Chapter 8
Spastic Motor Disorders

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Introduction

Spastic esophageal disorders are currently comprised of three main clinical entities, distal esophageal spasm (DES), hypercontractile or jackhammer esophagus, and type III (spastic) achalasia, as defined by high-resolution esophageal manometry. While no population-based studies exist for non-achalasia esophageal motility disorders, the prevalence of DES is thought be similar to that of achalasia, approximating 1 in 100,000 in the USA [1]. Recent studies also estimated that 1–4% of patients undergoing esophageal manometry for dysphagia and/or chest pain demonstrate findings suggestive of a spastic disorder [2–5].

Generally, spastic esophageal disorders are characterized by increased contractile vigor or premature propagation of swallow-induced esophageal body contractions. Despite similarities in symptomatology among patients with these disorders, the heterogeneity of this population (with respect to clinical outcomes) may signal mechanistically distinct esophageal pathologies. In addition, the evolution from conventional to high-resolution esophageal manometry (HRM) and the development of new diagnostic parameters by the Chicago Classification (CC) have shifted the notion of how spastic disorders should be defined [6]. Nutcracker esophagus was originally characterized on conventional manometry by an average contraction amplitude of greater than 180 mmHg in the distal esophagus, a cutoff that was subsequently increased to 220 mmHg to improve diagnostic specificity. When HRM became available and the initial versions of CC were established, this diagnosis was redefined using the new metric distal contractile integral (DCI). While a mean DCI

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value between 5000 and 8000 mmHg·s·cm was identified as hypertensive peristalsis or nutcracker esophagus, conditions with significantly increased contractile vigor (DCI greater than 8000 mmHg.s.cm) were further classified as hypercontractile or jackhammer esophagus. Most recently, nutcracker esophagus has been eliminated entirely from the latest iteration of CC (version 3.0) published in 2015, given that up to 5% of normal, healthy subjects may achieve mean DCI values within that range (5000–8000) [7]. Instead, hypercontractile or jackhammer esophagus is now defined in CC version 3.0 as DCI greater than 8000 mmHg·s·cm in at least 20% of liquid test swallows (which has not been observed in control subjects and thought to represent a more homogeneous phenotype) [6]. Hypertensive lower esophageal sphincter (LES), traditionally defined as a basal LES pressure of greater than 45 mmHg, is associated with high-amplitude peristaltic contractions in the distal esophagus in approximately 50% of patients who present with chest pain and may also be correlated with incomplete relaxation of the LES after a liquid swallow. However, the relationship between clinical symptoms and elevated basal LES pressure alone has not been clearly established. Hypertensive LES, therefore, is not currently a diagnostic entity in CC version 3.0. Hypercontractile LES, defined as a post-glutitive LES contraction with excessive duration or amplitude, has been previously described and associated with symptoms. A recent study found that including the hypercontractile LES to the DCI measurement of the esophageal body infrequently results in reclassification of diagnosis among patients presenting with dysphagia or chest pain. Hypercontractile LES, therefore, is now included as part of the evaluation of esophageal body hypercontractility in CC v3.0. The same manometric classification system defines DES as ≥20% premature contractions with a distal latency (DL) of less than 4.5 seconds. While both DES and spastic achalasia are characterized by premature propagation of contractions and diminished DL, insufficient LES relaxation is only a feature of the latter.

In this chapter, we will focus on the pathophysiology, clinical presentation, diagnosis, and management of DES and jackhammer esophagus, given the discussion of achalasia in the preceding chapter.

Pathophysiology

The pathophysiology of spastic esophageal disorders is not fully elucidated. Biopsies of the esophageal muscularis propria and myenteric plexus are rarely endoscopically accessible for clinicopathologic investigation, and patients with spastic disorders typically do not require esophageal surgery [1]. In the absence of more definitive histopathologic evidence, the prevailing theory for the mechanism underlying spastic esophageal disorders centers on the delicate balance between inhibitory and excitatory neuronal regulation of the esophageal smooth muscles [8]. The myenteric plexus located between the longitudinal and circular muscle layers of the esophagus contains the inhibitory and excitatory innervations responsible for motor function control of both muscular layers. At baseline, the esophagus

