Dysphagia: evaluation and treatment

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The major symptoms indicative of oropharyngeal or esophageal disease include dysphagia (difficulty in swallowing); odynophagia (painful swallowing); regurgitation; pyrosis (heartburn); and chest pain. Prominent pulmonary symptoms including chronic cough, wheezing, and recurrent pneumonias also may indicate a swallowing disorder. Other symptoms sometimes associated with esophageal diseases include belching, halitosis, rumination, and the globus sensation. The clinical evaluation of swallowing disorders relies heavily on a careful history. In most cases, an understanding of the symptom complex helps to delineate the level of dysfunction and type of evaluations needed to make a correct diagnosis. A careful history may determine the cause of dysphagia in over 80% of patients [1,2]. In particular, the history often helps to distinguish oropharyngeal from esophageal causes of dysphagia, and distinguish mechanical (anatomic) disorders from functional (motor) disorders.

This article discusses the evaluation and management of dysphagia, with an emphasis on the functional causes of dysphagia. Dysphagia refers to the sensation of impaired passage of food from the mouth to the stomach. This sensation occurs immediately after swallowing and is distinct from the globus sensation, which refers to a sensation of fullness or lump in the throat that is constant and unrelated to swallowing [3]. The true prevalence of dysphagia is unknown but epidemiologic studies estimate the prevalence in individuals over age 50 to be in the range of 16% to 22% [4,5]. A survey study of all ages in a Midwestern population estimated the prevalence of dysphagia to be 6% to 9% [6]. Importantly, up to 60% of nursing home occupants have feeding difficulties [7] and nursing home occupants with oropharyngeal dysphagia and aspiration have a 45% 12-month mortality [8]. Dysphagia is a major problem in the elderly population, which may greatly influence quality of life and mortality. Other situations in which symptoms of dysphagia occur commonly

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include patients with head injuries, cerebrovascular accidents, Parkinson's disease, or esophageal malignancy [4].

Basic physiology of swallowing

Dysphagia is clinically classified into two distinct types: oropharyngeal and esophageal [9]. Oropharyngeal dysphagia refers to difficulties in passage of a bolus from the mouth to the esophagus and is also referred to as transfer dysphagia. Esophageal dysphagia refers to disorders in passage of a bolus from the upper esophagus to the stomach, often resulting in the sense of food ''hanging up'' in the substernal region. An understanding of the basic swallowing mechanism helps to emphasize the importance of the distinction between oropharyngeal and esophageal causes of dysphagia. Physiologic differences between oropharyngeal and esophageal stages of swallowing determine the distinct symptoms and diseases that cause dysfunction in each of these stages of swallowing.

The tongue, oropharynx, upper esophageal sphincter (UES), and upper 5% of the esophagus are made up of striated muscle. The distal 50% to 60% of the esophagus and lower esophageal sphincter (LES) are made up of smooth muscle. Approximately 35% to 40% of the upper esophageal body is made up of both striated and smooth muscle. Innervation to the striated muscle comes directly from the central nervous system (CNS) by cranial nerves V, VII, IX, X, and XII and the cell bodies of the somatic efferent fibers are located in the nucleus ambiguous of the brainstem. These efferent fibers terminate in motor end plates on the striated muscle without intermediate neurons involved. The innervation of the smooth muscle portion of the esophagus and LES is more complex and involves intermediate neurons in the myenteric plexus of the wall of the esophagus. The vagus nerve (cranial nerve X) carries preganglionic fibers whose cell bodies originate in the dorsal motor nucleus of the brainstem. These cholinergic fibers innervate postganglionic neurons within the myenteric plexus, which may either be stimulatory (by acetylcholine release) or inhibitory (by nitric oxide or vasoactive intestinal peptide release) to smooth muscle. With these differences in neuromuscular anatomy, different types of illnesses lead to oropharyngeal dysfunction as compared with esophageal dysfunction. Diseases of oropharyngeal dysfunction typically involve the CNS (Parkinson's disease, cerebrovascular accidents [CVA], multiple sclerosis), motor neuron (amyotrophic lateral sclerosis, bulbar poliomyelitis), neuromuscular junction (myasthenia gravis), or striated muscle (polymyositis, muscular dystrophy), whereas diseases of esophageal dysfunction involve the myenteric plexus (diabetes mellitus, achalasia) or smooth muscle (scleroderma).

Once swallowing is initiated by CNS mechanisms, there is a typical sequence of events that is characterized by three stages of swallowing: (1) oral, (2) pharyngeal, and (3) esophageal. The oral stage of swallowing is voluntary and involves mastication and tongue movement that propels a bolus from the

oral cavity to the pharynx. The pharyngeal stage of swallowing is involuntary and transfers the bolus from the pharynx to the proximal esophagus. A number of closely coordinated actions occur during this stage that include (1) elevation and retraction of the soft palate with closure of the nasopharynx, (2) UES opening by UES relaxation and traction, (3) laryngeal closure at the level of the laryngeal vestibule, (4) tongue loading and propulsion, and (5) pharyngeal contraction. The entire pharyngeal stage of swallowing occurs in approximately 1 second [4]. The esophageal stage of swallowing is also involuntary and serves to transfer the bolus from the upper esophagus to the stomach. This occurs by the swallow-induced stimulation of a peristaltic contraction (primary peristalsis) in the esophageal body associated with LES relaxation. The contraction duration is usually 2 to 4 seconds and the overall time for a peristaltic wave to traverse the esophagus is 6 to 8 seconds. Secondary peristalsis occurs when a peristaltic wave is initiated by esophageal distention rather than a swallow-initiated event. As one may conclude from the outline of events induced by swallowing, transport of a bolus from the mouth to the stomach typically occurs within 10 seconds. If any part of this sequence fails to develop or progress, an ingested bolus may not pass normally leading to the complaint of dysphagia.

