

# Mayo Clinic Gastrointestinal Imaging Review

Second Edition



C. Daniel Johnson

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**Gastrointestinal  
Imaging Review**

*Second Edition*

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**Gastrointestinal  
Imaging Review**

*Second Edition*

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Some drugs and medical devices presented in this publication have US Food and Drug Administration (FDA) clearance for limited use in restricted research settings. It is the responsibility of the health care providers to ascertain the FDA status of each drug or device planned for use in their clinical practice.

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*To Therese, my wife, the love of my life*

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## ABOUT THE COVER

The cover for the book was adapted from the cover of the first edition. For the first edition, a magnificent Kandinsky painting was the inspiration and foundation for an illustration depicting each portion of the gastrointestinal tract. The paintings of Kandinsky were seen as analogous to radiographic images—abstract to many viewers and understood only with knowledge of anatomy, radiography, and pathology. To demonstrate that this edition is an updated and more modern version of the first, I selected a next-generation artistic style, that of Pablo Picasso, as the underlying structure. The beauty of the interrelated gastrointestinal organs has been preserved, but with an increasingly modern flair.

Jim Rownd, the artist for the cover of the first edition, again designed and created this second edition cover. The individual gastrointestinal components are placed on the title pages of their respective chapters. I am most grateful to Jim for his artistic guidance and talents. The freedom given to me to create the book of my choice is also greatly appreciated. I hope you enjoy it.

**C. Daniel Johnson, MD**



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## PREFACE

The purpose of this second edition is to update and supplement the first edition of *Mayo Clinic Gastrointestinal Imaging Review*. The goal of the book is to provide a radiologic atlas of common abnormalities that affect the gastrointestinal tract that can be detected with imaging examinations. Emphasis is placed on images that are large enough to study the findings with a minimal amount of text. The book is not intended to be an inclusive source of gastrointestinal diseases and their many manifestations. Rather, the most important disease processes affecting the gastrointestinal tract and their commonest presentations are included. Only a few selected pediatric cases are included to provide a comparison with adult disease processes. Readers are directed to pediatric textbooks for a more comprehensive review of these disorders. The content of this book is directed primarily to radiology residents learning the fundamentals of gastrointestinal imaging and for board preparation. In addition, radiologists preparing for recertification examinations may find the book helpful as an efficient review.

Many of the cases in this second edition were in the first edition, although outdated images have been replaced when possible and new disease entities and imaging approaches have been added. For example, many magnetic resonance images have been added. The format for cases remains standardized to a description of the radiologic findings, pertinent differential diagnoses, the actual diagnosis, and a brief discussion. Students are urged to review the case first without reading the text (answers). Numerous summary tables and illustrations synthesize information and provide key points and case references for review. New features of the book are the questions at the end of each chapter and a final chapter of examination-type questions. These have been added to help students prepare for written examinations and to assess their learning as they progress through the book. Selected readings and references are not included—an acknowledgment that readers of this book are likely looking for an efficient single-source review and that references are easily accessible online. There are multiple other textbooks on gastrointestinal imaging with comprehensive references that the reader should access for supplementation of their knowledge in this field.

C. Daniel Johnson, MD

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## ACKNOWLEDGMENTS

I am deeply indebted to the many members of the Department of Radiology at Mayo Clinic who provided cases for the book. I have had many mentors and assistants who made this project possible. My training in radiology was highly influenced by distinguished radiologists, including Harley C. Carlson, David H. Stephens, Robert L. MacCarty, Reed P. Rice, William M. Thompson, and Igor Laufer. I am grateful to all of them. Grant Schmidt, the coauthor of the first edition, provided much assistance in making the first edition successful. Although he didn't have time to coauthor this second edition, I am grateful to him for the many good ideas that he had for the initial textbook that remain part of this edition and for a long list of interesting cases that contributed to needed improvements for the book. My administrative assistant, Lisa Kay, was very helpful with printing, sorting, and organizing the revisions. The Section of Scientific Publications and Media Support Services at Mayo Clinic worked tirelessly to provide the product that I envisioned. I am grateful for the expert editorial assistance provided by the staff in Scientific Publications: LeAnn M. Stee (editor), Kenna Atherton (manager), Jane Craig (editorial assistant), and John Hedlund (copy editor/proofreader). The radiologic images were meticulously reviewed and prepared by Deborah Veerkamp, the drawings were originally created by David A. Factor, MS, and beautifully updated with color by Joanna King, MSMI, and the cover art was created by Jim Rownd.

