# American College of Radiology
# ACR Appropriateness Criteria®
# Dysphagia

**Variant 1:** **Oropharyngeal dysphagia with an attributable cause. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| Fluoroscopy barium swallow modified | Usually Appropriate | ☢☢☢ |
| Fluoroscopy pharynx dynamic and static imaging | May Be Appropriate | ☢☢☢ |
| Fluoroscopy biphasic esophagram | May Be Appropriate | ☢☢☢ |
| Fluoroscopy single contrast esophagram | May Be Appropriate | ☢☢☢ |
| CT neck and chest without IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest without and with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| Esophageal transit nuclear medicine scan | Usually Not Appropriate | ☢☢☢ |

**Variant 2:** **Unexplained oropharyngeal dysphagia. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| Fluoroscopy biphasic esophagram | Usually Appropriate | ☢☢☢ |
| Fluoroscopy barium swallow modified | May Be Appropriate | ☢☢☢ |
| Fluoroscopy single contrast esophagram | May Be Appropriate | ☢☢☢ |
| Fluoroscopy pharynx dynamic and static imaging | May Be Appropriate (Disagreement) | ☢☢☢ |
| Esophageal transit nuclear medicine scan | May Be Appropriate | ☢☢☢ |
| CT neck and chest without IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest without and with IV contrast | Usually Not Appropriate | ☢☢☢☢ |

**Variant 3:** **Retrosternal dysphagia in immunocompetent patients. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| Fluoroscopy biphasic esophagram | Usually Appropriate | ☢☢☢ |
| Fluoroscopy single contrast esophagram | May Be Appropriate | ☢☢☢ |
| Esophageal transit nuclear medicine scan | May Be Appropriate | ☢☢☢ |
| Fluoroscopy barium swallow modified | May Be Appropriate | ☢☢☢ |
| CT neck and chest without IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest without and with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| Fluoroscopy pharynx dynamic and static imaging | Usually Not Appropriate | ☢☢☢ |

**Variant 4:** **Retrosternal dysphagia in immunocompromised patients. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| Fluoroscopy biphasic esophagram | Usually Appropriate | ☢☢☢ |
| Fluoroscopy single contrast esophagram | May Be Appropriate | ☢☢☢ |
| Fluoroscopy barium swallow modified | May Be Appropriate | ☢☢☢ |
| CT neck and chest without IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest without and with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| Fluoroscopy pharynx dynamic and static imaging | Usually Not Appropriate | ☢☢☢ |
| Esophageal transit nuclear medicine scan | Usually Not Appropriate | ☢☢☢ |

**Variant 5:** **Early postoperative dysphagia. Oropharyngeal or retrosternal. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| Fluoroscopy single contrast esophagram | Usually Appropriate | ☢☢☢ |
| CT neck and chest with IV contrast | Usually Appropriate | ☢☢☢☢ |
| CT neck and chest without IV contrast | May Be Appropriate | ☢☢☢☢ |
| CT neck and chest without and with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| Esophageal transit nuclear medicine scan | Usually Not Appropriate | ☢☢☢ |
| Fluoroscopy barium swallow modified | Usually Not Appropriate | ☢☢☢ |
| Fluoroscopy biphasic esophagram | Usually Not Appropriate | ☢☢☢ |
| Fluoroscopy pharynx dynamic and static imaging | Usually Not Appropriate | ☢☢☢ |

**Variant 6:** **Delayed (greater than 1 month) postoperative development of dysphagia. Oropharyngeal or retrosternal. Initial imaging.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| CT neck and chest with IV contrast | Usually Appropriate | ☢☢☢☢ |
| Fluoroscopy single contrast esophagram | Usually Appropriate | ☢☢☢ |
| Fluoroscopy barium swallow modified | May Be Appropriate | ☢☢☢ |
| Fluoroscopy biphasic esophagram | May Be Appropriate | ☢☢☢ |
| Esophageal transit nuclear medicine scan | May Be Appropriate | ☢☢☢ |
| CT neck and chest without and with IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| CT neck and chest without IV contrast | Usually Not Appropriate | ☢☢☢☢ |
| Fluoroscopy pharynx dynamic and static imaging | Usually Not Appropriate | ☢☢☢ |