The two basic mechanisms responsible for dysphagia include either disordered motor function in the oropharynx or esophagus (functional causes of dysphagia) or mechanical narrowing of the oropharyngeal or esophageal lumen (mechanical causes of dysphagia). Most cases of oropharyngeal dysphagia involve altered motor function, whereas esophageal dysphagia may result from any of a number of motor or mechanical causes. A careful history alone helps delineate whether the likely cause of dysphagia is oropharyngeal or esophageal, and whether it is functional or mechanical in nature.

Epidemiologic studies point toward a high prevalence of dysphagia in the elderly, which raises the question about whether normal swallowing changes with age. There may be an age-related and dentition-related increase in the effort expended to prepare food for swallowing (oral stage) [10] but consistent age-related changes in pharyngeal or esophageal function have been difficult to demonstrate in healthy elderly patients [11]. Some studies have suggested an age-related decrease in the effectiveness of esophageal body peristaltic contractions, which might influence esophageal clearance of either a swallowed or refluxed bolus [12,13]. It seems that the predominance of cases of dysphagia in the elderly result from illnesses that occur more commonly in the elderly (CVA, Parkinson's disease, esophageal malignancy) rather than age-related changes in swallowing function.

Clinical evaluation of dysphagia

Historical features

The key historical points on which to focus in assessing patients with dysphagia involve differentiating oropharyngeal (transfer) dysphagia from

esophageal dysphagia, and differentiating a mechanical cause of dysphagia from a motor disorder. It is important to recognize that most cases of dysphagia have a recognizable cause and require some investigation to help direct therapy. In addition, the location of the sense of dysphagia may not be suggestive of the obstructive site because symptoms may be referred proximally.

Oropharyngeal dysphagia often leads to associated symptoms that originate in the oropharynx. Inability to chew or propel food into the pharynx, drooling of saliva or food, and difficulty initiating the act of swallowing suggest oral dysfunction. Coughing during a meal or nasal regurgitation of food or fluid suggests oropharyngeal dysfunction. Coughing or choking episodes while eating suggests poor laryngeal closure with tracheal aspiration, and this may be associated with recurrent aspiration pneumonias. The need to swallow repeatedly to clear food from the pharynx, dysarthria, and dysphonia also suggest oropharyngeal causes of dysphagia. In addition, dysphagia within 1 second of swallowing suggests an oropharyngeal origin [4]. The sense that a food bolus hangs up in the suprasternal notch may indicate either oropharyngeal or esophageal causes of dysphagia [14]. Swallowing with a gurgling noise may indicate the presence of a Zenker's diverticulum [3].

Esophageal dysphagia may lead to symptoms that are localized to the substernal or epigastric regions, although some patients may have distal esophageal symptoms referred to the suprasternal notch or neck [14]. In general, if the sensation of dysphagia is localized to the chest or abdomen, the cause is esophageal in origin. Patient's localization of obstructive symptoms corresponds to the actual site of the lesion in approximately 75% of cases [15]. Other symptoms associated with esophageal dysphagia include chest pain; late regurgitation (hours after eating, nocturnal regurgitation) of undigested food; or odynophagia. One oropharyngeal cause of dysphagia that may lead to late regurgitation of undigested food is a large Zenker's diverticulum, but otherwise this symptom is more suggestive of distal esophageal stasis (peptic stricture, malignancy, or achalasia).

Once esophageal dysphagia is suspected, the history may help to differentiate mechanical causes of dysphagia from neuromuscular (motor) causes of dysphagia. Patients who report dysphagia to both solids and liquids suggest a motor disorder, whereas patients who report dysphagia to solids only, or dysphagia to solids that is gradually worsening, suggest a mechanical disorder. If a food impaction occurs, patients with a motor disorder can frequently relieve the impaction and allow the bolus to pass with maneuvers, such as repeated swallowing, raising the arms over the head, throwing the shoulders back, or using the Valsalva's maneuver [3]. With mechanical disorders, the food impaction frequently must be regurgitated for relief. Likewise, patients with a spastic disorder of the esophagus often complain of associated chest pain and sensitivity to hot or cold liquids, whereas patients with a mechanical narrowing show no

temperature-dependent effects. Patients with episodic and nonprogressive dysphagia to solids without significant weight loss often have an esophageal web or distal esophageal ring (Schatzki's ring) [14]. Episodes of dysphagia often occur to bread or meat and may occur when eating a meal quickly or with alcohol. Dysphagia that occurs daily or is clearly worsening is more suggestive of a peptic stricture or esophageal malignancy. Significant weight loss, anorexia, or rapidly worsening dysphagia favors esophageal malignancy as the likely cause.

Patients who present with dysphagia may have other esophageal or systemic symptoms that help point to a specific cause of dysphagia. Odynophagia (painful swallowing) suggests esophageal mucosal inflammation and the most common causes include pill-induced esophagitis [14]; infectious esophagitis (*Candida*, cytomegalovirus, herpes) [16]; caustic ingestion; or peptic esophagitis with ulceration. Nasal regurgitation or regurgitation while swallowing suggests oropharyngeal dysfunction, whereas late regurgitation of undigested food suggests a distal esophageal obstruction, achalasia, or a Zenker's diverticulum. CNS and neuromuscular disorders constitute most causes of oropharyngeal dysphasia, so neurologic symptoms of stroke (hemiparesis, dysarthria, dysphasia, visual disturbances), cerebellar dysfunction (ataxia, altered gait), and extrapyramidal dysfunction (tremor, shuffling gait, dyskinesias) point strongly to oropharyngeal causes of dysphagia. Similarly, patients with collagen vascular disease (scleroderma and CREST syndrome [telangiectasias, sclerodactyly, calcinosis, arthritis]) often have esophageal motor disorders resulting in dysphagia [17].

Physical examination findings may provide clues to the cause of dysphagia particularly in identifying signs of neuromuscular dysfunction in patients with oropharyngeal dysphagia. Body weight and nutritional status may suggest disease duration and severity. Head and neck examination may reveal lymphadenopathy, thyromegaly, neck or oropharyngeal masses, and evidence of previous head and neck surgery or radiation therapy [4]. Muscle fasciculation, weakness, or fatigability may reflect motor neuron disease, myopathy, or myasthenia gravis and a neurologic examination may reveal focal sensory or motor dysfunction suggestive of CVA. Evidence of scleroderma or CREST syndrome may point toward esophageal dysfunction in patients with dysphagia.

