

Sleisenger and Fordtran's **Ninth Edition**
**GASTROINTESTINAL
AND LIVER DISEASE**

PATHOPHYSIOLOGY/DIAGNOSIS/MANAGEMENT

VOLUME 2



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Sleisenger and Fordtran's

Ninth Edition

GASTROINTESTINAL AND LIVER DISEASE

PATHOPHYSIOLOGY/DIAGNOSIS/MANAGEMENT

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Whipple's Disease

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Nausea and Vomiting

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Nausea and Vomiting

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Oral Diseases and Oral-Cutaneous Manifestations of Gastrointestinal and Liver Disease

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Liver Transplantation

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Nutritional Assessment and Management of the Malnourished Patient

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Surgical Peritonitis and Other Diseases of the Peritoneum, Mesentery, Omentum, and Diaphragm

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Mucosal Immunity

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Alcoholic Liver Disease

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Gastrointestinal and Hepatic Complications of Solid Organ and Hematopoietic Cell Transplantation

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Acute Abdominal Pain

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Abdominal Abscesses and Gastrointestinal Fistulas

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Bariatric Surgery

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Treatment of Gallstone Disease

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Foreign Bodies, Bezoars, and Caustic Ingestions

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Liver Chemistry and Function Tests

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Ulcers of the Small and Large Intestine

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Liver Physiology and Energy Metabolism

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Liver Physiology and Energy Metabolism

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Ascites and Spontaneous Bacterial Peritonitis

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Crohn's Disease

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Vascular Diseases of the Liver

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Endoscopic and Radiologic Treatment of Biliary Disease

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Diverticular Disease of the Colon

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Anatomy, Histology, Embryology, Developmental Anomalies, and Pediatric Disorders of the Biliary Tract

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Dyspepsia

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Irritable Bowel Syndrome

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Gastrointestinal and Hepatic Manifestations of Systemic Diseases

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Constipation

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Peptic Ulcer Disease

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Intestinal Electrolyte Absorption and Secretion

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Whipple's Disease

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Other Diseases of the Colon and Rectum

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Gallstone Disease

Timothy C. Wang, MD

Dorothy L. and Daniel Silberberg Professor of Medicine, Columbia University College of Physicians and Surgeons; Chief, Digestive and Liver Diseases, Columbia University Medical Center, New York, New York

Adenocarcinoma and Other Tumors of the Stomach

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Hereditary, Familial, and Genetic Disorders of the Pancreas and Pancreatic Disorders in Childhood

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Gastrointestinal Consequences of Infection with Human

Immunodeficiency Virus

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Radiation Injury

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Bariatric Surgery

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Surgical Peritonitis and Other Diseases of the Peritoneum, Mesentery, Omentum, and Diaphragm

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Chronic Abdominal Pain

Foreword

It is a pleasure to write the foreword for the 9th edition of Sleisenger and Fordtran's *Gastrointestinal and Liver Disease: Pathophysiology/Diagnosis/Management*, the classic textbook that has maintained its leadership position and progressively enhanced its reputation as the "go-to" book in its field. The extraordinary effort required to create a textbook that comprehensively and authoritatively presents the state of knowledge in an arena as broad and ever-expanding as gastroenterology is a daunting task but one that has been achieved with distinction in this 9th edition. The excellence and reliability exhibited by this considerably revised and updated edition amply validates the lasting value of the series.

Almost 40 years ago, Drs. Marvin Sleisenger and John Fordtran gathered a group of highly respected, thoughtful, and clinically excellent gastroenterologists to create what became the first edition of *Gastrointestinal and Liver Disease*. The book was a success from the onset. Subsequent editions have continued to successfully portray the accelerating evolution of gastroenterology. Gastroenterologists, internists, surgeons, pathologists, residents, and students from diverse backgrounds have relied on *Gastrointestinal and Liver Disease* as a thoughtful, extensively referenced, and user-accessible textbook. The images are well chosen and superbly produced. Important landmarks are noted, evaluated, and placed into proper perspective.

The 9th edition is ably edited by Drs. Mark Feldman, Lawrence Friedman, and Lawrence Brandt—all three highly respected clinicians and educators. This monumental undertaking continues a grand tradition and succeeds in providing authoritative overviews of the status of gastroenterology in the early 21st century. The editors are to be applauded for their efforts. The creation of a textbook requires considerable judgment in defining the current state of the art for a diverse range of disorders and in selecting authors best qualified to evaluate and lead the field. The editors have chosen the authors well for the 9th edition, with an admixture of established leaders and younger colleagues who represent the next generation that will advance gastroenterology.