# DYSPHAGIA

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## Summary of Literature Review

### Introduction/Background

Dysphagia is a swallowing disorder that may be caused by a wide variety of structural and functional abnormalities of the oral cavity, pharynx, esophagus, and gastric cardia. The term "dysphagia" is also used to describe the symptom of "subjective awareness of swallowing difficulty during passage of a liquid or solid bolus from the mouth to the stomach" or "the perception of obstruction during swallowing" [1]. As a symptom, dysphagia is usually indicative of an abnormality in the function or structure of the organs involved in swallowing, breathing, and speech. Some individuals who are not aware of their dysphagia seek medical attention for signs and symptoms of aspiration, pneumonia, weight loss, or malnutrition [2].

Dysphagia affects up to 22% of adults in the primary care setting and is more common in older adults [3,4]. Adults over 65 years of age account for up to two-thirds of all people with dysphagia [3]. Although the aging process is associated with neuromuscular changes, aging itself does not typically cause clinically significant dysphagia. Aging is associated with an increased prevalence of neuromuscular and degenerative disorders that can cause dysphagia; therefore, the presence of dysphagia should prompt evaluation [3,5]. It is also important to recognize that a person may have an asymptomatic swallowing disorder. In one study of 2,000 patients evaluated with videofluoroscopic examinations, 51% of patients were found to aspirate; however, of those who were aspirated, 55% demonstrated silent aspiration with an absent protective cough reflex [6].

### Special Imaging Considerations

Imaging studies are complementary to endoscopy and manometry in the evaluation of dysphagia. The optimal imaging study depends on the nature and location of the dysphagia and the clinical setting. Fluoroscopy remains the imaging modality of choice to evaluate dysphagia. The choice of fluoroscopic examination and oral contrast material used may depend on the nature and location of the patient's dysphagia as well as the clinical setting. For example, in the immediate postoperative scenario, the preferred method of radiographic evaluation may be a single-contrast study using a water-soluble contrast such as diatrizoate meglumine and diatrizoate sodium solution or iohexol rather than barium sulfate [7]. The ACR practice parameters for the indications and performance of adult esophagrams and upper gastrointestinal examinations can be referenced for the choice of fluoroscopic examinations (see the ACR Practice Parameter for the Performance of Esophagrams and Upper Gastrointestinal Examinations in Adults [8]).

### Barium Swallow Modified

A modified barium swallow is a videofluoroscopic procedure performed in conjunction with a speech therapist to evaluate a patient's oropharyngeal swallow and to examine the effectiveness of rehabilitation strategies [9,10]. The modified barium swallow focuses on the oral cavity, pharynx, and cervical esophagus to assess abnormalities of both the oral phase of swallowing (ie, difficulty propelling the bolus) and the pharyngeal phase (ie, laryngeal penetration, tracheal aspiration, cricopharyngeal dysfunction). Dynamic evaluation of swallowing function can assess bolus manipulation, tongue motion, hyoid, laryngeal, and pharyngeal elevation, soft-palate elevation,

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pharyngeal constrictor motion, epiglottic tilt, laryngeal penetration, and cricopharyngeus muscle function. The patient may be given varying consistencies of barium and barium-impregnated food to assess the patient's ability to swallow [9]. In conjunction with a speech therapist, various compensatory maneuvers (eg, a chin-tuck position or head turn) may be attempted to improve swallowing dysfunction [10].

**Pharynx Dynamic and Static Imaging**
Biphasic examination of the pharynx is performed by acquiring static and dynamic images of the pharynx. Double-contrast and single-contrast images of the pharynx and videofluoroscopy of swallowing are obtained. Pharyngeal function, structure, and motility are also assessed. The structural evaluation of the pharynx is superior to that obtained with a modified barium swallow because fluoroscopic spot images are obtained. Therapeutic maneuvers are not typically performed or assessed in this examination.

**Biphasic Esophagram**
A biphasic fluoroscopic evaluation of the esophagus includes single- and double-contrast techniques, including full-column, mucosal relief, and double-contrast views of the esophagus [11]. Esophageal function and motility are evaluated at fluoroscopy. Double-contrast technique provides more mucosal detail compared with the single-contrast technique. However, patient cooperation and mobility are required.

