American College of Radiology
ACR Appropriateness Criteria®
Epigastric Pain

Variant: 1 Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Fluoroscopy biphasic esophagram	Usually Appropriate	☢☢☢
Fluoroscopy upper GI series	Usually Appropriate	☢☢☢
Fluoroscopy single contrast esophagram	May Be Appropriate	☢☢☢
CT abdomen and pelvis with IV contrast	May Be Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	May Be Appropriate	☢☢☢
CT abdomen with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
MRI abdomen without and with IV contrast	Usually Not Appropriate	O
MRI abdomen without and with IV contrast with MRCP	Usually Not Appropriate	O
MRI abdomen without IV contrast	Usually Not Appropriate	O
MRI abdomen without IV contrast with MRCP	Usually Not Appropriate	O
CT abdomen without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT abdomen with IV contrast multiphase	Usually Not Appropriate	☢☢☢☢
CT abdomen without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 2 Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Fluoroscopy upper GI series	Usually Appropriate	☢☢☢
CT abdomen and pelvis with IV contrast	Usually Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	May Be Appropriate	☢☢☢
CT abdomen with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
CT abdomen without IV contrast	May Be Appropriate	☢☢☢
CT abdomen with IV contrast multiphase	May Be Appropriate	☢☢☢☢
Fluoroscopy biphasic esophagram	Usually Not Appropriate	☢☢☢
Fluoroscopy single contrast esophagram	Usually Not Appropriate	☢☢☢
MRI abdomen without and with IV contrast	Usually Not Appropriate	O
MRI abdomen without and with IV contrast with MRCP	Usually Not Appropriate	O
MRI abdomen without IV contrast	Usually Not Appropriate	O
MRI abdomen without IV contrast with MRCP	Usually Not Appropriate	O
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT abdomen without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 3 Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level

Fluoroscopy biphasic esophagram	Usually Appropriate	☢☢☢
Fluoroscopy single contrast esophagram	Usually Appropriate	☢☢☢
Fluoroscopy upper GI series	Usually Appropriate	☢☢☢
MRI abdomen without and with IV contrast	Usually Not Appropriate	O
MRI abdomen without and with IV contrast with MRCP	Usually Not Appropriate	O
MRI abdomen without IV contrast	Usually Not Appropriate	O
MRI abdomen without IV contrast with MRCP	Usually Not Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT abdomen with IV contrast multiphase	Usually Not Appropriate	☢☢☢☢
CT abdomen without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

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Summary of Literature Review

Introduction/Background

Epigastric pain can have multiple etiologies, including myocardial infarction, pancreatitis, acute aortic syndromes, gastroesophageal reflux disease (GERD), esophagitis, peptic ulcer disease (PUD), gastritis, duodenal ulcer disease, gastric cancer, and hiatal hernia. Symptoms associated with these diseases may overlap, and thus clinical history, risk factors, and symptoms are important to consider narrowing the differential diagnosis. This document focuses on the scenarios in which epigastric pain is accompanied by symptoms, such as heartburn, regurgitation, dysphagia, nausea, vomiting, and hematemesis, that raise suspicion for GERD, esophagitis, PUD, gastritis, duodenal ulcer disease, gastric cancer, or hiatal hernia. The situations in which epigastric pain is accompanied by relevant risk factors and symptoms, such as shortness of breath with exertion, pain radiating to the back, and other causes, suggesting the possibility of myocardial infarction, pancreatitis, or acute aortic syndromes are not the focus of this document and are discussed in other ACR Appropriateness Criteria documents (see the ACR Appropriateness Criteria® topics on "Acute Chest Pain-Suspected Aortic Dissection" [1], "Chest Pain-Possible Acute Coronary Syndrome" [2], "Chronic Chest Pain-High Probability of Coronary Artery Disease" [3], "Nontraumatic Aortic Disease" [4], and "Acute Pancreatitis" [5] for further guidance).

Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition

defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously wherein each procedure provides unique clinical information to effectively manage the patient's care).

Discussion of Procedures by Variant

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.