A textbook differs in important ways from a journal. In a textbook, the state of knowledge is presented at a given, and set, time. A line is drawn in the sand. A successful chapter in a textbook defines the state of knowledge regarding a subject, provides a clear definition of what is known,

outlines how the knowledge evolved, suggests what challenges may be ahead, and offers a framework of advice as to the most efficient and effective means of establishing the diagnosis and developing a plan for treatment. The goal is to provide a foundation and a guide that will serve us well in the varied situations we encounter in clinical practice.

There surely have been outstanding advances in gastroenterology to incorporate into the 9th edition. Notable examples are the further emergence of advanced diagnostic and therapeutic endoscopy, introduction of liver and intestinal transplantation, development of more precise diagnostic genetic and serologic tests, and game-changing results derived from the advent of minimally invasive surgery. New innovative and effective therapeutic agents have been developed. These days, drugs are increasingly designed to solve a specific identified problem. Increasingly, therapeutic agents provide the ability to modulate inflammation, inhibit fibrosis, and regulate the processes that lead to cell death.

In the 9th edition of *Gastrointestinal and Liver Disease*, we are provided a sturdy platform to aid us now and direct us toward the future. What lies ahead is likely to be exciting beyond our most ambitious speculations. Knowledge will continue to evolve. Innovative, often life-changing therapies will be discovered. New challenges will emerge that must be faced.

As time goes by, we all will undoubtedly rely even more on electronically transmitted information (including the online version of this textbook, in which the references will be updated regularly). The role for a comprehensive, respected medical textbook, however, is far from over. We salute those who wrote and those who edited *Gastrointestinal and Liver Disease*. Through their efforts we are provided with renewed confidence that tangible progress is being achieved on many fronts.

An effective textbook reminds us of the past, firmly grounds us in the present, and guides our expectations and hopes for the future. *Gastrointestinal and Liver Disease* is such a book. We, the readers and our patients, will benefit from the guide provided.

Willis C. Maddrey, MD

University of Texas Southwestern Medical Center
Dallas, Texas

Preface

The 9th edition of *Sleisenger and Fordtran's Gastrointestinal and Liver Disease* is the second edition for which the three of us have served together as editors and the first for which neither Dr. Fordtran nor Dr. Sleisenger has participated. We remain grateful to their inspiring examples as visionaries and superb editors and are pleased to present an edition that we believe is worthy of their high standards and commitment to excellence. This edition is the first for which a single purchase will provide all readers with both a copy of the book and access to the online version of the text; the latter will be updated regularly to keep readers abreast of new developments in the rapidly evolving field of gastroenterology and liver disease. Moreover, providing readers with online access has allowed us to reduce the bulk of the hard copy of the book by listing only 15 or so key references per chapter and referring the reader to the online version for the complete list of references cited in each chapter and linked to PubMed. We are confident that readers will appreciate the improved "portability" of the book.

Like its predecessors, the 9th edition presents a critical overview of the state of gastrointestinal practice and its scientific basis by eminent authorities in their respective fields. With authors from at least 12 countries on 4 continents, the book is truly international in scope. We have been aided in our preparation of the 9th edition by the valuable feedback provided by our colleagues, trainees, reviewers, and readers; this has led to incremental refinements and enhancements since the highly acclaimed 8th edition, which received the first prize for a textbook in Gastroenterology from The British Medical Association in 2007. Attributes of the book, we believe, are its logical organization, minimized redundancies, polished writing, incorporation of color figures into the body of the text, inclusion of clear, visually appealing algorithms to summarize clinical decision making, and practical approaches to patient management. As always, we have tried to incorporate new, high-quality scientific evidence as the basis of rational treatment, while alerting readers to emerging developments that hold promise for new approaches to patient management.