**Single-Contrast Esophagram**
A single-contrast esophagram or barium swallow includes full-column distension, mucosal relief views, and fluoroscopic observation of esophageal motility. Single-contrast studies are well suited for elderly, debilitated, obese, and postoperative patients as well as patients who are unable to fully cooperate with the biphasic examination. A single-contrast esophagram may be performed with barium or water-soluble contrast.

**Scintigraphy**
Scintigraphy may be useful to assess esophageal transit. Tc-99m–labeled substances may be mixed in liquid, semisolid, or solid form and swallowed in conjunction with dynamic image acquisition. This examination could be used to assess for motility abnormalities or gastroesophageal reflux.

**Discussion of Procedures by Variant**

**Variant 1: Oropharyngeal dysphagia with an attributable cause. Initial imaging.**

An accurate medical and surgical history from the patient or medical record is helpful to determine the appropriate test to optimally assess the patient. Typical functional and neurologic causes of oropharyngeal dysphagia include recent stroke, worsening dementia, myasthenia gravis, or amyotrophic lateral sclerosis. Many patients with oropharyngeal dysphagia can subjectively localize a sensation of blockage or discomfort in the throat. Patients with oropharyngeal dysphagia typically complain of food sticking in the throat or of a globus sensation with a lump in the throat. Other symptoms of oropharyngeal dysfunction include coughing or choking during swallowing (due to laryngeal penetration or aspiration), a nasal-quality voice or nasal regurgitation (due to soft palate insufficiency), food dribbling from the mouth, and difficulty initiating swallow or chewing (due to an abnormal oral phase of swallowing). It is also important to recognize that abnormalities of the mid or distal esophagus or even the gastric cardia may cause referred dysphagia to the upper chest or pharynx, whereas abnormalities of the pharynx rarely cause referred dysphagia to the lower chest [6]. Therefore, the esophagus and cardia should be evaluated in patients with pharyngeal symptoms, particularly if no abnormalities are found in the pharynx to explain these symptoms [12].

**Fluoroscopy Barium Swallow Modified**
Modified barium swallow is the study of choice when oropharyngeal dysphagia has an attributable cause and there is a high index of suspicion for swallowing dysfunction [13]. The modified barium swallow with different bolus consistencies is an assessment of the patient's swallowing status and allows the speech language pathologist to assess various maneuvers that will help initiate treatment [14].

**Fluoroscopy Pharynx Dynamic and Static Imaging**
The evaluation of the pharynx with dynamic and static imaging evaluates swallowing function similar to the modified barium swallow. However, this examination typically does not involve a variety of barium consistencies, does not include an evaluation of therapeutic options, and does not evaluate the thoracic esophagus and gastric cardia. Static images aid in evaluation for structural abnormalities of the pharynx.

**Fluoroscopy Single-Contrast Esophagram**
A modified barium swallow is preferred because of its ability to evaluate oropharyngeal function and structure with a variety of barium consistencies. Single-contrast esophagram may be a helpful adjunct if abnormalities in esophageal motility or gastroesophageal reflux are felt to be contributing to the patient's oropharyngeal symptoms.

**Fluoroscopy Biphasic Esophagram**
Biphasic esophagram may be used to diagnose aspiration or penetration and structural abnormalities; however, it does not provide a detailed evaluation of swallowing function or pharyngeal anatomy. A biphasic esophagram may be helpful if abnormalities in esophageal structure or function are felt to be contributing to the patient's oropharyngeal symptoms [15].

**CT Neck and Chest**
CT is usually not indicated in this clinical scenario because it does not assess oropharyngeal function.

**Esophageal Transit Nuclear Medicine Scan**
Scintigraphy is usually not indicated in this clinical scenario because it does not assess the oropharynx.

**Variant 2: Unexplained oropharyngeal dysphagia. Initial imaging.**

Patients with unexplained oropharyngeal dysphagia may need a more detailed barium study to determine the cause. Also, because abnormalities of the distal esophagus or gastric cardia can cause referred sensation of dysphagia in the upper chest or pharynx, the esophagus and gastric cardia should be evaluated in patients with pharyngeal symptoms, and a combined radiologic examination of the oral cavity, pharynx, esophagus, and gastric cardia is appropriate for patients with unexplained pharyngeal dysphagia.