is in a contractile state mediated by excitatory cholinergic neurons. During deglutition, activation of inhibitory neurons and the resultant release of transmitters such as nitric oxide and vasoactive intestinal peptide lead to relaxation of both the lower esophageal sphincter and the esophageal body. Normal peristalsis then follows when coordinated actions of the inhibitory and excitatory neurons lead to sequential contraction and relaxation of the esophageal body smooth muscle, progressing aborally toward the lower esophageal sphincter. This is facilitated by a neural gradient of increasing inhibitory ganglionic neurons when progressing distally to the lower esophageal sphincter [9]. Thus, the inhibitory innervation generally controls the relaxation of the lower esophageal sphincter and the peristaltic pattern of the esophageal body during a normal swallow, while the excitatory innervation is primarily responsible for the basal tone of the lower esophageal sphincter and the contractile force of esophageal body smooth muscles. Spastic disorders may, therefore, result from disturbances in the inhibitory system, excitatory system, or both (Fig. 8.1).

The pathology of DES is thought to be related to impaired inhibition, leading to a reduction in contractile latency and inappropriate premature contraction of the distal esophagus [8]. Prior research has shown a dose-dependent elongation of the latency period after swallowing, decrease in mean duration of contractions, and alleviation of clinical symptoms in DES patients following infusion of glyceryl trinitrate, which may enhance the nitric oxide-mediated inhibitory drive [10]. In a study of healthy, asymptomatic patients, administration of recombinant human hemoglobin, a nitric oxide scavenger, precipitated esophageal spasm, characterized

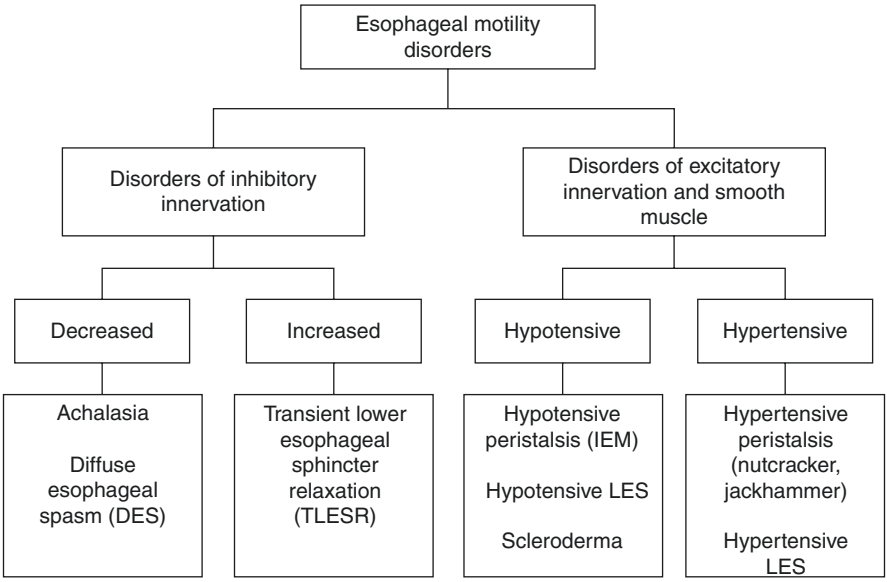

Fig. 8.1 Esophageal motility disorders

by increased velocity of peristaltic contraction and spontaneous, simultaneous high-pressure contractions, in eight out of nine subjects [11].

In contrast, the pathology in jackhammer esophagus is felt to be due to increased excitatory cholinergic drive, resulting in myocyte hypertrophy and amplified contractions [1]. The administration of an acetylcholinesterase inhibitor (edrophonium) has been shown to induce an increase in circular and longitudinal muscle contraction amplitude, duration, and asynchrony during peristalsis, whereas administration of an acetylcholine receptor antagonist (atropine) reversed those same effects in a dose-dependent manner [12, 13]. Other studies have postulated that an obstructive physiology at the esophagogastric junction (EGJ) may also yield a compensatory esophageal hypercontractility [14, 15].