To keep the book fresh and to ensure critical review of fields for which controversy exists, we have again rotated the authorship of many chapters, with approximately one third of the authors being new to this edition. We feel particularly fortunate to have enlisted contributors who are renowned authorities in their fields. Each has been chosen for his or her expertise and skills in communication, and it was a remarkable privilege for us to work with such accomplished colleagues. Reflecting recent trends in the practice of gastroenterology, three new chapters have been added to the 9th edition. First, a chapter by Drs. Woodard and Morton is devoted to Bariatric Surgery and complements the chapter on Obesity by Dr. Bray. This new chapter is an indication of the emerging role of the gastroenterologist not only in the selection of patients for bariatric surgery but also in the management of postsurgical complications and eventually in the endoscopic management of obesity. Second, a chapter on Barrett's Esophagus by Drs. Spechler and Souza has been separated from the chapter on Gastroesophageal Reflux Disease by Drs. Richter and Freidenberg, again reflecting the

importance and controversies concerning the premalignant nature of Barrett's esophagus and emerging approaches to its treatment. Third, a new chapter on Endoscopic Treatment of Pancreatic Disease complements the chapter on Endoscopic and Radiologic Treatment of Biliary Disease, both by Dr. Baron, with two different co-authors (Drs. Ferreira and Stockland, respectively), and reflects the expanding role of endoscopic interventions in the management of pancreatic disorders. Additionally, two chapters in the 8th edition have been merged into a single chapter in the 9th edition—Foreign Bodies, Bezoars, and Caustic Injury, by Drs. Pfau and Ginsberg.

The organization of the 9th edition is otherwise similar to that of the 8th edition with the exception that the section on Nutrition in Gastroenterology (Section II) has now been placed, more logically we believe, before the section on Symptoms, Signs, and Biopsychosocial Issues (Section III). In Section I on Biology of the Gastrointestinal Tract, we are delighted to welcome Drs. Dotan and Mayer, who provide a comprehensive overview of Gastrointestinal Immunology and Inflammation. In Section III, we welcome Dr. Millham (Acute Abdominal Pain), Dr. Yarze (Chronic Abdominal Pain), Dr. Tack (Dyspepsia), Dr. Rao (Fecal Incontinence), and Drs. Savides and D. Jensen (Gastrointestinal Bleeding), all recognized experts in their respective fields. We are also happy to welcome back Dr. Drossman, who has provided a masterly discussion of Biopsychosocial Issues in Gastroenterology. Section IV deals with Topics Involving Multiple Organs and includes an expanded discussion of Eosinophilic Disorders of the Gastrointestinal Tract, with a section on eosinophilic esophagitis, by Drs. Khan and Orenstein, and an expanded chapter on Preparation for and Complications of Gastrointestinal Endoscopy by Dr. Kimmey. Among the many other noteworthy contributors in this section are Drs. Li and Collins (Gastrointestinal Lymphomas), Dr. Demetri (Gastrointestinal Stromal Tumors), Dr. Oberg (Carcinoid Tumors), Drs. R. Jensen and Norton (Pancreatic and Gastrointestinal Endocrine Tumors), Drs. Larson and McDonald (Gastrointestinal and Hepatic Complications of Solid Organ and Hematopoietic Cell Transplantation), and Drs. Willett and Czito (Radiation Injury).

The next six sections cover the Esophagus, Stomach and Duodenum, Pancreas, Biliary Tract, Liver, and Small and Large Intestine. Among the new authors are Drs. Kahrilas and Pandolfino (Esophageal Motor and Sensory Function and Motor Disorders), Drs. Kaunitz and Schubert (Gastric Secretion), Drs. Crowe and Peura (*Helicobacter pylori*), Dr. Vakil (Peptic Ulcer Disease), Drs. Wang and Afdhal (Gallstone Disease), Dr. Andersson (Acalculous Cholecystitis, Cholesterosis, Adenomyomatosis, and Gallbladder Polyps), Drs. Blechacz and Gores (Tumors of the Bile Ducts, Gallbladder, and Ampulla), Dr. Misdraji (Anatomy, Histology, Embryology, and Developmental Anomalies of the Liver), Dr. Pratt (Liver Chemistry and Function Tests), Drs. O'Leary and Davis (Hepatitis C), Drs. Nevah and Fallon (Hepatic Encephalopathy, Hepatorenal Syndrome, Hepatopulmonary Syndrome, and Systemic Complications of Liver Disease), Drs. Belefer and Di Bisceglie (Hepatic Tumors and Cysts), Dr. Ramakrishna (Tropical Malabsorption and

Tropical Diarrhea), Dr. Foxx-Orenstein (Ileus and Pseudo-obstruction), Drs. Ludwig-Miller and Kurtz (Small Intestinal Neoplasms), and Dr. Marcello (Diseases of the Anorectum). The book concludes with an important section on Palliative, Complementary, and Alternative Medicine.