**Fluoroscopy Biphasic Esophagram**
Because some patients with lesions in the esophagus or at the gastric cardia can have referred dysphagia, the esophagus and cardia should be carefully evaluated as part of the barium study, particularly if no abnormalities are found in the pharynx to account for the patients' symptoms [15,16]. A study by Miles et al [12] of 111 patients with complaints of dysphagia for solids showed that 68% had abnormal esophageal transit and in one-third of these the abnormality in the esophagus was the only finding. In addition, patients with pharyngeal carcinomas have a significantly increased risk of synchronous esophageal carcinomas. A complete examination of the esophagus should be performed once a pharyngeal tumor is identified [15].

In patients with unexplained oropharyngeal dysphagia, the combination of videofluoroscopy and static images of the pharynx with an examination of the esophagus has a higher diagnostic value than either videofluoroscopy (such as a modified barium swallow) or static images (such as a biphasic or single-contrast esophagram) alone [17]. If a study is performed using solely static imaging, a biphasic study is preferable to a single-contrast barium swallow because of its superior depiction of mucosal processes.

**Fluoroscopy Single-Contrast Esophagram**
Double-contrast technique provides more superior mucosal detail compared with the single-contrast technique. However, patient cooperation and mobility are required and single-contrast technique may be better suited for those patients who are unable to fully cooperate with the biphasic examination, such as elderly, debilitated, and obese patients.

**Fluoroscopy Pharynx Dynamic and Static Imaging**
As in the modified barium swallow, a dynamic examination of the pharynx with videofluoroscopy permits assessment of the oral and pharyngeal swallowing phases. This study does not evaluate the thoracic esophagus or gastric cardia. In this examination, static images of the pharynx (eg, double-contrast spot films of the pharynx in frontal and lateral projections with high-density barium) permit better detection of structural abnormalities (ie, pharyngeal tumors, Zenker diverticulum) compared to the modified barium swallow [18]. Because some patients with lesions in the esophagus or gastric cardia can have referred dysphagia, the esophagus and cardia should be carefully evaluated as part of the barium study, particularly if no abnormalities are found in the pharynx to account for the patients' symptoms.

**Fluoroscopy Barium Swallow Modified**
A modified barium swallow examination may be of benefit in this setting, particularly if structural abnormalities have been excluded by direct endoscopic visualization. In a study by Madhavan et al [19], a videofluoroscopic

modified barium swallow identified a cause for dysphagia in 76% of patients. Localization of the videofluoroscopic finding to the site of the patients symptoms was accurate in 75% of cases when the finding was structural versus 18% when the finding was physiologic [19].

**CT Neck and Chest**
CT is usually not indicated in this clinical scenario as initial imaging because it does not assess oropharyngeal and esophageal mucosa and motility. CT may be helpful in the subsequent evaluation of patients if initial studies are not revealing.

**Esophageal Transit Nuclear Medicine Scan**
Nuclear scintigraphy could be used to assess for motility abnormalities or gastroesophageal reflux; however, it is not a substitute for examinations that evaluate the function and structure of the pharynx.

**Variant 3: Retrosternal dysphagia in immunocompetent patients. Initial imaging.**

Patients with retrosternal dysphagia experience a sensation of blockage or discomfort at any level between the thoracic inlet and the xiphoid process. Because retrosternal dysphagia can be caused by esophageal motility disorders or by structural abnormalities of the esophagus or cardia (ie, esophagitis, rings, strictures, or tumors), a biphasic esophagram is the preferable imaging procedure.

**Fluoroscopy Biphasic Esophagram**
The biphasic esophagram permits detection of both structural and functional abnormalities of the esophagus. Structural lesions include esophagitis, strictures, rings, and carcinoma. Functional abnormalities of the esophagus include gastroesophageal reflux and motility disorders.

The most important structural lesion is carcinoma of the esophagus or gastroesophageal junction. In one study, biphasic esophagography was found to have 96% sensitivity in diagnosing cancer of the esophagus or esophagogastric junction [20] comparable to the reported sensitivity of endoscopy for diagnosing these lesions. In two other large patient series, endoscopy failed to reveal any cases of esophageal carcinoma that had been missed on the barium studies [21,22]. The findings in these series suggest that endoscopy is not routinely warranted to rule out missed tumors in patients who have normal findings on radiologic examinations.