Radiographic and endoscopic assessment of dysphagia

The initial radiographic and endoscopic assessment of dysphagia is greatly influenced by whether the underlying cause is thought to be oropharyngeal or esophageal in origin. Goals in the evaluation of patients with oropharyngeal dysphagia include identifying structural causes of dysphagia, assessing the functional integrity of the oropharyngeal swallow, evaluating the risk of aspiration pneumonias, and determining if the pattern

of dysphagia is amenable to therapy [18]. The best initial test for suspected oropharyngeal dysphagia is the videofluoroscopic or cineradiographic swallowing study, often referred to as ''modified barium swallow'' [19]. A series of swallows of varied volumes and consistencies are imaged in a lateral position and recorded on videotape to permit slow motion, instant replay. This study can detect and analyze functional impairment in the oropharynx and can be used to test the efficacy of compensatory dietary modifications or swallowing maneuvers. This study is highly sensitive for the detection of oropharyngeal dysfunction and can help in directing management for most of these patients [20]. Nasoendoscopy using a small videoendoscope permits direct visualization of the mucosal surfaces of the oral cavity, nasopharynx, pharynx, and larynx. This is the best method for identification of structural lesions of the oropharynx and for the identification of mucosal lesions for biopsy. Modifications of nasal endoscopy to assess swallowing [21] or the integrity of pharyngeal sensation [22] have been used in select tertiary care centers for the evaluation of oropharyngeal dysphagia.

Once videofluoroscopy and nasoendoscopic examinations have been performed, additional testing in patients with oropharyngeal dysfunction may complement the findings from the initial studies. CT and MRI may be useful to assess for strokes, CNS tumors, and head and neck tumors. Electromyography may distinguish neurogenic from myogenic causes of muscle weakness [23] and serologic testing for acetylcholine receptor antibodies, creatinine phosphokinase, thyroid-stimulating hormone, or thyroid hormone levels may help to diagnose toxic or metabolic myopathies, such as myasthenia gravis, polymyositis, hypothyroidism, or thyrotoxicosis. Of note, standard manometry is rarely useful in the assessment of oropharyngeal dysphagia as compared with esophageal dysphagia because of technical considerations, including the need for high-fidelity transducers, unpredictable structural movement in the oropharynx with swallowing, and extreme asymmetry of pressure recordings within the oropharynx.

The initial evaluation of patients with suspected esophageal dysphagia may include either a standard barium swallow or upper gastrointestinal (GI) endoscopy. Upper GI endoscopy is almost always needed in the evaluation of esophageal dysphagia, both for diagnosis and possible therapy. For this reason, many clinicians use endoscopy as the initial diagnostic study for esophageal dysphagia and this indication accounts for 20% of all upper GI endoscopies in the United States [24]. Despite this approach, a barium swallow may be more sensitive than endoscopy in detecting subtle narrowing of the esophagus, such as lower esophageal rings, mild peptic strictures, or extrinsic compression of the esophagus [25]. In addition, sensitivity of a barium swallow to detect structural or functional abnormalities of the esophagus may be increased by the use of a solid bolus, such as a marshmallow or fluoroscopic examination with swallowing [26–28]. Esophageal motility disorders, such as achalasia or diffuse esophageal spasm, may be detected by barium swallow in 70% to 95% of

cases [27], whereas endoscopy may miss these motility abnormalities early in their clinical course. Barium studies are also advantageous in detecting large Zenker's or epiphrenic diverticula and paraesophageal hernias, which are all lesions that may be difficult to assess or more hazardous to detect endoscopically. Finally, a barium swallow may serve as a "road map" for subsequent endoscopy in patients with long or tight esophageal strictures that might need endoscopic dilation with fluoroscopic guidance. For many of these reasons, barium swallow remains the initial study of choice in evaluating patients with esophageal dysphagia among many, if not most, clinicians.

Upper GI endoscopy is required in most patients with esophageal dysphagia. Endoscopy has the advantages of assessing mucosal lesions, obtaining biopsies or cytology specimens, and offers therapeutic potential with endoscopic dilation. Endoscopy is the study of choice for patients with odynophagia because biopsy or cytology may be needed to differentiate infectious, neoplastic, pill-induced, or reflux-associated esophagitis [29]. In addition, endoscopy is recommended in any patient with esophageal dysphagia and no obvious cause on barium study to rule out subtle mucosal changes that might direct therapy.

Esophageal manometry

Esophageal manometry is the gold standard study for esophageal motor disorders and has been particularly useful for establishing the diagnosis of achalasia, diffuse esophageal spasm, and esophageal motor abnormalities associated with scleroderma or CREST syndrome [30]. Esophageal manometry is unnecessary in patients with dysphagia where a mechanical lesion is identified on endoscopy or barium swallow. When patients with esophageal dysphagia have a nondiagnostic barium swallow or upper GI endoscopy, however, esophageal motility abnormalities have been identified with esophageal manometry in up to 90% of subjects [31]. Whether the manometric evaluation significantly alters the management or outcome in patients with dysphagia remains controversial. One study of 363 patients referred for esophageal manometry in this setting concluded that the procedure altered treatment in only 4% [32]. A more recent study suggested that manometric evaluation helped to direct or alter therapy in 49% of 268 patients [33].

