Esophageal emergencies—primarily, perforation and conditions with the potential to progress to perforation—result in significant morbidity and mortality if they are not recognized and treated promptly. The spectrum of esophageal emergencies includes esophagitis, foreign body impaction, and traumatic esophageal injury. Because there is considerable variability in the clinical manifestations of emergent esophageal conditions, computed tomography (CT) may play both primary and complementary roles in their diagnosis and evaluation. An awareness of the CT findings associated with the spectrum of acute esophageal disease facilitates the accurate and prompt diagnosis of esophageal emergencies and thereby contributes to a more successful outcome.

CT Features of Esophageal Emergencies

Catherine A. Young, MD, JD • Christine O. Menias, MD • Sanjeev Bhalla, MD • Srinivasa R. Prasad, MD

Esophageal emergencies—primarily, perforation and conditions with the potential to progress to perforation—result in significant morbidity and mortality if they are not recognized and treated promptly. The spectrum of esophageal emergencies includes esophagitis, foreign body impaction, and traumatic esophageal injury. Because there is considerable variability in the clinical manifestations of emergent esophageal conditions, computed tomography (CT) may play both primary and complementary roles in their diagnosis and evaluation. An awareness of the CT findings associated with the spectrum of acute esophageal disease facilitates the accurate and prompt diagnosis of esophageal emergencies and thereby contributes to a more successful outcome.
Introduction
Esophageal processes such as esophagitis, foreign body impaction, traumatic esophageal injury, and complications of perforation often present emergently. The increasing use of cross-sectional imaging in emergent care settings, the availability and ease of computed tomography (CT), and the often nonspecific manifestations of acute esophageal conditions all ensure a role for CT in the initial detection and diagnosis of these pathologic processes. In addition, CT is a useful adjunct to conventional esophagography and direct visualization, helping delineate the location and extent of disease, assess complications, and exclude alternative diagnoses. Delays in diagnosis account for most of the morbidity and mortality associated with esophageal emergencies; accurate diagnosis and early initiation of an appropriate management strategy (conservative, endoscopic, or surgical) are integral to successful outcomes. The purpose of this article is to acquaint radiologists with characteristic CT findings of some commonly encountered emergent esophageal conditions and their associated complications.

Esophagitis
Gastroesophageal reflux disease is a common cause of noncardiac chest pain (1). Esophagitis related to the ingestion of caustic substances, irradiation, medication, or infection also may result in acute chest pain. In severe esophagitis, full-thickness esophageal necrosis may lead to perforation with associated complications. Contrast material–enhanced esophagography and endoscopy remain the reference standards for the evaluation of esophagitis. CT may be performed when the diagnosis is unclear or when a complication is suspected. Whatever the cause of severe esophagitis, its CT appearance is predominantly characterized by diffuse esophageal thickening, submucosal edema, and mucosal enhancement (Figs 1, 2).

Foreign Body Impaction
Although foreign body ingestion is seen relatively often in the emergency department, most ingested objects pass spontaneously, without intervention (2,3). However, the thin esophageal wall, the lack of a supporting adventitia,
and the relatively poor blood supply leave the esophagus vulnerable to perforation and pressure necrosis from foreign bodies that become lodged in it. Between 10% and 20% of ingested foreign bodies, including those retained within the esophagus, therefore require endoscopic removal, and surgery is needed in about 1% of cases (2, 4, 5). Sharp or pointed foreign bodies, button batteries, and objects that cause obstruction require emergent removal; less urgent intervention is indicated if a foreign body fails to spontaneously clear the esophagus in a timely manner (4–6). An argument has been made that vinyl gloves, which tend to harden, should be removed surgically rather than endoscopically (7).

Foreign body ingestion and impaction occur across all age groups, with a median age of about 40 years (2, 3, 5). The clinical manifestations of esophageal foreign body impaction are variable: Symptoms may include dysphagia, odynophagia, foreign body sensation, and food refusal. Regurgitation and an inability to swallow saliva are suggestive of esophageal obstruction. When a history of foreign body ingestion is elicited, a radiographic evaluation is performed, generally with conventional radiography of the neck, chest, and abdomen (2). Barium studies are discouraged because they may hinder subsequent attempts at endoscopic examination and retrieval (2, 4). CT may be useful in select cases when a more definitive diagnosis or localization is desired before endoscopic intervention, or when perforation or another complication is suspected (2). In patients who do not provide a history of foreign body ingestion and who report nonspecific symptoms such as chest pain, CT often is used to distinguish between or exclude potential causes during the initial evaluation (8).