Although double-contrast views best detect mucosal lesions (eg, tumors, esophagitis), prone single-contrast views of patients who continuously drink a low-density barium suspension best detect lower esophageal rings or strictures. Lower esophageal rings are two to three times more likely to be diagnosed on prone single-contrast views than on upright double-contrast views because of inadequate distention of the distal esophagus when the patient is upright [11,23]. In one study, the biphasic esophagram was found to depict about 95% of all lower esophageal rings, whereas endoscopy detected only 76% of these rings [23]. Similarly, biphasic esophagrams have been found to have a sensitivity of about 95% for the detection of peptic strictures, sometimes revealing strictures that are missed with endoscopy [24,25].

The biphasic esophagram is also a useful test in patients with esophageal motility disorders causing dysphagia. Videofluoroscopy of discrete swallows of a low-density barium suspension in the prone right antero-oblique position permits detailed assessment of esophageal motility. In various studies, videofluoroscopy has been found to have an overall sensitivity of 80% to 89% and specificity of 79% to 91% for diagnosing esophageal motility disorders (eg, achalasia, diffuse esophageal spasm) compared with esophageal manometry [17,26]. Occasionally, barium studies may even reveal dysmotility not seen at manometry (eg, some patients with the beak-like distal esophageal narrowing of achalasia are found to have complete relaxation of the lower esophageal sphincter on manometry) [27]. Even for those patients with a significant esophageal motility disorder detected on a barium study, manometry may be performed to further elucidate the nature of this motility disorder.

Endoscopy performed to evaluate the esophagus for structural abnormalities in patients with dysphagia is a highly accurate test for esophageal cancer when multiple endoscopic biopsy specimens and brushings are obtained. It is also more sensitive than double-contrast esophagography for detecting mild reflux esophagitis or other subtle forms of esophagitis. However, endoscopy is a much more invasive test than the barium study. It is also less sensitive than the barium study for detecting lower esophageal rings or strictures [11,23-25] and does not permit evaluation of esophageal motility disorders. For these reasons, a biphasic esophagram is often recommended as the initial diagnostic test for patients with dysphagia [3,5,28].

**Fluoroscopy Single-Contrast Esophagram**
Although the biphasic esophagram provides superior mucosal detail, allowing for earlier detection of subtle lesions, patient cooperation and mobility are required. For debilitated, immobile patients or patients who are limited in their ability to cooperate, a single-contrast esophagram may be necessary.

**Fluoroscopy Barium Swallow Modified**
In patients with retrosternal dysphagia, the entire esophagus and the gastric cardia should be assessed. Therefore, the modified barium swallow may not be appropriate.

**Fluoroscopy Pharynx Dynamic and Static Imaging**
Dynamic and static imaging of the pharynx may not be appropriate as the only examination performed in a patient with retrosternal dysphagia because the entire esophagus and gastric cardia should be assessed. This study does not evaluate the thoracic esophagus or gastric cardia.

**CT Neck and Chest**
CT is not usually indicated as an initial imaging modality in this clinical scenario because it does not assess esophageal mucosa and motility. CT may be helpful in the subsequent evaluation of patients if initial studies are not revealing.

**Esophageal Transit Nuclear Medicine Scan**
Specific protocols to assess esophageal emptying may be useful in patients with known or suspected achalasia but does not provide anatomic detail [29,30]. Radionuclide esophageal transit scintigraphy is a simple, noninvasive, and quantitative test of esophageal emptying that can be useful in these patients [3,31,32].