Clinical Presentation

Distal Esophageal Spasm

The predominant symptoms of DES are dysphagia and chest pain. Dysphagia can be from solid or liquid ingestion and may be accompanied by regurgitation, heartburn, odynophagia, as well as intermittent retention of swallowed bolus that may be relieved by emesis. Notably, patients' ability to localize the site of their bolus retention to the distal esophagus is notoriously inaccurate, with a success rate of only 60% [1]. Esophageal chest pain may be similar in quality and location to cardiac angina, often characterized by a crushing pressure radiating to the shoulder, jaw, or back. DES patients with chest pain may have higher distal esophageal contraction amplitudes compared to DES patients who experience primarily dysphagia or regurgitation [16]. Regardless, a high level of suspicion should be employed in patients with other risk factors for cardiovascular disease, which must be ruled out. Furthermore, because esophageal motility disorders (and especially spastic disorders) are rare compared to other etiologies of dysphagia, it is important to consider a broad differential including more commonly seen anatomic, inflammatory, infectious, neoplastic, and iatrogenic causes of dysphagia. Other esophageal diseases which can lead to dysphagia, such as gastroesophageal reflux disease (GERD), may also coexist with spastic disorders. In a study of 108 patients with DES, 41 (34%) had pathologic acid reflux diagnosed on pH testing or endoscopy [17]. In fact, GERD is also considered a possible etiologic contributor to DES. Epiphrenic diverticula may also occur as a consequence of spastic esophageal disorders, particularly in those with an underlying connection tissue disorder – in a series of 21 cases of epiphrenic diverticulosis, DES was found in 24%, nutcracker esophagus in 24%, and achalasia in 9% of patients [18].

Jackhammer Esophagus

Similar to DES, the most common presenting symptoms of hypercontractile esophagus are also dysphagia and chest discomfort. In a recent European cohort study of 34 patients with jackhammer esophagus, 23 patients (67.6%) suffered from dysphagia, and 16 patients (47.1%) reported having chest pain [19]. It has been suggested that bolus transit is less affected because the distal latency is preserved in a jackhammer pattern; however, the natural history of hypercontractile esophagus remains unknown.

Diagnosis

Upper Endoscopy

The evaluation of esophageal dysphagia often starts with an upper endoscopy to exclude structural causes including mechanical obstruction, stricture, ring, and esophagitis. In addition, endoscopy offers the ability to obtain multiple biopsies to rule out eosinophilic esophagitis in otherwise normal-appearing mucosa [20]. While no specific endoscopic findings are diagnostic of esophageal spastic disorders, the presence of epiphrenic diverticulosis should raise clinical suspicion. Abnormal and disorderly esophageal contractions may also be seen during endoscopy, although these findings are neither sensitive nor specific.

Esophageal Manometry

HRM with esophageal pressure topography has largely replaced conventional manometry in recent years, and measurements of integrated relaxation pressure (IRP), DL, and DCI form the very basis of categorization used to define esophageal motility disorders, making manometry indispensable in the diagnosis of spastic esophageal diseases. Under the most updated version of CC, DES and jackhammer esophagus are diagnosed based on the proportion of test swallows on HRM that are premature (short DL <4.5 sec) or hypercontractile (high DCI >8000 mmHg.s.cm), respectively, with ≥20% being the cutoff for both conditions (Fig. 8.2). More recently, other novel metrics have emerged that may further improve the interpretation of DCI to better characterize spastic disorders. One such technique separates the pre- and postpeak phases of the

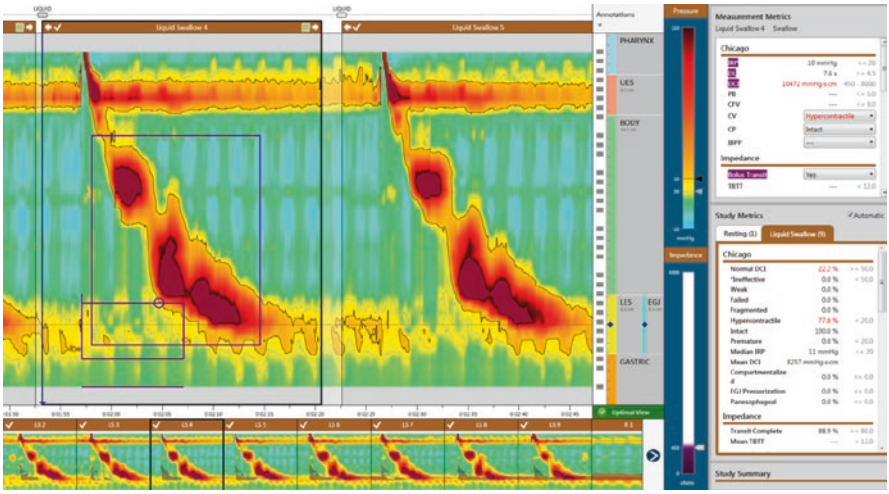

Fig. 8.2 Diagnosis of DES and jackhammer esophagus (Chicago Classification)

contractile pressure wave. The traditional DCI measurement appears to have a greater contribution from postpeak contractile activity in a study of 71 healthy subjects [21]. When asymptomatic controls were compared to 38 patients with jackhammer esophagus, those with jackhammer had greater contractile integral in both phases, as well as a higher postpeak to prepeak ratio. In addition, there was a correlation between this ratio and dysphagia symptom scores, suggesting that postpeak contractile integral (and abnormality in the postpeak phase of peristalsis) may play a greater role in dysphagia severity among patients with jackhammer esophagus [22].