The CT appearance of foreign body impaction is variable, depending on the item ingested, the site of impaction, and the presence of an underlying pathologic esophageal process or associated complication. Foreign body ingestion is most commonly seen in children (Fig 3), people with psychiatric disorders, and prisoners. In children, coins are the most frequently ingested foreign bodies (3, 9). Vinyl glove ingestion has been reported among people with cognitive deficits and pica (7) (Fig 4). Food boluses (often meat) account for most cases of foreign body impaction

**Figure 3.** Food impaction in the esophagus of a toddler with a 1-day history of food refusal. (a) Sagittal reformatted image from contrast-enhanced CT of the neck shows a tubular object with attenuation close to that of fat, lodged in the cervical esophagus (*). (b) Esophagram helps confirm the presence of an obstructing foreign body (*). A hot-dog end was removed from the normal esophagus at endoscopy.
Trauma injury to the esophagus may result from both extraluminal and intraluminal processes. Injuries that are proved due to extraluminal blunt or penetrating trauma typically involve the cervical and upper thoracic parts of the esophagus but are rare overall, probably because of the small size of the esophagus, its relatively protected position, and the likelihood of serious concomitant vascular, tracheal, or spinal cord injury (12,13). Intraluminal processes such as instrumentation, foreign body impaction, barotrauma, and erosive esophagitis, among others, give rise to a spectrum of injuries that may be characterized according to the degree of resultant esophageal perforation. At one end of the spectrum are injuries such as mucosal lacerations, intramural dissection, and hematoma, which are relatively innocuous; and, at the other end, transmural perforation, which is potentially indistinguishable from those produced by a neoplastic process (Fig 7).
intrathoracic perforation is generally considered a surgical emergency (13,14).

Figure 6. Foreign body impaction in the esophagus of a middle-aged woman with dysphagia and expectoration of blood-tinged saliva after eating fried chicken. (a) Lateral radiograph of the neck shows a radiopaque foreign body in the hypopharynx (arrow). (b) Axial nonenhanced CT image helps confirm the presence of a foreign body (arrow). Endoscopic visualization was unsuccessful, but the patient coughed up a 4-cm-long chicken bone immediately after removal of the endoscope.

Figure 7. Foreign body impaction in the esophagus of a 90-year-old woman with longstanding dysphagia who reported a diagnosis of esophageal cancer 2 years earlier. (a) Barium esophagram shows a complete obstruction of the esophagus at the level of the carina (arrowhead). (b) Axial contrast-enhanced chest CT image depicts a poorly enhancing esophageal mass (arrowheads) that has eroded the left main bronchus. (c) Photograph shows a medication blister pack that was removed from the airway at bronchoscopy, after which the inflammatory pseudotumor resolved. (Fig 7c courtesy of Bryan F. Meyers, MD.)

c.

catastrophic. Mucosal lacerations, most intramural perforations, and some cervical and contained perforations of the esophagus may be managed conservatively; acute free (uncontained) transmural intrathoracic perforation is generally considered a surgical emergency (13,14).
The symptoms of esophageal injury are often nonspecific. Pain is the most common symptom, and it is often severe. Dysphagia or odynophagia also is strongly suggestive of an esophageal abnormality. When esophageal injury (usually, perforation) is suspected, the imaging evaluation should generally commence with esophagography while the patient swallows a water-soluble contrast material. If no extra-esophageal leakage is observed, esophagography should be repeated during the oral administration of barium, which has a greater sensitivity for the detection of small perforations (15). In patients with penetrating trauma to the neck or chest, CT should be performed before contrast-enhanced esophagography, given the significant risk of damage to critical vascular structures. CT may be useful also in patients who are too ill to cooperate in esophagography or as a complement to contrast-enhanced luminal studies, to further delineate the extent of disease, assess complications, and guide therapy (13,15,16). In patients with acute chest pain, CT is used to exclude serious conditions such as aortic dissection and pulmonary embolism (8). CT findings of esophageal injury include esophageal wall thickening, periesophageal gas and fluid collections, contrast material extravasation, mediastinal fluid collection, mediastinal inflammation, focal esophageal wall defect, and pleural effusion. Inasmuch as some findings are nonspecific and may be subtle, the diagnosis of esophageal injury requires a high index of suspicion in appropriate clinical settings.

**Mallory-Weiss Tear and Other Mucosal Lacerations**

A Mallory-Weiss tear is a longitudinal mucosal laceration observed in the distal esophagus or across the gastroesophageal junction. Its pathogenesis is similar to that of Boerhaave syndrome: Both occur in the setting of retching or vomiting, frequently after excessive alcohol consumption; they also may occur as a complication of endoscopy (16). Some degree of hematemesis is invariably present and is an indication for upper endoscopy. Similar linear mucosal lacerations occurring elsewhere in the esophagus as a result of forceful swallowing of an impacted foreign body or food bolus may pose a diagnostic dilemma. A mucosal laceration without transmural perforation is likely to be radiographically occult. However, to the attentive observer, CT images of the esophagus in patients with chest pain occasionally show evidence of hemorrhage or foci of extraluminal gas at a site of mucosal injury (Fig 8). Unless bleeding persists, the treatment of a Mallory-Weiss tear, like that of other mucosal lacerations, is supportive (16).
Intramural Dissection and Hematoma