As always in my career, my wife, Therese Johnson, has encouraged me and supported me in this effort. Always unselfish with her time and always willing to pick up the slack when I was not available at home, she continues to help me achieve when I would not have otherwise.

I hope readers find the book an efficient way to learn the myriad and fascinating ways of the gastrointestinal tract through imaging.

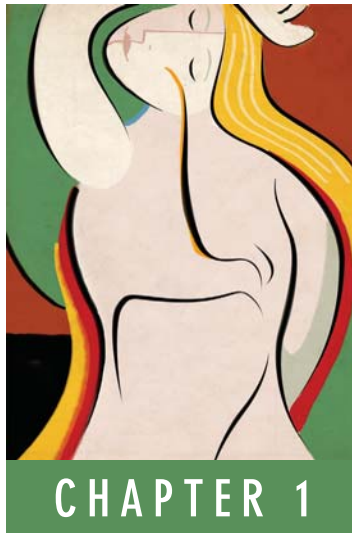
**C. Daniel Johnson, MD**

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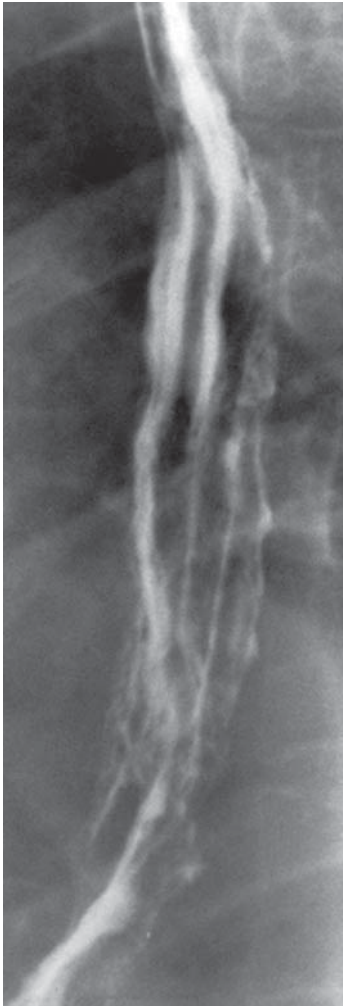
## ESOPHAGUS

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## CASE 1.1

**Findings**

Double-contrast esophagram. Thickened and somewhat nodular folds are seen in the distal esophagus.

**Differential Diagnosis**

1. Reflux esophagitis
2. Esophageal varices

**Diagnosis**

Mild reflux esophagitis

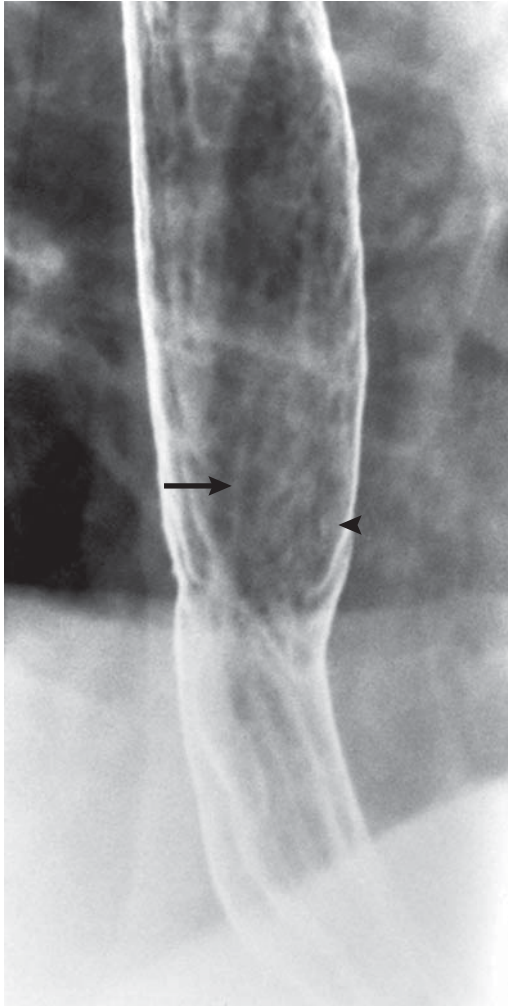
**Discussion**

Reflux esophagitis is a common indication for and finding at UGI. If fold thickening is the only finding on a triphasic esophagram, mild esophagitis commonly is found endoscopically. Folds are considered abnormal if they exceed 2 to 3 mm in diameter.