The 9th edition of this book remains a living tribute to its founding editors, Drs. Marvin Sleisenger and John Fordtran, and the current editors are proud to strive to uphold the tradition of excellence established by our predecessors. We are particularly grateful to Druanne Martin, Anne Snyder, and Jeffrey Gunning and their colleagues at Elsevier for their

commitment to this classic book, which has been a labor of love for the editors. We believe that the 9th edition of *Sleisenger and Fordtran's Gastrointestinal and Liver Disease* remains the ideal resource for all who seek excellence in the care of patients with gastrointestinal and liver disorders.

Mark Feldman, MD
Lawrence S. Friedman, MD
Lawrence J. Brandt, MD

The 9th edition of *Sleisenger and Fordtran's Gastrointestinal and Liver Disease* is the second edition for which the three of us have served together as editors and the first for which neither Dr. Fordtran nor Dr. Sleisenger has participated. We remain grateful to their inspiring examples as visionaries and superb editors and are pleased to present an edition that we believe is worthy of their high standards and commitment to excellence. This edition is the first for which a single purchase will provide all readers with both a copy of the book and access to the online version of the text; the latter will be updated regularly to keep readers abreast of new developments in the rapidly evolving field of gastroenterology and liver disease. Moreover, providing readers with online access has allowed us to reduce the bulk of the hard copy of the book by listing only 15 or so key references per chapter and retaining the reader to the online version for the complete list of references cited in each chapter and linked to PubMed. We are confident that readers will agree that this improved "portability" of the book.

Like its predecessors, the 9th edition presents a critical overview of the state of gastrointestinal practice and its scientific basis by eminent authorities in their respective fields. With authors from at least 12 countries on 4 continents, the book is truly international in scope. We have been aided in our preparation of the 9th edition by the valuable feedback provided by our colleagues, trainees, reviewers, and readers; this has led to incremental refinements and enhancements since the highly acclaimed 8th edition, which received the first prize for a textbook in Gastroenterology from The British Medical Association in 2007. Although the book, we believe, is its logical organization, minimized redundancies, polished writing, incorporation of color figures into the body of the text, inclusion of clear, visually appealing algorithms to summarize clinical decision making, and practical approaches to patient management. As always, we have tried to incorporate new, high-quality scientific evidence as the basis of rational treatment, while alerting readers to emerging developments that hold promise for new approaches to patient management.

To keep the book fresh and to ensure critical review of fields for which controversy exists, we have again retained the authorship of many chapters, with approximately one-third of the authors being new to this edition. We feel particularly fortunate to have enlisted contributors who are renowned authorities in their fields. Each has been chosen for his or her expertise and skills in communication, and it was a remarkable privilege for us to work with such accomplished colleagues. Reflecting recent trends in the practice of gastroenterology, three new chapters have been added to the 9th edition. First, a chapter by Dr. Woodward and Martin is devoted to bariatric surgery and complements the chapter on Obesity by Dr. Bray. This new chapter is an indication of the mounting role of the gastroenterologist not only in the selection of patients for bariatric surgery but also in the management of postoperative complications and eventually in the endoscopic management of obesity. Second, a chapter on Barrett's Esophagus by Dr. Spechler and Souza has been expanded from the chapter on Gastroesophageal Reflux Disease by Drs. Richter and Fendrick, again reflecting the

its treatment. Third, a new chapter on Endoscopic Treatment of Pancreatic Disease complements the chapter on Endoscopic and Radiologic Treatment of Biliary Disease, both by Dr. Baron, with two different co-authors (Dr. Farnett and Stockland, respectively), and reflects the expanding role of endoscopic interventions in the management of pancreatic disease. Additionally, two chapters in the 8th edition have been merged into a single chapter in the 9th edition—Foreign Bodies, Bowels, and Canals, infarct by Drs. Pilon and Glasberg.