**Variant 4: Retrosternal dysphagia in immunocompromised patients. Initial imaging.**

The major consideration in immunocompromised patients with dysphagia or odynophagia (painful swallowing) is infectious esophagitis, most commonly due to *Candida albicans* or herpes simplex virus. In HIV-positive patients, *Candida* is most often the cause of esophageal symptoms; cytomegalovirus, herpes simplex, and idiopathic ulcers (also known as HIV ulcers) are the other most common etiologies [33]. HIV-positive patients with esophageal symptoms may be treated empirically with antifungal therapy without first undergoing a diagnostic examination. However, most gastroenterologists prefer that those who have severe symptoms at presentation or persistent symptoms be evaluated by endoscopy. Endoscopy is preferred because of the ability to obtain specimens (eg, histology, cytology, immunostaining, or culture) [3,33]. The endoscopic or radiographic appearance alone usually does not accurately predict diseases other than *Candida* esophagitis; diagnosis requires specimen acquisition for laboratory study [33,34].

**Fluoroscopy Biphasic Esophagram**
Esophagrams are preferred by some as an initial diagnostic study and can be useful in guiding management. A biphasic esophagram is more accurate than single-contrast esophagram for detecting ulcers or plaques associated with infectious esophagitis [35-37]. However, a single-contrast esophagram may be performed if the patient is too sick or debilitated to tolerate a double-contrast examination. Patients with radiographically diagnosed *Candida* or herpes esophagitis may be treated with antifungal or antiviral agents, respectively, without endoscopic evaluation. Endoscopy is warranted for patients with giant esophageal ulcers to differentiate cytomegalovirus and HIV and begin appropriate therapy [34].

**Fluoroscopy Single-Contrast Esophagram**
Although the biphasic esophagram provides superior mucosal detail, allowing for earlier detection of subtle lesions, patient cooperation and mobility are required. For debilitated, immobile patients or patients who are limited in their ability to cooperate, a single-contrast esophagram may be necessary.

**Fluoroscopy Barium Swallow Modified**
A modified barium swallow does not evaluate esophageal anatomy and structure. It may not be appropriate because it may fail to reveal the etiology of retrosternal dysphagia. However, it may be useful to evaluate swallowing function in the setting of pharyngeal infection.

**Fluoroscopy Pharynx Dynamic and Static Imaging**
Dynamic and static imaging evaluates swallowing and oropharyngeal motility and structure. Performed alone, it may not be appropriate because it may fail to reveal the etiology of retrosternal dysphagia.

**CT Neck and Chest**
CT is usually not indicated as an initial imaging modality in this clinical scenario because it does not assess esophageal mucosa and motility. CT may be helpful in the subsequent evaluation of patients if initial studies are not revealing.

**Esophageal Transit Nuclear Medicine Scan**
Scintigraphy is usually not indicated in this clinical scenario.

**Variant 5: Early postoperative dysphagia. Oropharyngeal or retrosternal. Initial imaging.**

Dysphagia is a common complaint following surgery on the oropharynx, soft tissues of the neck, cervical spine, esophagus, or stomach. Imaging should be tailored to the type and location of surgery (oropharyngeal versus retrosternal) and the time of onset of symptoms following surgery. In the immediate or early postoperative period, fluid collections, anastomotic leaks, perforation, and abscess may be of clinical concern [38].

**Fluoroscopy Single-Contrast Esophagram**
A single-contrast esophagram is the study of choice for patients presenting with dysphagia following surgery to the neck, c-spine, esophagus, or stomach [1,39]. When there is a question of leak or fistula, the study is ideally performed by utilizing water-soluble contrast followed by barium if necessary.

Esophagrams are highly specific for the detection of leaks but not sensitive. Roh et al [39] showed that the sensitivity of the esophagram in diagnosing a leak was 36% and specificity was 97%. For this reason, a CT examination may be ordered if there is a high clinical suspicion following a negative esophagram. Lantos et al [40] showed that esophagography had a sensitivity of 79%, specificity of 73%, positive predictive value of 73%, and negative predictive value of 79% for detecting leaks, and esophagography and CT combined had a sensitivity of 100%, specificity of 27%, positive predictive value of 56%, and negative predictive value of 100%. The sensitivity of esophagography increased when high-density barium was administered after water-soluble contrast, whereas the sensitivity of CT was the same with and without oral contrast agent. Esophagrams have a slightly lower sensitivity and substantially higher specificity compared with CT for detecting leaks after esophagectomy [41].

**Fluoroscopy Biphasic Esophagram**
Biphasic esophagram is not usually indicated when a patient has dysphagia in the immediate postoperative period. Single-contrast technique utilizing water-soluble contrast is preferable because evaluation for postoperative leak is the primary concern.

