artery) and retracts medially. The surgeon to the patient's left side uses one hand to keep abdominal contents away from the area of dissection and the other hand to distract tissue laterally.
- ◆ Dissection proceeds along the greater curvature with care to stay at least 2 cm away from the gastroepiploic artery. The artery eventually ends, and the lateral arcades supplying the stomach become short gastric arteries.
- ◆ The anterior and posterior leafs of the short gastrics may be divided with the ultrasonic scalpel, or may be divided with sequential firings of the endoscopic stapler (2.0-mm-thick staples). Often the highest short gastrics enter the cardia of the stomach immediately adjacent to the left crus. Dissection into the splenic artery or pancreas must be avoided. Dense adhesions in this area may make dissection difficult.
- ◆ Typically there are loose adhesions between the posterior aspects of the stomach and pancreas, which are divided with cautery.
- ◆ The stomach is retracted anteriorly, and the pedicle of the left gastric artery is identified. Sharp dissection with blunt-tip scissors or with cautery is used to dissect all nodes at the origin of the left gastric artery and sweep them onto the specimen. Celiac nodes can also be dissected in this fashion. (Figure 1-4) The base of the left gastric artery is clamped with an endovascular stapler that is 45 mm in length and 2.5 mm in height. The right gastroepiploic artery should be palpated at this point to insure that the celiac axis has not been clamped and the stapler is fired. (Figure 1-5)
- ◆ At this point dissection proceeds along the greater curvature of the stomach toward the pylorus. The gastroepiploic artery may wander away from the greater curvature of the stomach in this location.
- ◆ A Kocher maneuver is performed by retracting all abdominal contents to the patient's left side. Any adhesions between the gallbladder and duodenum are lysed. The duodenum is found at the pylorus and followed to where it attaches to the retroperitoneum. The highest peritoneal attachments are incised with scissors. The surgeon's index finger may then be introduced behind the lateral attachments, and cautery on the index finger will release the attachments. Gentle blunt sweeping of the duodenum medially can be performed with the surgeon's finger or a sponge stick. The medial blood supply to the duodenum must be preserved.

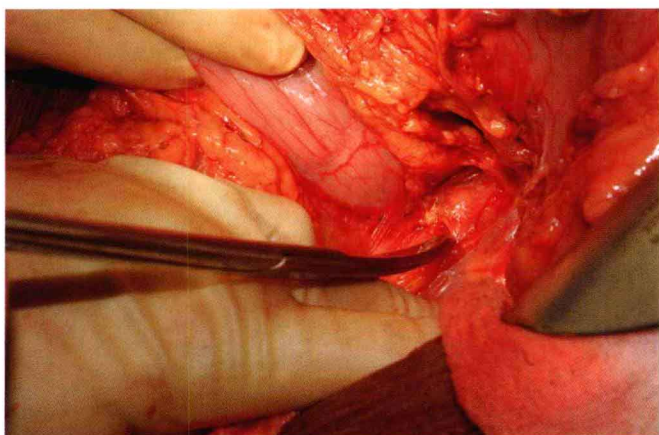


Figure 1-4

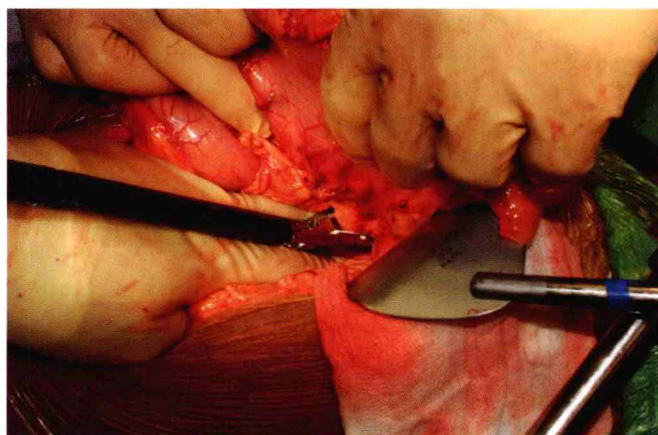


Figure 1-5