Development of reflux esophagitis depends on several factors, including the acidity of the refluxed contents, the efficacy of esophageal clearance, and the frequency of reflux. These factors are particularly important in patients with Zollinger-Ellison syndrome and those with scleroderma, groups commonly affected with reflux esophagitis. Varices (cases 1.46 and 1.47) change shape with fluoroscopic observation and often have a serpentine and nodular configuration.

**Disease type: Inflammatory and Ulcerative Diseases**

## CASE 1.2



### Findings

Double-contrast esophagram. Linear erosions (arrow) and punctate superficial erosions (arrowhead) are present within mildly nodular mucosal background. The esophagus is shortened, and a small hiatal hernia is present.

### Differential Diagnosis

1. Reflux esophagitis
2. Herpes esophagitis
3. *Candida* esophagitis

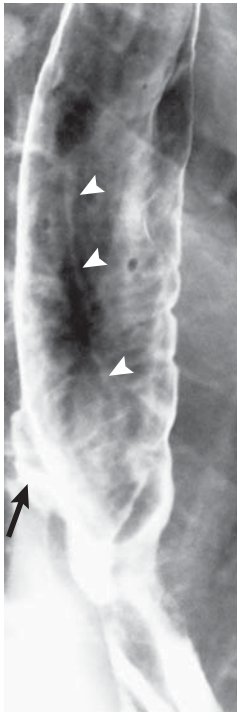
### Diagnosis

Moderate reflux esophagitis

### Discussion

Moderate esophagitis usually is characterized by the presence of superficial erosions that may be either punctate or linear. Fold thickening and nodularity also often are findings on the mucosal-relief phase images. In patients with long-standing disease with esophageal intramural fibrosis, the esophagus shortens and pulls the stomach into the thorax. This type of “short esophagus” hiatal hernia is present in this case. Herpes esophagitis (cases 1.17 and 1.18) is usually associated with multiple discrete superficial ulcers that may be located anywhere in the esophagus. *Candida* esophagitis (cases 1.15 and 1.16) most often has multiple plaquelike filling defects throughout the esophagus.

## CASE 1.3



## Findings

**CASE 1.3.** Double-contrast esophagram. A large, flat ulcer is present in the distal esophagus (arrow) with associated diminished distensibility of the lower esophageal segment. There is also a long linear ulcer (arrowheads) with a surrounding halo of edema.

**CASE 1.4.** Double-contrast esophagram. Mucosal nodularity, a deep ulcer, and luminal narrowing are present. Transverse folds due to chronic scarring and buckling of the mucosa also are present (arrows). Sharp spiculations are seen just superior to the deep ulcer; these are due to transverse folds seen in profile (arrowheads). Asymmetric scarring causes the distal deformity and narrowing.

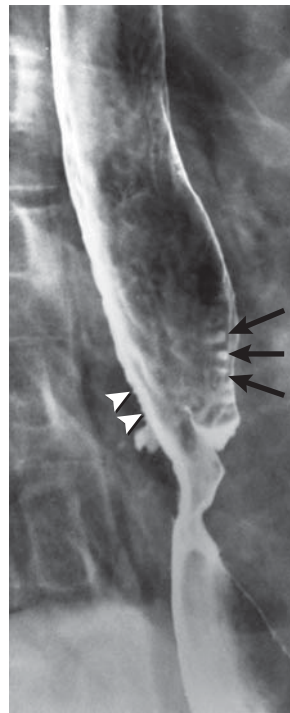
## Differential Diagnosis

1. Transverse folds and severe reflux esophagitis
2. Feline esophagus
3. Carcinoma of the esophagus

## Diagnosis

Severe reflux esophagitis

## CASE 1.4



## Discussion

Transverse folds develop as a result of a prior linear ulceration with scar formation within the longitudinal muscle layers of the distal esophagus. They usually do not span the entire esophageal lumen.