GERD is a common medical disorder in the western world; it is reported that as many as 7% of Americans have episodes of heartburn every day and approximately 42% experience heartburn at least once a month [6]. Although GERD is a common disorder, its diagnosis is not straightforward; the primary reason for this is that the symptoms are nonspecific and overlap with other conditions [6]. GERD questionnaires, esophageal manometry, esophageal pH testing, imaging examinations, and upper endoscopy are routinely used for diagnosis [6].

PUD has an incidence of 0.1% to 0.3% [7]. Early diagnosis, treatment of Helicobacter pylori infections, and widespread use of proton pump inhibitors have all led to reducing the prevalence of PUD. It is still important to diagnose PUD, because PUD-related complications can be seen in 2% to 10% of cases, and PUD-related perforation is a surgical emergency with a mortality rate of up to 30% [7,8]. Although endoscopy is considered the standard test of choice for diagnosing these entities, patients may present with nonspecific symptoms, which may lead to an imaging study in which these entities could be identified.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
A. CT abdomen and pelvis

Although a CT examination is not the test of choice for initial imaging if acid reflux, esophagitis, gastritis, peptic ulcer, or duodenal ulcer is strongly suspected, patients with these entities may present with nonspecific/overlapping symptoms and may undergo a CT abdomen and pelvis as the initial diagnostic test for evaluation [7].

Distal esophageal wall thickening (≥5 mm) on CT has been reported to have a moderate association with reflux esophagitis with the following test performance characteristics: area under the receiver operating characteristic curve of 0.78, sensitivity of 56%, and specificity of 88% [9]. Presence of air in the esophagus, especially the middle and lower parts, can suggest a diagnosis of GERD [10]. Although CT may occasionally show morphological changes in the gastroesophageal junction in patients with reflux esophagitis, CT is not typically used for this indication [8].

Findings suggestive of the diagnosis of gastritis or PUD on CT can include the following: gastric or duodenal wall thickening due to submucosal edema; mucosal hyperenhancement or fat stranding

due to inflammation; fluid along the gastroduodenal region; focal outpouching of the mucosa resulting from ulcerations; focal interruption of mucosal enhancement resulting from an ulcer crater eroding through the epithelial lining of the mucosal layer into the submucosal layer or muscularis propria; focal perforation of a gastric ulcer with associated free air; or gastric outlet obstruction due to edema or chronic inflammatory changes near the antrum and pylorus [7,8]. Active bleeding from a peptic ulcer can be detected when hyperdense blood products accumulate at the site of the ulcer or in the stomach/duodenal lumen or as an area of active contrast extravasation [8].

PUD is the main cause of nontraumatic gastroduodenal perforation [11]. In a study by Lee et al [11], the following features were seen with perforation: extraluminal gas (97%), fluid or fat stranding along the gastroduodenal region (89%), ascites (89%), focal wall defect and/or ulcer (84%), and wall thickening (72%). Of these features, a wall defect and/or ulcer showed a positive likelihood ratio for gastroduodenal perforation of 36.83 and wall thickening showed a positive likelihood ratio of 10.52. Combined, these two features showed 95% sensitivity and 93% specificity for localization of a site of perforation [11]. If oral contrast is administered, extraluminal contrast may be seen at the site of perforation [8].

When gastric disease is suspected, the CT examination should be performed with intravenous (IV) contrast (to assess for submucosal edema, mucosal hyperenhancement due to inflammation, a focal outpouching of the mucosal bowel lining resulting from the crater of the ulcer, focal interruption of mucosal enhancement resulting from the ulcer crater eroding through the epithelial lining of the mucosal layer into the submucosal layer, or muscularis propria) and a neutral oral contrast such as water or dilute barium suspension (positive oral contrast can impede assessment of mucosal enhancement and preclude assessment of intraluminal bleeding) [12]. There is limited value of performing a CT abdomen and pelvis without and with IV contrast for this indication. A CT examination without IV contrast may help in diagnosing PUD by detecting findings such as extraluminal gas, reactive fluid, fat stranding along the gastroduodenal region, ascites, focal wall defect, or a large ulcer. However, the addition of IV contrast significantly improves conspicuity of findings such as interrupted mucosal enhancement and bowel wall hyperenhancement, making the CT examination more sensitive in diagnosis.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
B. CT abdomen

Although a CT abdomen examination may provide the same clues to diagnose acid reflux, esophagitis, gastritis, peptic ulcer, or duodenal ulcer as a CT abdomen and pelvis examination, the latter is usually chosen when overlapping or nonspecific symptoms are encountered. If gastric disease is strongly suspected, it would be appropriate to omit the pelvis from the examination.