Barium Swallow

Barium esophagram is often used as an adjunct to endoscopy and manometry, providing valuable information regarding peristalsis, esophageal sphincters function, and bolus transit and clearance through the EGJ [1]. The study is best performed in the prone position to obviate any contribution from gravity to esophageal clearance. However, in a study of 100 patients with complaints of esophageal symptoms who were evaluated by barium swallow and gold standard HRM, barium esophagram had a sensitivity of only 77% and specificity of 35% for detecting non-achalasia esophageal dysmotility, thereby limiting its role as a stand-alone test for spastic motility disorders [23].

The classic finding of corkscrew or rosary bead appearance on barium swallow (Fig. 8.3), corresponding to the simultaneous smooth muscle contractions of DES, is also rare. In 1 study of 14 patients with DES diagnosed on barium study

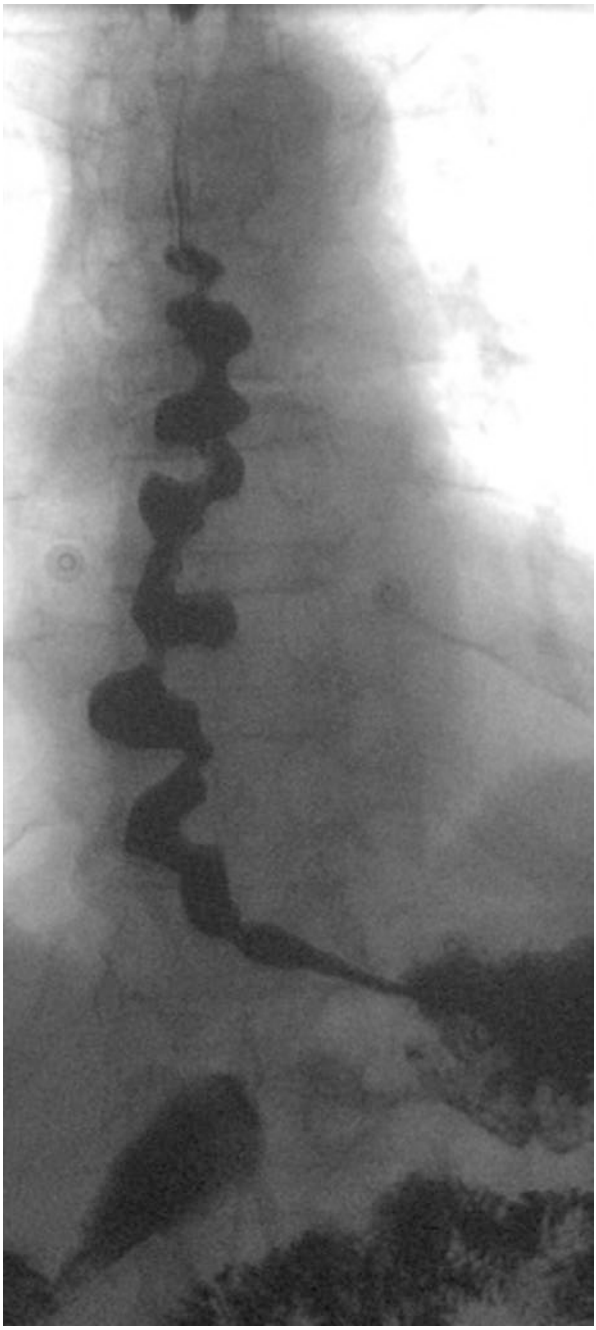

Fig. 8.3 Classic finding of corkscrew or rosary bead appearance on barium swallow

and confirmed by HRM, only 2 patients had a corkscrew appearance, whereas the rest demonstrated nonperistaltic contractions that did not fully obliterate the lumen [24]. Another study of 108 DES patients, of which 76 had esophagrams, noted 46 patients (61%) with abnormal peristalsis, although only 3 (4%) exhibited a corkscrew appearance [17]. Similarly, jackhammer esophagus may be associated with both normal and nonspecific barium swallow findings, including uncoordinated primary peristalsis and tertiary contractions [25].