Severe esophagitis usually is characterized by the presence of an ulcer crater. Typically, patients with severe esophagitis have superficial erosions and fold thickening in addition to the characteristic ulcer.

Transverse folds from esophagitis should be distinguished from the folds in feline esophagus (case 1.5) because transverse folds are fixed, fewer in number, coarser, and shorter. Changes of both active and chronic disease commonly coexist (as seen in these cases).

## CASE 1.5

**Findings**

Double-contrast esophagram. **A.** Multiple thin, transverse folds are present in lower esophagus.

**B.** Exposure taken a few seconds later is normal, without evidence of previously seen folds.

**Differential Diagnosis**

1. Feline esophagus
2. Transverse folds of chronic reflux esophagitis

**Diagnosis**

Feline esophagus

**Discussion**

Feline esophagus is recognized by the presence of multiple transverse folds present transiently as the

esophagus begins to collapse. The folds are fine and delicate, numerous, and symmetric. They usually cross the entire esophageal lumen. They develop from contractions of the longitudinally oriented muscularis mucosae. Their transience distinguishes them from the fixed, larger folds occasionally found in reflux esophagitis (case 1.4). Transverse folds of esophagitis usually do not cross the esophageal lumen. They also should be distinguished from the broad transverse bands seen in nonpropulsive tertiary contractions (case 1.59).

The name is derived from the similar-appearing esophagographic findings in cats. Usually these findings are associated with active changes of reflux esophagitis. Some investigators have suggested that they are more common in patients with esophagitis.

**Disease type: Inflammatory and Ulcerative Diseases**

## CASE 1.6

**Findings**

**CASE 1.6.** Double-contrast esophagram. Luminal irregularity and narrowing are present in the distal esophagus with associated asymmetric sacculations.

**CASE 1.7.** Single-contrast esophagram. A short esophagus hiatal hernia has irregularity and outpouchings about the lower esophageal segment.