When gastric disease is suspected, the CT examination should be performed with IV contrast (to assess for submucosal edema, mucosal hyperenhancement due to inflammation, a focal outpouching of the mucosal bowel lining resulting from the crater of the ulcer, focal interruption of mucosal enhancement resulting from the ulcer crater eroding through the epithelial lining of the mucosal layer into the submucosal layer or muscularis propria) and neutral oral contrast such as water or dilute barium suspension (positive oral contrast can impede assessment of mucosal enhancement and preclude assessment of intraluminal bleeding) [12]. There is limited value of performing a CT abdomen without and with IV contrast for this indication. A CT examination

without IV contrast may help in diagnosing PUD by detecting findings such as extraluminal gas, reactive fluid, fat stranding along the gastroduodenal region, ascites, focal wall defect, or a large ulcer. However, the addition of IV contrast significantly improves conspicuity of findings, such as interrupted mucosal enhancement and bowel wall hyperenhancement, making the CT examination more sensitive in diagnosis.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
C. CT Abdomen Multiphase

Multiphase contrast-enhanced examinations are not routinely performed in patients with suspected acid reflux, esophagitis, gastritis, peptic ulcer, or duodenal ulcer, but a CT angiographic protocol, including precontrast, arterial, and portal venous phases or a 2-phase dual-energy protocol with arterial and portal venous phases, may be used for patients with suspected acute gastrointestinal (GI) bleeding. These protocols may be used if GI bleeding as a complication of PUD is suspected [12]; otherwise, there would be limited utility of a multiphase examination.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
D. FDG-PET/CT Skull Base to Mid-Thigh

Although patients with GERD and esophagitis may exhibit increased radiotracer uptake in the distal esophagus on fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET [13], there is no relevant literature to support the use of FDG-PET/CT in the prospective diagnosis of acid reflux, esophagitis, gastritis, peptic ulcer, or duodenal ulcer.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
E. Fluoroscopy Biphasic Esophagram

Fluoroscopy continues to be an important radiologic modality for the evaluation of patients with epigastric pain due to reflux symptoms, esophagitis, or for nonspecific abdominal pain that could be due to GERD or PUD. Depending on the symptoms, the evaluation may be performed with an esophagram/barium swallow, an upper GI series, or a combination of the two.

A barium swallow/esophagram can be performed as a multiphasic examination that includes upright double-contrast views with a high density barium suspension, prone single-contrast views with a low-density barium suspension, and mucosal-relief views with either density of barium suspension [14]. The double-contrast phase optimizes the ability to detect inflammatory or neoplastic diseases, whereas the single-contrast phase optimizes the ability to detect hiatal hernias and lower esophageal rings or strictures [14].

Barium esophagram provides anatomic and functional information on esophageal length, presence, and size of hiatal hernia, diverticulum, esophageal stricture, as well as the presence of gastroesophageal reflux events with provocation [6]. Reflux esophagitis may manifest as fine nodularity or granularity of the mucosa, erosions or ulcers, thickened longitudinal folds, inflammatory esophagogastric polyps, and scarring with strictures, sacculations, or fixed transverse folds [14]. Single-contrast examinations have a reported sensitivity of 77% for detecting endoscopically proven esophagitis. Double-contrast examinations have a higher sensitivity of 80% because of their ability to reveal mucosal abnormalities that cannot be visualized on single-contrast studies. An even higher sensitivity of 88% is achieved by using a combined technique [14-

16]. As such, a combined technique is most favorable for this assessment.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer or duodenal ulcer. Initial imaging.
F. Fluoroscopy Single-Contrast Esophagram

Although a biphasic examination is preferred to a single-contrast examination to assess for reflux/esophagitis, a single-contrast examination may be necessary because of patient capabilities. A single-contrast examination may be helpful by revealing reflux, lower esophageal rings, or strictures [12].