Specific esophageal motility disorders that may be diagnosed or confirmed by esophageal manometry include achalasia, nutcracker esophagus, diffuse esophageal spasm (DES), hypertensive LES, ineffective esophageal motility (IEM), esophageal hypomotility associated with collagen vascular diseases, and nonspecific esophageal motility disorders (NEMD) [34,35]. The manometric diagnosis and treatment of these disorders is discussed later. Esophageal manometry is used most often to evaluate symptoms of chest pain or to evaluate patients with gastroesophageal reflux disease before antireflux surgery or 24-hour esophageal pH

testing. In one large review of 3 years experience in an esophageal motility laboratory [34], 251 (22%) of 1161 of the manometric studies were performed for symptoms of dysphagia. A total of 132 (53%) of 251 of these studies were abnormal with the most common abnormalities being achalasia (36%) and nonspecific esophageal motility disorders (39%). In patients with suspected achalasia, esophageal manometry ideally should precede endoscopy because a specific treatment plan (eg, pneumatic dilation, botulinum toxin injection, Heller myotomy) could be performed in conjunction with endoscopy. Manometry in achalasia may be hampered by an inability to blindly pass the motility catheter across the LES because of a tortuous, dilated esophageal lumen or hypertensive LES. In this setting, endoscopic passage of the catheter across the LES may be used to obtain a complete manometric study that confirms the diagnosis.

Other esophageal studies that may be used in the evaluation of patients with esophageal dysphagia include radionuclide esophageal transit scintigraphy [28] and chest CT or MRI. Esophageal transit scintigraphy can assess bolus transit through the esophagus and may complement manometric findings. When compared with esophageal manometry, transit scintigraphy has a positive predictive value of 68% for esophageal motility disorders, with the highest diagnostic accuracy being seen in patients with achalasia [28]. Because this technique is less frequently available and less sensitive than esophageal manometry for motor disorders, it remains primarily used in the research setting [14]. Chest imaging with CT or MRI may be useful in establishing the diagnosis of tumors, vascular structures, or other mass lesions that may cause extrinsic compression or invasion of the musculature or nerves associated with esophageal function. Likewise, endoscopic ultrasound may also be useful in evaluating patients with extrinsic compression or esophageal muscular or neurologic dysfunction.

Management of dysphagia

The overall management of dysphagia is influenced significantly by whether the dysphagia has an oropharyngeal or esophageal cause, and by whether the dysfunction is secondary to a mechanical process or a motor disorder. Most cases of oropharyngeal dysphagia are caused by motor abnormalities involving the oropharyngeal musculature (usually from CNS causes [Table 1]), whereas esophageal cases of dysphagia may be caused by either mechanical or motor disorders (Table 2). Because of the distinction between oropharyngeal and esophageal dysphagia, the management of each is discussed separately.

Oropharyngeal dysphagia

In most patients with oropharyngeal dysphagia, laryngoscopy and a videofluoroscopic swallowing study serve as the primary studies to delineate

Table 1
Common causes of oropharyngeal dysphagia

Structural lesions	Examples
Pharyngeal diverticula	Zenker's diverticulum
	Lateral pharyngeal pouch or diverticula
Intrinsic lesions	Oropharyngeal or laryngeal carcinoma
	Surgical resection
	Cricopharyngeal achalasia
	Cricopharyngeal bar and rings
	Proximal esophageal webs (Plummer-Vinson)
	Radiation injury
Extrinsic compression	Osteophytes, skeletal abnormalities
	Thyromegaly

Neuromusuclar diseases	Examples
Central nervous system	Cerebrovascular accidents, head injury, neoplasm,
	Parkinson's disease, multiple sclerosis, amyotrophic
	lateral sclerosis, Huntington's chorea
Peripheral nervous system	Poliomyelitis, amyotrophic lateral sclerosis
	Tabes dorsalis
	Glossitis, pharyngitis, thrush (sensory)
Neuromuscular transmission	Myasthenia gravis
Myopathies	Polymyositis, dermatomyositis
	Muscular dystrophies
	Alcoholic myopathy
	Thyrotoxicosis, hypothyroidism
	Amyloidosis, Cushing's syndrome

the cause of dysphagia (Fig. 1). In addition, the video barium swallow helps assess the risk of aspiration and whether specific maneuvers (swallowing posture, swallowing technique, diet modifications) are useful therapeutically. Mechanical abnormalities that might require specific therapy include cricopharyngeal strictures; oropharyngeal tumors; posterior hypopharyngeal (Zenker's) diverticulum; and cervical webs. In patients with benign strictures or webs, esophageal dilation is generally safe and effective with good results reported in up to 75% [36]. Patients with dysfunction of the UES may also benefit from esophageal dilation [37] or cricopharyngeal myotomy [4,38]. Many of these patients have an associated Zenker's diverticulum, which results from UES dysfunction. In this setting, surgical cricopharyngeal myotomy with diverticulectomy or endoscopic myotomy with diverticulostomy using an endoscopic stapling device is safe and effective, with good results reported in over 90% [4,38]. Other structural findings that might contribute to symptoms of oropharyngeal dysphagia include a cricopharyngeal bar, cervical osteophyte, or lateral pharyngeal diverticula. Cricopharyngeal bars and cervical osteophytes have been reported in 5% to 30% of patients with oropharyngeal dysphagia but attributing the symptoms of dysphagia to these findings may be difficult [39,40]. In selected cases, myotomy for a cricopharyngeal bar [41] or surgical

Table 2
Common causes of esophageal dysphagia

Lesions	Examples
Structural lesions	Examples
Intrinsic lesions	Peptic stricture, Schatzki's ring
	Esophageal carcinoma
	Leiomyoma, lymphoma
	Hiatal hernia
Extrinsic compression	Mediastinal tumors (lung cancer, lymphoma)
	Vascular structures (dysphagia lusoria)
	Surgical changes (fundoplication)
Motor disorders	
Primary motor disorders	Achalasia
	Diffuse esophageal spasm
	Hypertensive lower esophageal sphincter
	Nutcracker esophagus
	Ineffective esophageal motility
Secondary motor disorders	Collagen vascular diseases or Scleroderma, CREST
	Diabetes mellitus
	Alcoholism
Mucosal diseases	
Esophagitis	Gastrointestinal reflux diseases
	Infectious esophagitis
	Pill-induced
	Radiation injury
	Caustic ingestion

removal of cervical osteophytes [42] may help improve symptoms of dysphagia. Lateral pharyngeal diverticula have been reported in up to 50% of asymptomatic patients and are infrequently found to be the cause of dysphagia [43].