Computed Tomography (CT) Scan and Endoscopic Ultrasound (EUS)

Spastic disorders may be associated with esophageal wall thickening which can be detected on cross-sectional CT imaging. In a series of 33 patients with evidence of DES on barium swallow, 7 (21%) were found to have esophageal muscle thickening on CT, up to 11.9 mm just proximal to the gastroesophageal junction, whereas normal thickness typically does not exceed 3 mm [26]. This thickening is more likely to be smooth and circumferential as opposed to nodular and asymmetric, which may raise the possibility of tumor involvement. EUS is another imaging modality which can quantify esophageal thickening as well as identify any intramural or extrinsically compressing masses that could lead to abnormal contraction.

Intraluminal Impedance Measurement

Multichannel intraluminal impedance measurement allows for an evaluation of bolus transit without subjecting patients to the radiation exposure intrinsic to barium esophagrams, with 97% concordance with videofluoroscopy in determining bolus transit among asymptomatic patients [27]. Among patients with dysphagia, concordance was similarly high for severe barium stasis and incomplete bolus transit (97%) [28]. HRM with concurrent intraluminal impedance measurement has also been employed to assess bolus transit as a function of distal esophageal amplitude, where contractions <30 mmHg corresponded to 85% sensitivity and 66% specificity in identifying incomplete bolus transit [1, 29]. Additional studies are needed to determine how these complementary technologies may be best utilized in further characterizing spastic esophageal disorders.

Functional Lumen Imaging Probe (FLIP)

FLIP utilizes high-resolution impedance planimetry, which measures esophageal wall and EGJ compliance by assessing how distension pressure of the esophagus reacts to volumetric expansion. FLIP offers an adjunctive method, primarily in conjunction with manometry, to objectively evaluate esophageal motility disorders. As FLIP is performed during upper endoscopy, it also minimizes patient discomfort, as it does not require trans-nasal catheter insertion while awake. The primary, and most validated, metric obtained on FLIP is the EGJ-distensibility index (DI), considered abnormal if <2.8 mm^2/mmHg. The newer FLIP topography identifies patterns of esophageal body contractile response to esophageal distention that may correspond to esophageal motility disorders. While repetitive antegrade contractions is the normal esophageal response on FLIP, repetitive retrograde contractions have been associated with spastic esophageal dysmotility. In a recent study of 145 patients with dysphagia, FLIP was able to identify patterns suggestive of dysmotility in 50% of those with normal HRM. In addition, in some patients diagnosed with jackhammer esophagus on HRM, FLIP findings were more indicative of spastic achalasia, highlighting the fact that this method may be particularly useful in cases where a manometric diagnosis is unclear [30, 31].

Treatment

Management Approach

Despite proposed differences in the pathophysiology underlying each spastic disorder, the management approach to both DES and hypercontractile esophagus is similar. Initially, an assessment for and treatment of GERD should be undertaken – not only because GERD is a common culprit of dysphagia as well as chest pain and has significant symptom overlap with spastic esophageal disease but also because GERD itself may induce or worsen esophageal dysmotility. Appropriate treatment of reflux may, therefore, reduce esophageal symptoms related to dysmotility. Moreover, many medications used to treat spasticity are smooth muscle relaxants, which may worsen any underlying reflux that may be present. In fact, prior studies have found GERD to be significantly more common than primary esophageal motility disorders in noncardiac chest pain. Treatment targeting esophageal spasm without first ruling out or controlling underlying GERD may worsen the patients' symptoms.

In patients with no pathologic acid reflux or well-controlled GERD, primary efforts should be focused on symptom relief of dysphagia and noncardiac chest pain. In the following discussion of the pharmacotherapeutic, endoscopic, and surgical modalities of treatment of spastic esophageal disorders, much of the experience is anecdotal, and more large, prospective, randomized, controlled trials (Table 8.1) are needed to further validate the value of these therapies.