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer or duodenal ulcer. Initial imaging.
G. Fluoroscopy Upper GI Series

The double-contrast upper GI series is a beneficial diagnostic test for evaluating structural and functional abnormalities of the esophagus, stomach, and duodenum [17]. Fluoroscopic evaluation of the esophagus may reveal findings of esophagitis as detailed above. In addition, evaluation of the stomach can be helpful in diagnosing gastritis, which may manifest as enlarged areae gastricae, disruption of the normal polygonal areae gastricae pattern by multiple uniform nodules, thickened gastric folds, erosions, or an ulcer with smooth folds radiating to the margin. In contrast, findings concerning for malignancy include an ulcer associated with nodularity of the adjacent mucosa, mass effect, or coarse, lobulated, or irregular radiating folds [17]. This examination should be performed when symptoms are nonspecific and differential possibilities of esophagitis, gastritis, or PUD are being considered.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
H. MRI Abdomen

In general, MRI is not routinely used to diagnose GERD. For patients presenting with nonspecific symptoms when gastritis or peptic ulcer or duodenal ulcer is suspected, MRI may be able to suggest these diagnoses, but a CT examination is typically chosen over MRI because of its ability to detect free air associated with a perforated ulcer and its shorter time interval to obtain the examination.

Variant 1: Epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer. Initial imaging.
I. MRI Abdomen with MRCP

There is no relevant literature to support the use of MR cholangiopancreatography (MRCP) sequences in the prospective diagnosis of acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer.

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.

Gastric adenocarcinoma has an incidence rate of 7.3 per 100,000 with 27,600 new cases estimated in 2020 and a 5-year relative survival rate of 32% [18]. Although endoscopy with biopsy is the reference standard for diagnosing gastric cancer, patients often present with nonspecific symptoms and undergo an imaging test for workup of those symptoms; gastric cancer may be first detected on such imaging.

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
A. CT abdomen and pelvis

Although endoscopy is the reference standard for diagnosing gastric cancer, patients may present with nonspecific symptoms and may undergo an imaging test for workup of those symptoms; gastric cancer may be first detected on such imaging. Additionally, malignancy is now the most common cause of gastric outlet obstruction in adults because the incidence of PUD has decreased because of the widespread use of H2 blockers [12]. If a gastric outlet obstruction is suspected, a CT may be ordered for anatomic evaluation.

In some cases, a gastric mass may not be well seen on CT because of gastric underdistension. However, multiple other imaging findings may nonetheless be identified on CT that are concerning for this diagnosis, such as nodular or irregular wall thickening or enhancement, soft tissue attenuation of wall thickening (rather than low attenuation thickening due to edema), perforation with an ulcerated mass, lymphadenopathy, and distant metastases [7,8,12].

When gastric disease is suspected, the CT examination should be performed with IV contrast (to assess for nodular wall thickening, soft tissue attenuation of the wall thickening) and neutral oral contrast such as water or dilute barium suspension to help delineate the intraluminal space [12]. There is limited value of performing a CT abdomen and pelvis without and with IV contrast for this indication. A CT abdomen and pelvis without IV contrast will be less sensitive in establishing this diagnosis [12,19].

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
B. CT abdomen

Although a CT abdomen examination may provide the same clues to diagnose gastric cancer as a CT abdomen and pelvis examination, the latter is usually chosen when nonspecific/overlapping symptoms are encountered. Additionally, including the pelvis may be valuable for assessing distant metastases.

When gastric disease is suspected, the CT examination should be performed with IV contrast (to assess for nodular wall thickening, soft tissue attenuation of the wall thickening) and neutral oral contrast such as water or dilute barium suspension [12]. There is limited value in performing a CT abdomen without and with IV contrast for this indication. A CT abdomen without IV contrast will be less sensitive in establishing this diagnosis [12,19].