In most patients with oropharyngeal dysphagia symptoms are from neuromuscular causes (see Table 1). Once neuromuscular dysfunction is identified, treatment may be directed by the specific cause of dysfunction and the degree of functional impairment. Swallowing therapy with diet modification, swallowing posture, and swallowing technique may improve symptoms and oral nutrition, even when the underlying neurologic disorder has no specific therapy [44,45]. For this reason, a multidisciplinary approach to these patients between speech pathology, radiology, otolaryngology, neurology, and gastroenterology is essential. A recent comprehensive review of swallowing therapy techniques, rationale, and therapeutic results is available for more detailed information [4]. In patients with high risk of aspiration, endoscopically placed feeding tubes (percutaneous endoscopic gastrostomy [PEG]) or nasogastric feeding tubes may be required for early enteral feeding. Based on nutritional parameters and patient survival, enteral feeding through a PEG tube may be superior to nasogastric feeding in patients with acute stroke and dysphagia [46].

Algorithm 1 - Approach to Oropharyngeal Dysphagia
History and Physical (see text)

Videofluoroscopic Swallowing
Study

Motor Abnormality

Treat underlying disease
(If possible)

Structural Lesion

Nasoendoscopy

Specific therapy

Unsafe to Swallow
(Aspiration)

Abnormal UES function

Abnormal transit
(Oropharyngeal,
pharyngoesophageal)

Nutritional Support
(PEG)

Esophageal dilation,
myotomy

Swallow modifications,
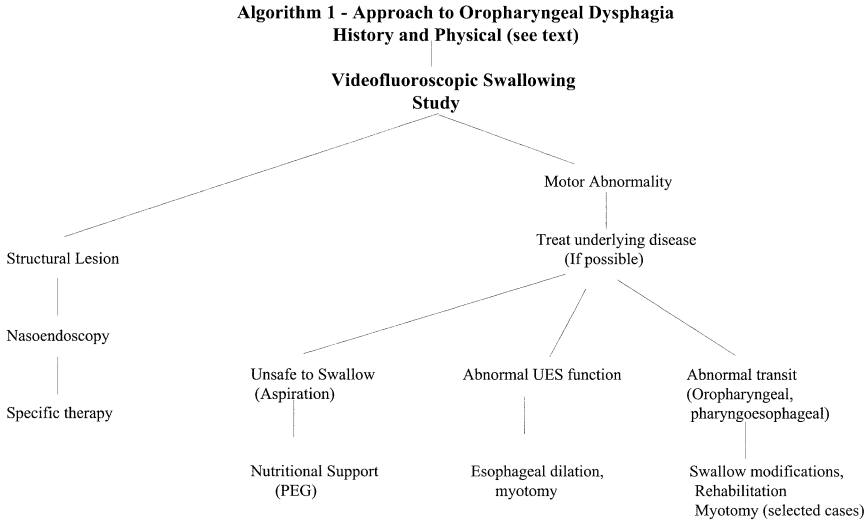Rehabilitation
Myotomy (selected cases)

Fig. 1. Approach to oropharyngeal dysphagia, history and physical using videofluoroscopic swallowing study.

Drug therapy for patients with oropharyngeal dysphagia may be useful for specific neuromuscular diseases that affect the swallowing mechanism. Myasthenia gravis, Parkinson's disease, and dermatomyositis-polymyositis each have specific immunosuppressive, anti-inflammatory, or neuromodulating drugs that might improve the swallowing symptoms in some patients with these disorders. Unfortunately, specific drug therapy for myasthenia gravis or Parkinson's disease has not significantly improved the symptoms of dysphagia in most of these patients [47,48]. Immunosuppressive therapy in patients with inflammatory myopathies may be more promising in improving symptoms of dysphagia in this setting [49]. Conditions associated with drooling of saliva or increased oral secretions may benefit symptomatically from anticholinergic therapy (eg, transdermal scopolamine) to reduce salivation but this does not likely improve symptoms of dysphagia [50].

Because pharmacologic therapy has little influence on most patients with neuromuscular causes of oropharyngeal dysphagia, cricopharyngeal myotomy has been used in this setting in a attempt to palliate symptoms of dysphagia. The efficacy of myotomy in patients with neuromuscular causes of dysphagia is variable with reports of good responses ranging from 20% to 100% in small series [51]. A review of 15 case series of patients with neurogenic dysphagia who underwent cricopharyngeal myotomy suggests an overall beneficial response rate of approximately 50% [52]. Selection criteria for which of these patients might benefit from surgical myotomy remain unknown.

Esophageal dysphagia

Patients with esophageal dysphagia usually have a recognizable mechanical or motor abnormality that accounts for their symptoms of dysphagia (Tables 2 and 3). Nonspecific measures recommended for all patients in this setting include chewing food well, staying upright while eating, and avoiding hurried meals. Nutritional supplementation with full liquid supplements (eg, Ensure [Abbott Laboratories, Abbott Park, IL], Boost [Mead Johnson, Evansville, IN]) may be useful if patients have had weight loss. In patients with mechanical esophageal narrowing, the use of a mechanical soft or pureed diet may also be advisable. In severe or prolonged cases of dysphagia, enteral tube feedings using a nasogastric tube or gastrostomy tube (PEG) may be required.

Mechanical esophageal narrowing

Specific therapy for esophageal causes of dysphagia depends on the etiology, particularly whether the dysphagia is caused by a mechanical narrowing (peptic stricture, esophageal ring, neoplasm) or a motor disorder (achalasia, spastic disorder of the esophagus, ineffective esophageal motility). The management of mechanical causes of esophageal dysphagia involves the use of intermittent esophageal dilation using graded esophageal bougienage or balloon dilation. It is estimated that 60% to 70% of benign esophageal strictures in the United States are peptic strictures resulting from gastroesophageal reflux disease [53]. Importantly, symptoms of dysphagia in this setting are only partly accounted for by the diameter of the esophageal lumen, suggesting that active esophagitis contributes significantly to these symptoms [54]. Aggressive antireflux therapy using proton pump inhibitors is essential in patients with symptomatic peptic strictures. The choice between bougie dilators and balloon dilation has been evaluated in a number of randomized trials and no clear consensus for one technique over the other has been identified [14,55]. The use of fluoroscopic guidance for esophageal dilation has been advocated by some [55] but is probably only needed in patients with complicated strictures or large hiatal hernias [56]. The recommended techniques and schedules for graded esophageal dilation

Table 3
Esophageal dysphagia: mechanical versus motor disorders

History	Mechanical disorder	Motor disorder
Onset	Gradual or sudden	Usually gradual
Progression	Often	Usually not
Type of bolus	Solid (unless high-grade obstruction)	Solids or liquids
Response to bolus	Often must be regurgitated	Usually passes with repeated swallowing or drinking liquids
Temperature dependent	No	Worse with cold liquids; may improve with warm liquids

have been recently reviewed [57] and are not discussed in detail in this article.