The organization of the 9th edition is otherwise similar to that of the 8th edition with the exception that the section on Nutrition in Gastroenterology (Section II) has now been placed, more logically, we believe, before the section on Symptoms, Signs, and Biopsy/Endoscopic Issues (Section III). In Section I on Biology of the Gastrointestinal Tract, we are delighted to welcome Drs. Hatan and Mayer, who provide a comprehensive overview of Gastrointestinal Immunology and Information in Section II, we welcome Dr. Millman (Acute Abdominal Pain), Dr. Yano (Chronic Abdominal Pain), Dr. Jack (Dyspepsia), Dr. Rao (Fecal Incontinence), and Drs. Savides and D. Jensen (Gastrointestinal Bleeding). We also all recognized experts in their respective fields. We are also happy to welcome back Dr. Dumas, who has provided a masterly discussion of Biopsy/Endoscopic Issues in Gastroenterology. Section IV deals with topics involving Multiple Organs and includes an expanded discussion of Hemorrhagic Disorders of the Gastrointestinal Tract with a section on esophageal esophageitis by Drs. Khan and Glasberg, and an expanded chapter on Preparation for Endoscopy. Among the many other noteworthy contributors in this section are Drs. Li and Collins (Gastrointestinal Lymphomas), Dr. Demetri (Gastrointestinal Stromal Tumors), Dr. Oberoi (Carcinoid Tumors), Drs. R. Jensen and Nelson (Pancreatic and Gastrointestinal Endocrine Tumors), Dr. Lamon and McDonald (Gastrointestinal and Hepatic Complications of Solid Organ and Hematopoietic Cell Transplantation), and Drs. Williams and Cello (Radiation Injury).

The next six sections cover the Esophagus, Stomach and Duodenum, Pancreas, Biliary Tract, Liver, and Small and Large Intestine. Among the new authors are Drs. Kahrilas and Randolph (Esophageal Motor and Sensory Function and Motor Disorders), Drs. Kahrilas and Schubert (Esophageal), Drs. Crowe and Lewis (Esophageal Pathology), Drs. Wang and Adler (Viral Hepatitis), Dr. Anderson (Alcoholic Liver Disease), Drs. Chalasani, Adamyan, and Gallelli (Cholelithiasis), Drs. Black and Gores (Tumors of the Biliary Tract), Dr. Mink (Anatomy, Histology, and Development), Anomalous of the Liver, Dr. Pilon (Liver Chemistry and Function Tests), Dr. O'Leary and Davis (Hepatitis C), Dr. Neehan and Felson (Hepatic Metastases), Hepatobiliary System, Hepatic Complications of Systemic Diseases, and Systemic Complications of Liver Disease), Dr. Baker and Dr. Bickel (Hepatic Tumors and Cysts), Dr. Ramakrishna (Tropical Metabolism and

Contents

Volume 1

SECTION I

Biology of the Gastrointestinal Tract

CHAPTER 1

Gastrointestinal Hormones and Neurotransmitters

Rodger A. Liddle

3

CHAPTER 2

Mucosal Immunity

Iris Dotan and Lloyd Mayer

21

CHAPTER 3

Cellular Growth and Neoplasia

Daniel C. Chung and Daniel K. Poldolsky

31

SECTION II

Nutrition in Gastroenterology

CHAPTER 4

Nutritional Assessment and Management of the Malnourished Patient

Joel B. Mason

47

CHAPTER 5

Nutrition in Gastrointestinal Diseases

Mark H. DeLegge

77

CHAPTER 6

Obesity

George A. Bray

99

CHAPTER 7

Bariatric Surgery

Gavitt Woodard and John Morton

115

CHAPTER 8

Eating Disorders

Anne E. Becker and Christina Wood Baker

121

CHAPTER 9

Food Allergies

Hugh A. Sampson

139

SECTION III

Symptoms, Signs, and Biopsychosocial Issues

CHAPTER 10

Acute Abdominal Pain

Frederick H. Millham

151

CHAPTER 11

Chronic Abdominal Pain

Joseph C. Yarze and Lawrence S. Friedman

163

CHAPTER 12

Symptoms of Esophageal Disease

Kenneth R. DeVault

173

CHAPTER 13

Dyspepsia

Jan Tack

183

CHAPTER 14

Nausea and Vomiting

Juan-R. Malagelada and Carolina Malagelada

197

CHAPTER 15

Diarrhea

Lawrence R. Schiller and Joseph H. Sellin

211

CHAPTER 16

Intestinal Gas

Fernando Azpiroz and Michael D. Levitt

233

CHAPTER 17

Fecal Incontinence

Satish S. C. Rao

241

CHAPTER 18

Constipation

Anthony J. Lembo and Sonal P. Ullman

259

CHAPTER 19

Gastrointestinal Bleeding

Thomas J. Savides and Dennis M. Jensen

285

CHAPTER 20

Jaundice

Steven D. Lidofsky

323

CHAPTER 21

Biopsychosocial Issues in Gastroenterology

Douglas A. Drossman

337

SECTION IV

Topics Involving Multiple Organs

CHAPTER 22

Oral Disease and Oral-Cutaneous Manifestations of Gastrointestinal and Liver Disease

Ginat W. Mirowski and Lawrence A. Mark

353