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
C. CT Abdomen Multiphase

Multiphase contrast-enhanced examinations are not routinely performed in patients with gastric cancer, but a CT angiographic protocol including precontrast, arterial, and portal venous phases or a 2-phase dual-energy protocol with arterial and portal venous phases may be used for patients with suspected acute GI bleeding [12].

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
D. FDG-PET/CT skull base to mid-thigh

Although patients with gastric cancer may exhibit increased radiotracer uptake at the site of malignancy on FDG-PET, there is no relevant literature to support the use of FDG-PET/CT as the test of choice for initial imaging for gastric cancer.

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
E. Fluoroscopy biphasic esophagram

A biphasic esophagram does not evaluate the stomach and hence would not be useful for initial imaging for gastric cancer.

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
F. Fluoroscopy single contrast esophagram

A single-contrast esophagram does not evaluate the stomach, and hence would not be useful for initial imaging for gastric cancer.

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
G. Fluoroscopy upper GI series

The double-contrast upper GI series is a beneficial diagnostic test for evaluating structural and functional abnormalities of the esophagus, stomach, and duodenum [17]. An ulcer associated with nodularity of the adjacent mucosa, mass effect, or coarse, lobulated, or irregular radiating folds or oral contrast projecting into the mass (either inside or outside expected luminal contour) is concerning for gastric malignancy, requiring an endoscopic evaluation for a definite diagnosis [17].

Fluoroscopic examinations hold a special role in diagnosing scirrhous gastric carcinoma. Scirrhous gastric carcinomas may manifest as diffuse, long-segment, or even short-segment narrowing of a portion of the stomach. Endoscopy and biopsy have a poor sensitivity in diagnosing this entity, and a fluoroscopic examination may be essential in its diagnosis. Tumor cells invading the gastric wall result in a desmoplastic reaction that narrows the gastric lumen, making the wall rigid and nondistensible at fluoroscopy, with obliteration of gastric peristalsis [17].

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
H. MRI abdomen

Although patients with gastric cancer may exhibit nodular or irregular wall thickening or enhancement, lymphadenopathy, or distant metastases on MRI, there is no relevant literature to support the use of MRI in the prospective diagnosis of gastric cancer.

Variant 2: Epigastric pain with clinical suspicion for gastric cancer. Initial imaging.
I. MRI abdomen with MRCP

There is no relevant literature to support the use of MRCP sequences in the prospective diagnosis of gastric cancer.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.

In a patient with epigastric pain/discomfort and reflux symptoms, a hiatal hernia may be suspected. Hiatal hernias are reported to affect 10% to 50% of the population, with sliding hernias accounting for more than 85% of hiatal hernias and paraesophageal hernias accounting for up to 5% of all operated hiatal hernias [20].

In a relatively healthy patient with only a sliding hiatal hernia and reflux symptoms, dietary modification and a short treatment course of proton pump inhibitor may be curative with no additional testing necessary [21]. In a patient with longstanding/severe symptoms, the hernia may be large and/or of a paraesophageal type necessitating corrective surgery. In some cases, hiatal hernias may be associated with a shortened length of thoracic esophagus above the hernia, necessitating an esophageal lengthening procedure (eg, Collis gastroplasty) for successful treatment [21].

Size, subtype of the hernia, and severity of symptoms drive treatment, which ranges from medical

management to corrective surgery [20].

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
A. CT abdomen and pelvis

There is no relevant literature to support the use of CT abdomen and pelvis for initial imaging for hiatal hernia.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
B. CT abdomen

There is no relevant literature to support the use of CT abdomen for initial imaging for hiatal hernia.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
C. CT abdomen multiphase

There is no relevant literature to support the use of multiphase CT for initial imaging for hiatal hernia.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
D. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT for initial imaging for hiatal hernia.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
E. Fluoroscopy biphasic esophagram

Although endoscopy can be used to diagnose a hiatal hernia based on the site of the gastroesophageal junction and diaphragmatic impression on the esophagus, barium studies provide a more accurate depiction of the anatomic features of the hernia and also enable better determination of other factors that contribute to reflux symptoms, including the size of the hiatal hernia, opening of the gastroesophageal junction, and loss of the angle of Hiss [6,21-23]. Barium studies also are better than endoscopy for differentiating sliding hiatal hernias from paraesophageal hernias [6]; this distinction is important because the surgical approach for treating a paraesophageal hernia is different from a sliding hiatal hernia [21,23]. The importance of imaging in this context is reflected in the Esophageal Diagnostic Advisory Panel Consensus of the American College of Surgeons, which states that all patients who are considered for antireflux surgery require a barium esophagram [6].