**Fluoroscopy Barium Swallow Modified**
When oropharyngeal dysphagia occurs postoperatively and there is a high index of suspicion for swallowing dysfunction, a modified barium swallow is the study of choice, especially if leak has been excluded clinically or with imaging.

In the immediate postoperative period, if a leak or perforation is of clinical concern, a single-contrast esophagram with water-soluble contrast may be more appropriate because it is better suited to evaluate postoperative structural abnormalities. However, a modified swallow performed with water-soluble contrast material has been shown to be effective in the diagnosis of leakage [41]. In this study there were no adverse events associated with aspiration of iohexol as water-soluble contrast material [41]. A modified barium swallow examination does not evaluate the entire esophagus. It is not appropriate for postoperative retrosternal dysphagia because it does not evaluate the retrosternal anatomy.

**Fluoroscopy Pharynx Dynamic and Static Imaging**
Pharynx dynamic and static imaging is usually not appropriate because it is a double-contrast barium evaluation of the pharynx alone. A single-contrast esophagram with water-soluble contrast possibly followed with barium is more appropriate to evaluate for postoperative leak or fistula in a patient who has had surgery in the neck and is complaining of oropharyngeal dysphagia [42]. Furthermore, this study does not evaluate the thoracic esophagus and gastric cardia. Alone, pharynx dynamic and static imaging is not appropriate for postoperative retrosternal dysphagia because it does not evaluate the retrosternal anatomy but may be useful combined with esophageal evaluation.

**CT Neck and Chest**
For oropharyngeal and retropharyngeal dysphagia, CT of the neck and chest with intravenous (IV) contrast is

indicated when there is concern of early postoperative complications, such as leak, fluid collection, abscess, or hematoma [40,43]. CT has a slightly higher sensitivity and substantially lower specificity than esophagography for detecting clinically relevant leaks after esophagectomy [40,43]. The use of CT as the initial imaging test in these patients can lead to earlier diagnosis and treatment of leaks missed on esophagography. In many patients, both CT and esophagrams are performed especially when the clinical concern is high. Lantos et al [40] showed that esophagography had a sensitivity of 79%, specificity of 73%, positive predictive value of 73%, and negative predictive value of 79% for detecting leaks, whereas CT had a sensitivity of 86%, specificity of 33%, positive predictive value of 55%, and negative predictive value of 71%; esophagography and CT combined had a sensitivity of 100%, specificity of 27%, positive predictive value of 56%, and negative predictive value of 100%.

CT may be useful to assess the position of surgical hardware or complication related to surgical hardware with respect to the oropharynx and airway. Oral contrast administered immediately before the examination may be a helpful adjunct to facilitate interpretation of esophageal integrity and anatomy, though one study showed the use of oral contrast did not change the sensitivity of CT for detection of leaks [40].

CT scan with IV contrast better defines the anatomic structures of the neck and chest compared to CT without IV contrast because normal soft-tissue and blood vessel enhancement are better delineated from postoperative fluid collections, such as hematomas and abscesses.

Obtaining a CT scan with and without IV contrast offers little additional benefit compared to a CT with IV contrast alone.

**Esophageal Transit Nuclear Medicine Scan**
Scintigraphy is usually not indicated in this clinical scenario.

**Variant 6: Delayed (greater than 1 month) postoperative development of dysphagia. Oropharyngeal or retrosternal. Initial imaging.**

Dysphagia occurring weeks or months following surgery may be due to dysmotility, gastroesophageal reflux, or structural abnormalities, such as anastomotic strictures, diverticula, or recurrent disease [38]. The incidence of dysphagia after laryngectomy is reported to occur in up to 72% of patients [44], and aspiration occurs in 65% of patients [45]. In addition to patients who have undergone operations to the oropharynx, larynx, and esophagus, operative procedures on the cervical spine may also cause dysphagia and significant disability. In the latter group of patients, dysphagia may be caused by structural abnormalities (displaced surgical hardware or bone graft) or functional abnormalities resulting in aspiration or penetration [1]. Patients following esophageal and gastric surgery can also experience dysphagia related to many potential complications.