Other settings in which esophageal dilation with bougienage has been used effectively include patients with a lower esophageal ring (Schatzki's ring); postfundoplication dysphagia; or as palliation for malignant esophageal obstruction. Abrupt dilation using a large esophageal bougie is the treatment of choice for patients with a lower esophageal ring [58], although endoscopic rupture of Schatzki's rings using biopsy forceps at four quadrants has also been used [59]. Despite excellent results with abrupt dilation in this setting, recurrent symptoms typically occur necessitating periodic repeat dilatations [60]. Following surgical fundoplication for gastroesophageal reflux disease, dysphagia is very common in the early postoperative period and usually improves without specific intervention. In patients with persistent dysphagia after fundoplication, esophageal dilation may relieve symptoms in two thirds of cases if the fundoplication is intact on endoscopy or barium studies [61]. Patients with dysphagia secondary to malignancy can be palliated in the short term with esophageal dilation [62] but may require placement of endoluminal stents or endoscopic treatment with laser therapy or photodynamic therapy [63] for longer-term palliation.

Patients with symptoms of dysphagia and no evidence of mechanical narrowing on endoscopy or barium studies suggest a motor disorder may be the cause of their symptoms (Fig. 2). The question of whether empiric esophageal dilation in this setting improves symptoms has been evaluated in a few studies [64,65]. Patients with solid food dysphagia and normal endoscopy improved significantly after esophageal dilation, whereas patients with both solid and liquid dysphagia improved infrequently.

Motor disorders of the esophagus

The major recognizable motor disorders of the esophagus include achalasia; DES; nutcracker esophagus; hypertensive (or hypersensitive) LES; IEM; and esophageal hypomotility associated with collagen vascular diseases. NEMD described in earlier studies [34] predominantly reflect patients with IEM [35]. The manometric criteria for these disorders are delineated in Table 4.

Achalasia. Achalasia is the most treatable esophageal motor disorder that usually presents with symptoms of dysphagia or regurgitation. Chest pain has been reported in up to 63% of patients [66] but is less often the chief complaint at presentation. Other symptoms include nocturnal regurgitation, cough, or heartburn. Dysphagia is often worse with solids but may occur with both solids and liquids. Primary achalasia is characterized by inflammatory infiltration of the myenteric plexus in the esophageal wall, leading to degeneration of neurons. This process preferentially involves the nitric oxide-producing inhibitory neurons that influence relaxation of esophageal smooth muscle [67] resulting in incomplete relaxation of the

Algorithm 2 - Approach to Esophageal Dysphagia

History and Physical (see text)

Barium Swallow and/or Endoscopy

Structural lesion

Esophagitis

No Lesion

Motor Abnormality

Endoscopy with Dilation

Treat for underlying Cause (GERD, antifungal Or antiviral therapy) If dysphagia Persists

Empiric Dilation

If dysphagia Persists

Esophageal Manometry

Specific Therapy (GERD, neoplasia)

Esophageal Manometry

Esophageal Manometry

Functional dysphagia; Other esophageal motor disorders; (DES, hypertensive, LES, IEM, Nutcracker)

Reassurance Antireflux therapy trial

Nitrates or Calcium Channel Blockers

Anticholinergic agents; low dose tricyclics

Refractory patients: esophageal dilation, pneumatic dilation, Botox, myotomy

Achalasia

Elderly patient; High risk with Co-morbidities

Botox

Nitrates or Calcium channel blockers

Young patient (< 40)

Laparoscopic Heller Myotomy

Average risk Patient
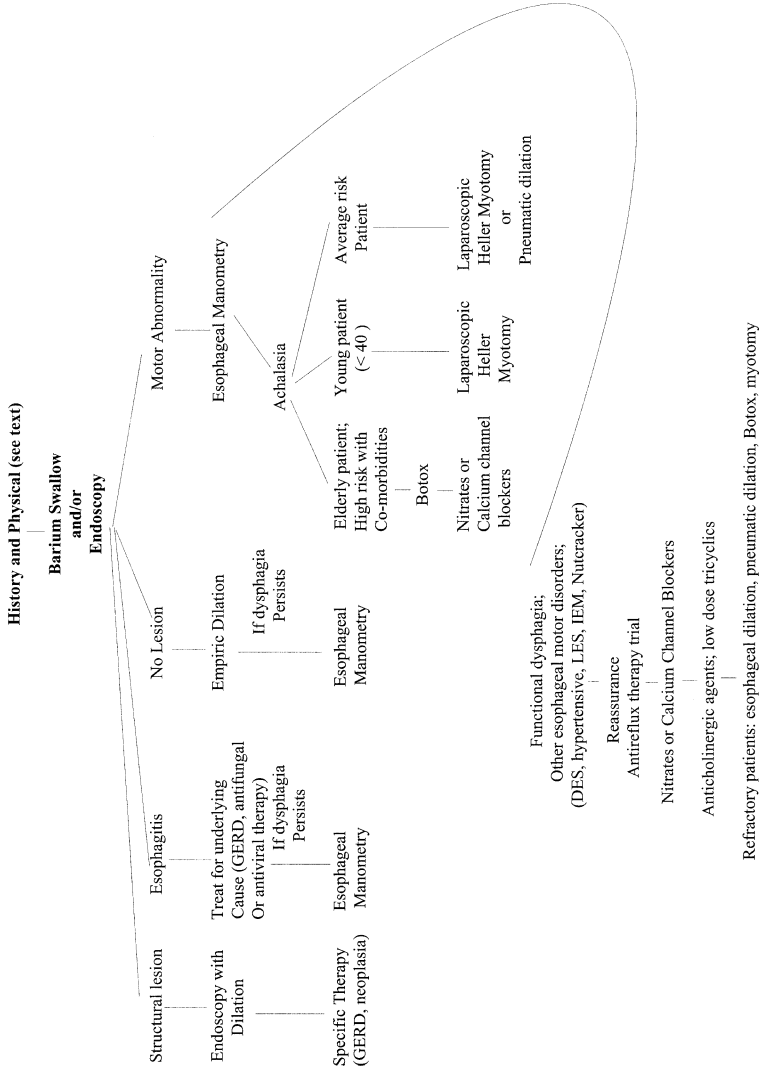
Laparoscopic Heller Myotomy or Pneumatic dilation