Table 8.1 Trials of treatment therapies for spastic esophageal disorders

Therapy	Intervention (alternative intervention for clinical use)	Study design	Study size (N)	Level of evidence
Pharmacologic				
Smooth muscle relaxants				
Peppermint oil	Five drops in 10 mL of water (2 Altoid mints sublingually qac)	Case series	8	4 [32]
Calcium channel blockers	Diltiazem 60–90 mg qid (Nifedipine 10 mg qac)	Double-blind crossover, per protocol analysis	14	1D [33]
Nitrates	IV glyceryl trinitrate 100–200mcg/kg/h (sublingual nitroglycerin, isosorbide dinitrate 10 mg during or after meals)	Case series	5	4 [10]
Neuromodulators				
Tricyclic antidepressants	Imipramine 50 mg qhs vs clonidine 0.1 mg bid vs placebo bid (nortriptyline/amitriptyline 10–25 mg qhs)	Double-blind, placebo-controlled crossover	60	1C [34]
Trazodone	Trazodone 100–150 mg daily vs placebo	Double-blind, placebo-controlled	29	3 [35]
Selective serotonin reuptake inhibitors	IV citalopram 20 mg (fluoxetine 10–20 mg/day, paroxetine 10–20 mg/day, sertraline 25–50 mg/day)	Double-blind crossover	10	3 [36]
Phosphodiesterase-5 inhibitors	Sildenafil 50 mg vs placebo	Double-blind, placebo-controlled	17	1D [37]
Theophylline	Theophylline SR 200 mg bid vs placebo	Double-blind, placebo-controlled	25	1D [38]
Endoscopic				
Botulinum toxin injection	Botulinum toxin injection 8 × 12.5 U vs saline 8 × 0.5 mL in 4 quadrants at 2 and 7 cm above EGJ	Double-blind, placebo-controlled crossover	22	1D [39]

Table 8.1 (continued)

Therapy	Intervention (alternative intervention for clinical use)	Study design	Study size (N)	Level of evidence
Esophageal dilation	Mercury bougienage 54Fr therapeutic vs 24Fr placebo (pneumatic dilation)	Double-blind, placebo-controlled crossover	8	1D [40]
Peroral endoscopic myotomy	Peroral endoscopic myotomy	Systematic review, meta-analysis	179	1A [41]
Surgical				
Heller myotomy	Extended myotomy (14 cm in esophagus, 2 cm below EGJ) with anterior fundoplication	Case series	20	4 [42]
Adjunctive				
Biofeedback	Sipping while viewing motility tracings, double swallows	Case report	1	5 [43]

Abbreviations: *qac* before each meal, *qid* four times daily, IV intravenous, *qhs* before bedtime, *bid* twice daily, *EGJ* esophagogastric junction

Pharmacotherapy

Current medical therapies for spastic disorders of the esophagus can be divided into two main categories based on treatment targets, namely, the abnormal motor function and the sensitivity of the esophagus. Smooth muscle relaxants decrease the amplitude and restore the peristaltic pattern of esophageal smooth muscle contractions, while neuromodulators aim to reduce the afferent input and hypersensitivity of the esophagus to control symptoms.

Smooth Muscle Relaxants

Peppermint oil has been shown to act as a smooth muscle relaxant in the gastrointestinal tract of animal models and has had some success in the treatment of colonic spasm, dyspepsia, and irritable bowel syndrome [44–47]. In a series of eight patients with DES, peppermint oil, administered as five drops in 10 mL of water, completely eliminated simultaneous esophageal contractions in all patients with decreased variability of amplitude and duration of contractions, although chest pain was relieved in only two patients [32].

Other dedicated smooth muscle relaxants, such as calcium channel blockers and nitrates, aim to decrease esophageal body contraction amplitude as well as LES pressure. In a small randomized, double-blind, crossover prospective trial of 14 patients with high-amplitude esophageal contractions, diltiazem was found to have

a positive impact on chest pain symptoms as well as peristaltic pressure on manometry compared to placebo [33]. Effective doses have been suggested in the range of diltiazem 60–90 mg four times daily and nifedipine 10 mg given 30 minutes prior to meals. Nitrates were shown to significantly decrease the mean duration of esophageal contractions and alleviate symptoms during swallows in a small case series of five DES patients with no reported adverse side effects of headache, flushing, or hypotension [10]. No controlled trials on the effect of nitrates on DES or jackhammer esophagus have been conducted to date.