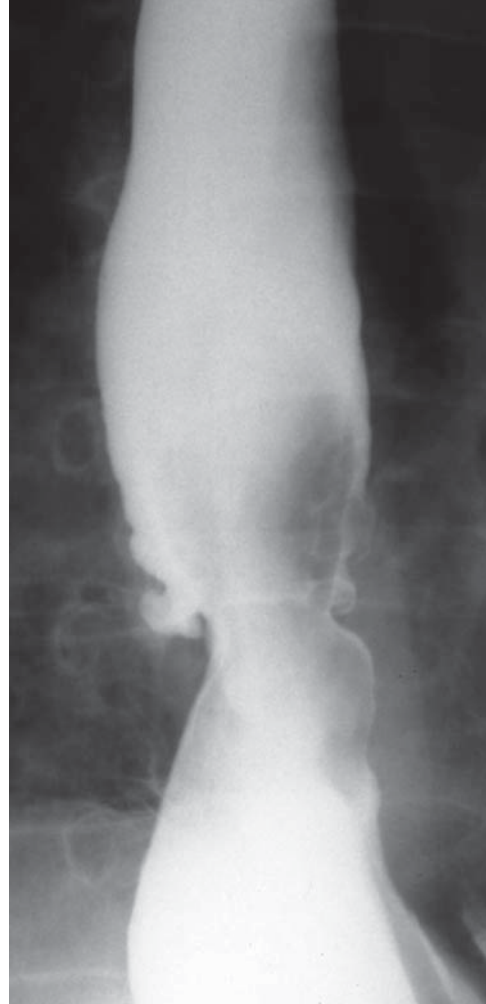
**Differential Diagnosis**

1. Active reflux esophagitis
2. Chronic reflux esophagitis
3. Esophageal carcinoma

**Diagnosis**

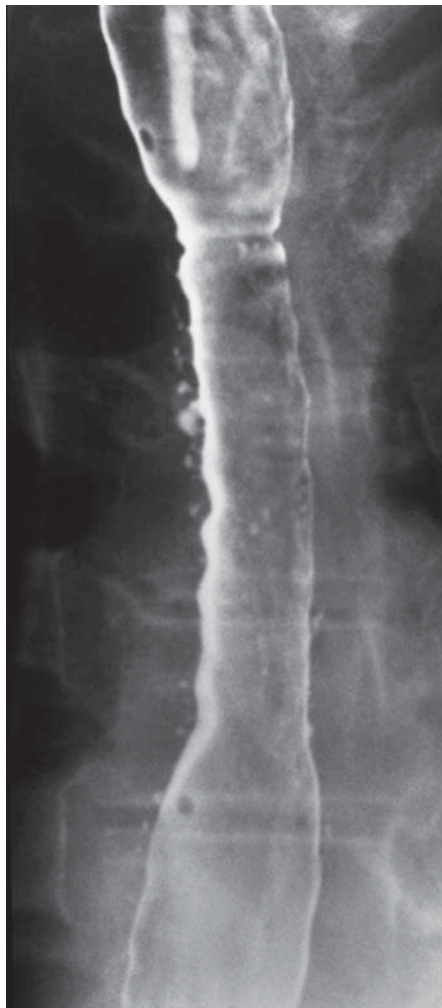
Chronic reflux esophagitis

## CASE 1.7

**Discussion**

Chronic and active changes of reflux esophagitis often coexist. It may be impossible to exclude active ulceration or carcinoma in patients with marked deformity. Endoscopy should be recommended for patients with such problematic findings. Changes of chronic reflux esophagitis can result in scarring and considerable deformity of the esophagus.

## CASE 1.8



### Findings

Double-contrast esophagram. Multiple tiny outpouchings are seen within the mid esophagus around a localized stricture.

### Differential Diagnosis

Intramural esophageal pseudodiverticulosis

### Diagnosis

Intramural esophageal pseudodiverticulosis

### Discussion

Intramural esophageal pseudodiverticulosis is seen as multiple tiny outpouchings that either diffusely or segmentally affect the esophagus. Because the tiny

necks may not fill completely, there is an apparent lack of communication with the esophageal lumen. Pathologically, these outpouchings are dilated submucosal glands, most commonly due to chronic reflux esophagitis. Elderly patients are most frequently affected and complain of progressive dysphagia due to the often-associated esophageal strictures. Up to 90% have an associated smooth stricture in the mid or upper esophagus. Dilation of the stricture usually cures the symptoms. The radiographic appearance is analogous to Rokitansky-Aschoff sinuses in the gallbladder and is virtually pathognomonic of this condition. *Candida* organisms are frequently cultured from the esophagus in patients with this condition, but they are believed to be a secondary invader rather than a causative factor.

**Disease type: Inflammatory and Ulcerative Diseases**

## CASE 1.9

**Findings**

Single-contrast esophagram. A short stricture is present in the mid esophagus, with some luminal irregularity at the level of the stricture. A short esophagus-type hiatal hernia also is visible.

**Differential Diagnosis**

1. Barrett esophagus stricture
2. Reflux stricture
3. Medication-induced esophagitis or stricture
4. Caustic ingestion-induced stricture

**Diagnosis**

Barrett esophagus stricture

**Discussion**

A focal esophageal stricture above the gastroesophageal junction is suggestive of Barrett esophagus. Barrett esophagus is histologically described as metaplasia and replacement of the normal squamous epithelium with gastric-type adenomatous mucosa. Chronic reflux esophagitis is nearly always the underlying cause of the disease. Some authorities estimate that nearly 10% of patients with reflux esophagitis have some adenomatous transformation in the esophagus.

This case is a typical example of Barrett esophagus. The short-esophagus hiatal hernia indicates long-standing esophagitis. Usual reflux-induced strictures (case 1.20) are located immediately above the gastroesophageal junction. Because adenomatous tissue is acid-resistant, strictures in Barrett esophagus develop near the squamous-adenomatous transition zone. Barrett strictures commonly are seen in the upper and mid esophagus. Medication-induced esophagitis (case 1.13) usually occurs at areas of anatomical narrowing—thoracic inlet, near aortic arch, or left mainstem bronchus. Caustic strictures (case 1.25) are usually long and associated with a typical history of caustic ingestion.