Fig. 2. Approach to esophageal dysphagia, history and physical using barium swallow or endoscopy.

Table 4
Manometric findings in esophageal motor disorders

Disorder	LES function	Esophageal body
Achalasia	Abnormal relaxation[a]; elevated resting pressure (> 45 mm Hg); incomplete relaxation (residual > 8 mm Hg)	Absent distal peristalsis[a]; elevated baseline pressure
Diffuse esophageal spasm	Normal or isolated incomplete relaxation	Simultaneous contractions in > 20% wet swallows with intermittent peristalsis[a]; repetitive contractions (> 3 peaks) or prolonged duration (> 6 s)
Nutcracker esophagus	Normal	Increased distal peristaltic amplitude (> 180 mm Hg)[a]; prolonged contraction duration (> 6 s)
Hypertensive LES	Elevated resting pressure (> 45 mm Hg)[a], normal or incomplete LES relaxation (residual pressure > 8 mm Hg)	Normal
Ineffective esophageal motility	Normal or low resting pressure (< 10 mm Hg)	Increased failed peristalsis (> 30% swallows); or distal peristaltic amplitude < 30 mm Hg in 30% of swallows[a]
Collagen vascular disease (scleroderma, CREST)	Low resting pressure (< 10 mm Hg)	Absent peristalsis

[a] Required for diagnosis.
Abbreviation: LES, lower esophageal sphincter.

LES and absent distal esophageal peristalsis. Secondary or pseudoachalasia may result from an infection (*Trypanosoma cruzi*) in Chagas' disease or from malignancies involving the esophageal neural plexus or causing a paraneoplastic syndrome [68]. Treatment for achalasia is directed at reducing the resting LES pressure so that the sphincter is no longer a significant barrier to the passage of swallowed material [14]. Pharmacologic treatment with nitrates or calcium channel blockers before meals may improve symptoms of dysphagia temporarily, but treatment is limited by side effects and lack of efficacy [69]. Controlled trials have not shown clear benefit as compared with placebo [70].

Similarly, botulinum toxin can be injected into the LES during upper endoscopy and LES pressure is effectively reduced by inhibiting acetylcholine release from local neurons [71]. This treatment can be very effective for the short-term relief of dysphagia, but this beneficial effect is clearly temporary. Two thirds of patients are improved for at least 6 months and the median duration of response is 16 months [71,72]. The longest remission observed has been 28 months. Although this treatment is quite safe, it should only be considered for patients who have serious comorbidities that preclude the use of pneumatic dilation or surgical myotomy for more definitive treatment.

Pneumatic dilation and surgical myotomy of the LES are the only two treatments that have consistently improved symptoms and esophageal emptying in patients with achalasia [73–76]. Pneumatic dilation using balloon dilators with diameters of 3 to 4 cm results in disruption of muscle fibers at the LES. Most large series report good short-term results in 60% to 85% of patients after one session of pneumatic dilation [14], but up to 50% of patients may require further therapy (either repeat pneumatic dilation or surgery) within 5 years [75,77]. Patients under age 40 clearly have worse results with pneumatic dilation [75,77,78]. LES pressure less than 10 mm Hg after dilation predicts excellent results [77]. The most important complication of pneumatic dilation is esophageal perforation that might require surgical repair. Most large series report this rate of perforation at 2% to 6% [72,76]. A number of factors have been suggested as risk factors for perforation in this setting, including malnutrition, weight loss, low LES pressure, high-amplitude contractions, epiphrenic diverticulum, previous pneumatic dilation, large balloon size, or high inflation pressures [79,80]. None of these factors has been shown to increase the risk of pneumatic dilation, although the presence of an epiphrenic diverticulum remains a contraindication for most clinicians. Because of the risk of perforation following pneumatic dilation, gastrogaffin or barium swallow is recommended in all patients shortly after pneumatic dilation (as soon as the sedation has worn off) to seek evidence of perforation [76].

Surgical (Heller) myotomy is the major alternative treatment to pneumatic dilation in patients with achalasia. The standard open myotomy usually has been performed with a thoracic approach and good to excellent

symptomatic relief is reported in 70% to 90% of patients [81,82]. A major recent advance is the use of minimally invasive surgery for the performance of this procedure [83]. Laparoscopic Heller myotomy has the advantage of markedly less hospitalization and postoperative recovery time with good early results. Reflux esophagitis has been reported in approximately 10% of patients following surgical myotomy and many surgeons choose to perform a partial fundoplication to reduce this risk [83]. Because of the risk of persistent dysphagia following fundoplication in this setting and the recent availability of highly effective medical antireflux therapies (eg, proton pump inhibitors), this author favors the use of surgical myotomy without fundoplication. Sustained relief of dysphagia after surgical myotomy has been reported to be 80% to 85% at 10 years and 67% at 20 years [74].