An alternative to nitrates is phosphodiesterase-5 inhibitor, which blocks the degradation of nitric oxide, thereby prolonging smooth muscle relaxation in symptomatic DES and jackhammer esophagus [9]. Sildenafil, a commonly used phosphodiesterase-5 inhibitor, was found to lower LES pressure and contraction amplitudes in a randomized double-blind study of 6 healthy subjects and 11 patients with hypercontractile esophagus [37]. In a case report of two patients with refractory DES, sildenafil 25–50 mg twice daily relieved dysphagia and chest pain and suppressed esophageal contraction completely for liquid swallows and reduced frequency of spasm for solid swallows [48]. Limitations include side effects of headache and dizziness as well as lack of insurance coverage for a medication which is mainly approved for erectile dysfunction [9].

Neuromodulators

Patients with chest pain refractory to calcium channel blockers or nitrates may benefit from neuromodulators which primarily target a reduction in visceral hypersensitivity rather than an improvement in the underlying esophageal motility. Low-dose tricyclic antidepressants (TCA) have been the best studied neuromodulators thus far. Imipramine 50 mg at nighttime was shown in a randomized, double-blind, placebo-controlled trial of 60 patients with normal coronary angiograms to significantly reduce chest pain [34]. Other commonly used TCA include amitriptyline and nortriptyline, starting at doses of 10–25 mg with escalation to 50–75 mg over weeks to months with minimal mood-altering effect [49]. Due to the variable effect of tricyclics on respective acetylcholine, histamine, and adrenergic receptors, failure of one drug in this class to modulate pain is not necessarily predictive of future failure with another TCA. Possible side effects of TCA should be discussed with patients including drowsiness (therefore medication is optimally taken at bedtime), orthostatic hypotension, constipation, dry mouth, urinary retention, and blurred vision due to its anticholinergic effect. If improvement is achieved with TCA, the medication should be continued for 6–12 months before initiating a slow taper to the lowest effective dose for symptom control. The anxiolytic, trazodone, has also been shown in a double-blind, placebo-controlled trial of 29 patients to improve the sense of global well-being as well as distress over esophageal symptoms. However, both the placebo and trazodone (100–150 mg) groups reported significant reduction in chest pain, highlighting the importance of reassurance and multidisciplinary anxiety and hypervigilance-reducing strategies in this population [1, 35]. Selective

serotonin reuptake inhibitors (SSRI) have a more targeted pharmacologic effect than TCA [50]. Intravenous citalopram 20 mg was investigated in a double-blind, crossover study of ten healthy volunteers and found to increase the threshold of first perception as well as discomfort related to both mechanical balloon distention and chemical acid perfusion in the esophagus [36]. Recommended initial doses of SSRIs include fluoxetine 10–20 mg/day, paroxetine 10–20 mg/day, and sertraline 25–50 mg/day [50]. Due to their selective 5-HT activity, SSRIs are typically better tolerated than TCAs, although nausea, vomiting, diarrhea, and stomach upset may occur [51].

Theophylline also acts both as a smooth muscle relaxant and a visceral analgesic by blocking adenosine receptors [52]. Following an open-label pilot study, a subsequent randomized placebo-controlled study of 25 patients with esophageal chest pain found that theophylline 200 mg twice daily improved chest pain in 58% of patients compared to 6% in the placebo group [38, 53].

Endoscopic Therapy

Patients with spastic esophageal disorders who are refractory to pharmacologic therapies may be candidates for endoscopic treatment, including botulinum toxin injection. While primarily studied and utilized in the treatment of achalasia, botulinum toxin injection has demonstrated some symptomatic benefits in non-achalasia spastic motility disorders as well when delivered to multiple levels of the esophageal body (2 and 7 cm above LES). A smaller study of 13 patients reported symptomatic improvement of DES and jackhammer esophagus at 2 months and, to a lesser extent, at 6 months [54]. In a prospective, randomized crossover trial of 22 patients with DES or nutcracker esophagus, botulinum toxin resulted in a 50% response rate at 1 month compared to 10% in placebo saline injection [39].

Esophageal dilation has been suggested in spastic esophageal disorders; however, the rationale and evidence are lacking. In a prospective, double-blind, crossover trial of eight patients with nutcracker esophagus, there were no significant differences in chest pain, dysphagia, LES pressure, or contraction amplitude between placebo dilation with a 24Fr bougie compared to therapeutic dilation with a 54Fr bougie [55]. In a case series of nine patients who were refractory to medical and bougienage dilation, pneumatic dilation produced improvement in dysphagia and regurgitation in eight patients over 37.4 months with associated LES pressure reduction. However, there are no controlled trials to date for this therapy, and the risk of perforation (up to 5% in achalasia patients) may outweigh the benefit [40]. Moreover, it is unclear whether patients who had symptomatic improvement from pneumatic dilation would be more appropriately classified as having spastic achalasia, highlighting the importance (and difficulty) of manometric diagnostic accuracy [9].