**Fluoroscopy Single-Contrast Esophagram**
A single-contrast esophagram is useful to define the postoperative anatomy and the caliber of the pharynx and esophagus (assessing for stricture and extrinsic compression) as well as the caliber of an anastomosis. Barium may be utilized if leak is not a concern. A single-contrast esophagram may also be helpful if abnormalities in esophageal motility or gastroesophageal reflux are felt to be contributing to the patient's oropharyngeal symptoms.

**Fluoroscopy Biphasic Esophagram**
In the late postoperative period, the biphasic esophagram may be helpful if abnormalities in esophageal structure or function are felt to be contributing to the patient's dysphagia symptoms.

**Fluoroscopy Barium Swallow Modified**
A modified barium swallow may be performed if postoperative oropharyngeal dysmotility is suspected as the cause of the patient's dysphagia, particularly if there is a concern for swallowing dysfunction, including associated penetration or aspiration. Evaluating the passage of various bolus consistencies through strictures may also be beneficial for therapeutic planning [46,47]. Because a modified barium swallow examination does not evaluate the entire esophagus, it is usually not appropriate for postoperative retrosternal dysphagia.

**Fluoroscopy Pharynx Dynamic and Static Imaging**
Pharynx dynamic and static imaging is usually not appropriate because it is a double-contrast barium evaluation of the pharynx alone. A single-contrast esophagram with water-soluble contrast possibly followed with barium is more appropriate to evaluate for postoperative leak or fistula in a patient who has had surgery in the neck and is complaining of oropharyngeal dysphagia [42]. Furthermore, this study does not evaluate the thoracic esophagus

and gastric cardia. Alone, pharynx dynamic and static imaging is not appropriate for postoperative retrosternal dysphagia because it does not evaluate the retrosternal anatomy but may be useful combined with esophageal evaluation.

**CT Neck and Chest**

For delayed postoperative oropharyngeal and retropharyngeal dysphagia, CT of the neck and chest with IV contrast may be indicated if there is clinical concern that recurrent disease or a late postoperative fluid collection may be the etiology of the patient's symptoms [48]. In those patients who have undergone cervical spine surgery, CT may also be useful to assess the position of surgical hardware or a complication related to surgical hardware with respect to the oropharynx and airway [49]. Oral contrast administered immediately before the examination may be a helpful adjunct to facilitate identification of the esophageal lumen.

CT scan with IV contrast better defines the anatomic structures of the neck and chest compared to CT without IV contrast because normal soft-tissue and blood vessel enhancement are better delineated from postoperative fluid collections, such as hematomas and abscesses.

Obtaining a CT scan with and without IV contrast offers little additional benefit compared to a CT with IV contrast alone.

**Esophageal Transit Nuclear Medicine Scan**

Nuclear scintigraphy could be used to assess for motility abnormalities or gastroesophageal reflux; however, it is not a substitute for examinations that evaluate postoperative function and structure of the pharynx and esophagus.

**Summary of Recommendations**

- **Variant 1:** Fluoroscopy barium swallow modified is usually appropriate for the initial imaging of oropharyngeal dysphagia with an attributable cause.
- **Variant 2:** Fluoroscopy biphasic esophagram is usually appropriate for the initial imaging of unexplained oropharyngeal dysphagia.
- **Variant 3:** Fluoroscopy biphasic esophagram is usually appropriate for the initial imaging of retrosternal dysphagia in immunocompetent patients.
- **Variant 4:** Fluoroscopy biphasic esophagram is usually appropriate for the initial imaging of retrosternal dysphagia in immunocompromised patients.
- **Variant 5:** Fluoroscopy single-contrast esophagram and CT neck and chest with IV contrast are usually appropriate for the initial imaging of oropharyngeal or retrosternal dysphagia occurring in the early postoperative period. These procedures are complementary (ie, both tests may be performed).
- **Variant 6:** CT neck and chest with IV contrast and fluoroscopy single-contrast esophagram are usually appropriate for the initial imaging of oropharyngeal or retrosternal dysphagia occurring in the late postoperative period, more than 1 month after surgery. These procedures are complementary (ie, both tests may be performed).

**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 go to www.acr.org/ac.

**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 [50].

| 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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