   Few studies have directly compared pneumatic dilation with surgical myotomy and most of these studies have been retrospective [84,85]. These studies suggested that success rates for surgical therapy were generally better (85% versus 65%), although not uniformly so in all studies. Two prospective randomized trials of myotomy and pneumatic dilation have been reported [73,86]. The larger trial [73] reported excellent results in 95% of surgical patients at 5 years versus 65% of patients treated with pneumatic dilation. The second trial found equal effectiveness between treatments at 3 years of follow-up. In sum, most studies suggest that surgical myotomy may be more effective for short- and long-term relief of dysphagia. The choice between these techniques in an individual patient remains strongly influenced by patient preference and the local availability of clinicians experienced in each technique.

DES, nutcracker esophagus, and hypertensive LES. Patients with DES, nutcracker esophagus, and hypertensive LES most often present with symptoms of chest pain. DES is characterized by incoordinated motility with intermittent peristalsis and intermittent aperistaltic (simultaneous) esophageal contractions. Hypersensitivity to cholinergic stimulation has been seen in DES, suggesting a possible defect in neural inhibition from decreased nitric oxide release [87]. Nutcracker esophagus is characterized by peristaltic contractions of high amplitude or prolonged duration in patients with chest pain, and this accounts for most patients with manometrically confirmed spastic disorders of the esophagus [34,88]. Hypertensive LES is diagnosed infrequently and is characterized by an elevated resting LES pressure with normal relaxation and esophageal body peristalsis [34]. Dysphagia is very rare in patients with nutcracker esophagus but may occur in a significant subset of patients with DES or hypertensive LES. The management of dysphagia in these patients has included the use of nitrates, calcium channel blockers, and anticholinergics with variable results [89,90]. Nifedipine has been shown to reduce esophageal contraction amplitudes, but its usefulness for symptomatic relief has not been demonstrated in controlled trials [89,90]. Pneumatic dilation and long surgical myotomy have

been used in refractory patients with these spastic esophageal disorders, but no controlled trials are available to assess these measures in this setting. Low-dose trazodone or tricyclic antidepressants [89,91] have been used for chest pain symptoms in this setting but their use for dysphagia is unknown.

Ineffective esophageal motility, hypomotility in scleroderma, and CREST. Ineffective esophageal motility (IEM) is defined as distal esophageal amplitudes less than 30 mm Hg in more than 30% of wet swallows [35]. Hypomotility in scleroderma or CREST syndrome is characterized by a very low resting LES pressure and aperistaltic esophageal body contractions. Both of these esophageal motor disorders are strongly associated with gastroesophageal reflux disease and may be more common in patients with respiratory or oropharyngeal symptoms of gastroesophageal reflux disease. These esophageal motility disorders may account for symptoms of nonobstructive dysphagia in patients with gastroesophageal reflux disease [92] and aggressive medical treatment of gastroesophageal reflux disease is the most important factor in managing dysphagia in these patients. In addition to high-dose proton pump inhibitor therapy for gastroesophageal reflux disease, metoclopramide may be used to assist in the medical antireflux therapy in these patients. In general, antireflux surgery is avoided in patients with these disorders of esophageal peristalsis because of concerns for worsened dysphagia postoperatively.

Functional dysphagia. As defined by the Rome II criteria [93], the diagnosis of functional dysphagia is made in patients who have at least 12 weeks in the past year of the sense of esophageal dysphagia in the absence of pathologic gastroesophageal reflux, achalasia, or other motility disorder with a recognized pathologic basis. The presence of esophageal motor disorders on manometry, such as DES, nutcracker esophagus, or hypertensive LES, does not preclude the diagnosis of functional dysphagia. This is the least prevalent of the functional esophageal disorders but has been suspected in as many as 7% to 8% of people in a survey for functional disorders [52]. Possible causes for functional dysphagia may include failed or incoordinated esophageal peristalsis [94] and abnormal intraesophageal sensation [95]. Management of patients with functional dysphagia, including those patients with DES, hypertensive LES, or IEM, usually should include reassurance, emphasizing the nonprogressive and benign nature of this disorder [93]. A trial of antireflux therapy should be considered, particularly in patients with IEM. The antireflux treatment trial should not be long term, however, if pathologic reflux cannot be demonstrated or antireflux therapy is ineffective. If symptoms are precipitated by specific events (exercise, stress, or particular foods), treatment with sublingual nitrates or nifedipine before meals may be a reasonable next step. Patients with chronic symptoms may be treated with longer-acting diltiazem or nifedipine, although no pharmacologic agent has been shown consistently to help in these patients. If chest pain and anxiety

or depressive symptoms are also present, treatment with low-dose trazodone (50 to 100 mg three times a day), amitriptyline (25 mg at bedtime), or imipramine (50 mg at bedtime) may be tried [96,97]. Mechanical interventions, such as bougie esophageal dilation, botulinum toxin injection, pneumatic dilation, or surgical myotomy, may be considered but should be used only in highly selected refractory patients. Bougie dilation is most reasonable for patients with intermittent solid food dysphagia because a subtle stricture or ring may be overlooked [64,98]. Response rates in this setting may be as high as 80% for 2 years. Patients with hypertensive LES may be managed like patients with achalasia, using botulinum toxin injection, pneumatic dilation, or surgical myotomy, but this should only be used in refractory patients with a documented delay in distal esophageal emptying on radiographic studies [99]. Surgical myotomy for functional dysphagia is almost never indicated because of the nonprogressive nature of this disorder [93].

Summary

The evaluation of dysphagia begins with a careful history, which usually points to the underlying cause in up to 80% of cases. The goals of the history are to distinguish oropharyngeal causes from esophageal causes of dysphagia and to distinguish mechanical from motor disorders of the esophagus in those patients with esophageal dysphagia. Evaluation typically begins with a videofluoroscopic examination in patients with oropharyngeal dysphagia and begins with a routine barium swallow or upper GI endoscopy in patients with esophageal dysphagia. Esophageal manometry may be an adjunct to the evaluation of patients with esophageal dysphagia, particularly to confirm specific motor disorders, such as achalasia. The management of functional causes of dysphagia is supportive and empiric given the lack of well-controlled treatment studies in this heterogenous group of patients.

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