Over the past decade, peroral endoscopic myotomy (POEM) has become a promising alternative to surgery by accessing the circular muscle layer at the LES via a submucosal tunnel. While the majority of studies have been dedicated to the treat-

ment of achalasia, a systematic review and meta-analysis of 8 observational studies comprising 179 patients with spastic disorders including 18 patients with DES and 37 with jackhammer esophagus found success rates of 88 and 72%, respectively [41]. More recently, an international multicenter study of POEM in non-achalasia esophageal motility disorders, including 17 DES, 18 jackhammer esophagus, and 15 EGJ outflow obstruction patterns, reported clinical success in 85% of DES and jackhammer patients and 93% of EGJOO patients. Challenges unique to performing POEM in DES include hyperactive spastic contractions complicating the creation of the submucosal tunnel, need for greater length of the myotomy, extended procedure duration, and increased postoperative pain and hospital length of stay [56]. At present, there are no randomized controlled trials comparing POEM to other therapeutic modalities and no longitudinal studies of POEM for spastic disorders.

Surgery

Heller myotomy involves a surgical, rather than endoscopic, incision of the circular muscle layer of the LES and is often accompanied by a partial or full fundoplication as a preventative measure against postsurgical reflux. As with POEM, longer myotomies tend to be performed for DES compared to achalasia, the extent of which is often guided by manometry [9]. In a prospective study evaluating 20 patients with extended myotomy (14 cm in the esophagus and 2 cm below the EGJ) and anterior fundoplication for DES, dysphagia and chest pain were improved in 100 and 90%, respectively, over 50 months of follow-up [42]. There is sparse data available regarding surgical myotomy in jackhammer esophagus. Notably, in both POEM and surgical myotomy techniques, the disruption of the LES alone does not fully address the underlying reduced latency or hypercontractile pathophysiology of DES and jackhammer esophagus, respectively, and should be considered in the overall management of these disorders [25].

Adjunctive Therapy

Biofeedback, consisting of sipping water while viewing a corresponding motility tracing and double swallowing with and without visual feedback, has been shown in a single case study of DES to reduce anxiety regarding esophageal symptoms [43]. Biofeedback using diaphragmatic breathing led to symptom reduction in five of nine patients with functional esophageal chest pain, but not in functional heartburn [57]. Cognitive behavioral therapy (CBT) has also been used for management of noncardiac chest pain. A small randomized, controlled study revealed significant reduction in chest pain, disruption of daily life, autonomic symptoms, as well as psychological morbidity in patients who underwent CBT compared to conventional treatment [52, 58]. To date, no studies evaluating the role of CBT in spastic disorders have yet to be conducted.

Prognosis

The overall prognosis for patients suffering from DES and hypercontractile esophagus is good, with no known increased risk for esophageal malignancy or mortality. Although the above treatments may not always be effective, spastic esophageal conditions typically have a benign course and may even improve with time. A longitudinal study encompassing 3–10 years following the initial manometry diagnosis of 137 patients with DES, nutcracker esophagus, and hypocontractile esophagus revealed that symptoms of dysphagia and chest pain in all three conditions improved significantly over time [59]. In rare cases, patients with DES may progress to develop achalasia, although there are no known manometric or clinical predictors [60].

Conclusion

The spastic esophageal disorders, encompassing distal esophageal spasm, jackhammer esophagus, and spastic achalasia, have evolved in definition over time with the advent of high-resolution manometry and esophageal pressure topography. Although often classified together due to a similarity in clinical presentation characterized by dysphagia and chest pain, their underlying pathophysiology suggests fundamental differences as disorders of decreased inhibitory versus increased excitatory innervation. Emerging technologies such as impedance planimetry and novel manometric parameters complement traditional diagnostic modalities such as endoscopy and contrast radiography, with the hope of clarifying the clinical and physiological distinctions among these spastic disorders. As new techniques such as peroral endoscopic myotomy demonstrate higher success and comparable safety profiles compared to conventional pharmacotherapy or even other endoscopic and surgical therapies, additional longitudinal, randomized controlled studies will be needed to validate the treatment of spastic esophageal disorders.

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