Often referred to collectively as submucosal dissection or intramural rupture, intramural dissection and intramural hematoma of the esophagus are rare. By contrast to mucosal laceration and transmural perforation, they may be considered intermediate forms of esophageal injury. Symptoms include an abrupt onset of retrosternal chest pain, dysphagia or odynophagia, and hematemesis, with most patients experiencing at least two of the three, and with hematemesis generally occurring later in the clinical course (17). A history of recent instrumentation is probably the most important risk factor. Other contributing events are foreign body impaction and forceful vomiting. Spontaneous intramural hematoma of the esophagus also has been reported, most often in patients who are undergoing anticoagulant drug therapy or who have inherent coagulopathy (16,17).

CT findings of dissection correlate with those seen at esophagography: a mucosal flap with submucosal distribution of gas or contrast material, giving the esophagus the classic double-barreled appearance (Figs 9, 10). Dissection tends to occur posterior to the true lumen of the esophagus,
symptoms may mimic those of acute myocardial infarction or aortic dissection. CT imaging is invaluable for its ability to help differentiate intramural hematoma of the esophagus from acute cardiovascular disease (16,18). The distinction is integral to proper treatment, because anticoagulation therapy is understandably contraindicated in the presence of an intramural hematoma of the esophagus. With conservative management, intramural esophageal dissection and hematoma are expected to resolve within a few days or weeks (16,17).
Transmural Perforation

Transmural perforation may occur in a variety of settings. Its clinical presentation and CT appearance are similarly variable, depending on the mechanism of injury, the site and size of perforation, and the time elapsed since the onset of symptoms (13,15). Iatrogenic perforation of the esophagus is increasingly common, with therapeutic endoscopic procedures such as stricture dilation (Fig 13) and stent placement (Fig 14) being the leading causes (16). Perforation also occurs, albeit infrequently, as a complication of surgical procedures such as gastric fundoplication, esophageal myotomy, thyroidectomy, and anterior cervical diskeyectomy (16,19). Thermal injury to the anterior wall of the esophagus, a complication of left atrial radiofrequency ablation, may lead to full-thickness necrosis and perforation (20) (Fig 15). In addition, esophageal rupture may occur spontaneously, as in Boerhaave syndrome, in which incomplete cricopharyngeal relaxation during vomiting results in abruptly increased intraluminal pressure sufficient to rupture the esophagus. The distal left posterior wall is the most common site of spontaneous rupture, which classically results in pneumomediastinum and left pleural effusion (Figs 16, 17). Perforation of the cervical esophagus should be considered in the presence of cervical subcutaneous emphysema or...
esophagitis, Barrett syndrome, esophageal cancer, and aortic rupture. The optimal treatment of esophageal perforation depends on a host of considerations. Treatment methods range from nonsurgical management to esophagectomy or surgical exclusion and diversion; however, with an early diagnosis of uncontained perforation, surgery remains the mainstay of therapy (13,14).

Figures 16, 17. Emetogenic esophageal perforation (Boerhaave syndrome) in two late-middle-aged men. (16) Axial contrast-enhanced CT image demonstrates leakage of oral contrast material adjacent to the distal esophagus, with associated pneumomediastinum and left pleural effusion. Diffuse irregularity is visible in the mucosa lining the esophageal lumen (arrowhead). (17) Axial nonenhanced CT image shows oral contrast material, gas, and debris outside the esophagus (arrowheads) but confined within the mediastinum (arrows). The presence of an esophageal rupture was confirmed at surgery.

Figure 18. Emetogenic esophageal perforation. (a) Esophagram obtained in a young man with schizophrenia and bulimia shows leakage of barium from the cervical esophagus (*). (b) Axial contrast-enhanced CT image of the neck depicts a defect in the left posterior wall of the esophagus (arrowheads), through which gas and pooling barium (arrow) have escaped. Rupture of the cervical esophagus is typically associated with subcutaneous emphysema.

a superior mediastinal fluid collection (Fig 18). Patients with cervical esophageal perforation typically present with crepitus and neck pain instead of chest or epigastric pain. Other possible causes of noniatrogenic esophageal perforation include foreign body impaction, caustic and infectious esophagitis, Barrett syndrome, esophageal cancer, and aortic rupture. The optimal treatment of esophageal perforation depends on a host of considerations. Treatment methods range from nonsurgical management to esophagectomy or surgical exclusion and diversion; however, with an early diagnosis of uncontained perforation, surgery remains the mainstay of therapy (13,14).
Complications

Historically, most of the mortality associated with esophageal emergencies has been attributed to delays in the diagnosis and treatment of esophageal perforation (14). As mentioned earlier, esophagitis, foreign body impaction, and a variety of traumatic injuries may progress to transmural perforation. Whatever its cause, perforation is a common point of origin for a number of potentially life-threatening complications as other intrathoracic organs are compromised. Mediastinitis (Figs 17, 18), pneumonia, empyema (Fig 19), and lung abscess (Fig 20) are among the most commonly seen complications (21). Tissue destruction due to mediastinal inflammation, infection, or both may result in the development of a fistula between the esophagus and adjacent structures, including the tracheobronchial tree (Figs 21, 22).