A biphasic esophagram can be useful for this indication. In addition to detecting the presence and size of a hiatal hernia, the esophagram will provide anatomic and functional information on esophageal length, esophageal stricture, presence of gastroesophageal reflux, and reflux esophagitis [6].

Reflux esophagitis may manifest as fine nodularity or granularity of the mucosa, erosions or ulcers, thickened longitudinal folds, inflammatory esophagogastric polyps, and scarring with strictures, sacculations, or fixed transverse folds [14]. Single-contrast examinations have a reported sensitivity of 77% for detecting endoscopically proven esophagitis. Double-contrast examinations have a higher sensitivity of 80% because of its ability to reveal mucosal abnormalities that cannot be visualized on single-contrast studies. An even higher sensitivity of 88% is achieved by using a combined technique [14-16]. As such, a combined technique is most favorable for this assessment. If the hiatal hernia is large, an upper GI series evaluation should be included for complete assessment of the stomach.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
F. Fluoroscopy single contrast esophagram

A single-contrast esophagram may be considered in some instances. Although it may not reveal the mucosal irregularity resulting from reflux disease, it may delineate the hernia, reveal reflux, lower esophageal rings, or strictures [14]. If the hiatal hernia is large, an upper GI series evaluation should be included for complete assessment of the stomach.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
G. Fluoroscopy upper GI series

The double-contrast upper GI series is a beneficial diagnostic test for evaluating structural and functional abnormalities of the esophagus, stomach, and duodenum [17]. A double-contrast upper GI series is the most useful test for diagnosing a hiatal hernia. In addition to detecting the presence and size of a hiatal hernia, the esophagram will provide anatomic and functional information on esophageal length, esophageal stricture, presence of gastroesophageal reflux, and reflux esophagitis [6]. Reflux esophagitis may manifest as fine nodularity or granularity of the mucosa, erosions or ulcers, thickened longitudinal folds, inflammatory esophagogastric polyps, and scarring with strictures, sacculations, or fixed transverse folds [14]. Fluoroscopic evaluation of the stomach will provide a complete evaluation of the hiatal hernia including its size and subtype.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
H. MRI abdomen

There is no relevant literature to support the use of MRI abdomen for initial imaging for hiatal hernia.

Variant 3: Epigastric pain with clinical suspicion for hiatal hernia. Initial imaging.
I. MRI abdomen with MRCP

There is no relevant literature to support the use of MRI abdomen with MRCP for initial imaging for hiatal hernia.

Summary of Highlights

- **Variant 1:** Fluoroscopy biphasic esophagram or fluoroscopy upper GI series is usually appropriate as the initial imaging for epigastric pain with clinical suspicion for acid reflux or esophagitis or gastritis or peptic ulcer or duodenal ulcer; the diagnostic test of choice will vary based on the associated symptoms. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). The panel did not agree on recommending CT abdomen with IV contrast for patients in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. Imaging with this procedure is controversial in this patient population but may be appropriate.
- **Variant 2:** Fluoroscopy upper GI series or CT abdomen and pelvis with IV contrast is usually appropriate as the initial imaging of epigastric pain with clinical suspicion for gastric cancer. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). The panel did not agree on recommending CT abdomen with IV contrast for patients in this clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. Imaging with this procedure is controversial in this patient

population but may be appropriate.

- **Variant 3:** Fluoroscopy biphasic esophagram or fluoroscopy single contrast esophagram or fluoroscopy upper GI series is usually appropriate as the initial imaging for epigastric pain with clinical suspicion for hiatal hernia. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation

exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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Disclaimer

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

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