Figures 19, 20. Common complications of esophageal perforation. (19) Empyema in a middle-aged woman with a delayed presentation and treatment after spontaneous esophageal rupture. Axial contrast-enhanced CT image shows a loculated gas-containing pleural fluid collection (pl), a finding characteristic of empyema. e = esophagus. (20) Lung abscess in a middle-aged woman with a previous diagnosis of squamous cell cancer of the esophagus and a recent onset of fever. (a) Axial contrast-enhanced CT image of the abdomen and pelvis serendipitously reveals a right lower lobe abscess (A) abutting the esophagus (e). (b) Coronal reformatted CT image depicts the interface between the abscess (A) and the circumferential esophageal mass (arrowheads), where there is no intervening fat plane. These findings were suggestive of esophageal perforation, which was confirmed at subsequent esophagography. e = esophagus.

Figures 21, 22. Aerodigestive fistulas. (21) Axial contrast-enhanced CT image obtained in a patient with esophageal cancer (e) shows an esophagobronchial fistula (arrowhead) that formed as the mass eroded the left main bronchus (b). (22) Axial contrast-enhanced CT image demonstrates the probable cause of recurrent pneumonia in a patient with AIDS: a fistula between the patulous thickened esophagus (e) and the trachea (t). The fistula was believed to result from severe esophagitis due to candidiasis.
Figure 23. Esophagogastric fistula in a patient with persistent pain after gastric fundoplication complicated by esophageal perforation. (a) Axial nonenhanced CT image demonstrates an intraperitoneal gas collection (s) extending from the gastroesophageal junction to the anterior gastric fundus (s), a finding suggestive of an esophagogastric fistula. (b) Barium esophagram helps confirm the presence of an esophagogastric fistula (arrowheads).

Figure 24. Aortoesophageal fistula in a middle-aged man with a history of erosive esophagitis and chest pain initially thought to have a cardiac origin. (a) Axial contrast-enhanced CT image obtained with an aortic dissection protocol shows mediastinitis and a large gas-containing abscess (A) directly abutting the aorta. The wall of the proximal descending aorta is irregular, giving rise to small projections of contrast material from the esophagus (arrowheads), findings suggestive of an aortoesophageal fistula. (b) Coronal reformatted CT image from the same study as a nicely depicts the long interface between the two lumina, with total obliteration of the intervening fat plane (arrowheads). These findings and the history of hematemesis are indicative of an aortoesophageal fistula (22). The diagnosis was confirmed at endovascular treatment and subsequent surgery.
stomach (Fig 23), and, very rarely, the aorta (Fig 24).

Conclusions
CT is a useful adjunct to barium esophagography and direct visualization in the diagnosis and evaluation of esophageal emergencies. CT evaluation of the esophagus requires a high index of suspicion in appropriate clinical settings and attention to findings that may be subtle yet significant. Given the orientation of the esophagus, multiplanar reformatted images are ideally suited to this task and often yield a better appreciation of the extent of disease and its relation to adjacent structures. An awareness of the CT findings associated with the spectrum of acute esophageal disease will promote the radiologist’s ability to accurately diagnose esophageal emergencies, thereby reducing delays in diagnosis that are likely to have a negative effect on outcomes.

References
When a history of foreign body ingestion is elicited, a radiographic evaluation is performed, generally with conventional radiography of the neck, chest, and abdomen. Barium studies are discouraged because they may hinder subsequent attempts at endoscopic examination and retrieval.

Bones from fish and chicken constitute the second most common foreign body in both pediatric and adult populations and are more likely to become lodged in the hypopharynx or cervical esophagus, where they may be difficult to visualize endoscopically; CT may be especially useful in such cases.

CT findings of esophageal injury include esophageal wall thickening, periesophageal gas or fluid collections, contrast material extravasation, mediastinal fluid collection, mediastinal inflammation, focal esophageal wall defect, and pleural effusion. Inasmuch as some findings are nonspecific and may be subtle, the diagnosis of esophageal injury requires a high index of suspicion in appropriate clinical settings.

CT is invaluable for its ability to help differentiate intramural hematoma of the esophagus from acute cardiovascular disease.

Iatrogenic perforation of the esophagus is increasingly common, with therapeutic endoscopic procedures such as stricture dilation and stent placement being the leading causes.