



“Functional approach” to esophageal body diverticula

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Abstract: Esophageal diverticula should be considered as epiphenomena of an esophageal motility disorder, thus a targeted approach should be taken into consideration when a treatment is indicated. Conventional surgical management consists in diverticulectomy or diverticulopexys, associated or not with a myotomy and/or fundoplication on the basis of the underlying motor disorder. A thorough endoscopic evaluation of the diverticulum, associated with a functional assessment of the esophageal motility is mandatory before the treatment. Surgical management of epiphrenic diverticula is often more challenging due to the long operation time and high postoperative complication and mortality rates, and reserved to referral centres. To date, despite the fact that diagnostic workup is now codified, there is not a solid consensus about the management of the diverticula, including the use of routine versus selective myotomy and whether or not a fundoplication should be included. Beyond its classical indications, recently the POEM technique has been applied for the performance of an endoscopic diverticulectomy by mean the submucosal myotomy of the diverticular septum. No literature data about the comparison between these different approaches are reported, so we reviewed literature data about the treatment modalities of diverticula of the esophageal body (mid-esophageal and epiphrenic), to highlight how to best address the choice.

Keywords: Esophageal diverticula; diverticulectomy; esophageal motor disorder; esophageal manometry; myotomy; fundoplication; per-oral endoscopic myotomy (POEM)

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Introduction

Esophageal diverticula represent a rare entity, often asymptomatic, accidentally diagnosed endoscopically or radiologically. When symptomatic, patients typically report dysphagia and/or food regurgitation, especially those affected by achalasia or distal esophageal spasm, but weight loss, chest pain, halitosis, and aspiration are also common complaints (1).

According to published data, an underlying esophageal motility disorder is found in 45% to 100% of patients undergoing a functional study, and the new high-resolution manometry could increase this diagnostic yield due to the

intermittent nature of some motility disorders (2).

The presence of symptoms represents another main indication to treatment (3). These symptoms are mainly related to the motility disorder responsible for the development of the diverticulum, and the possible food retention within the larger diverticular sac (4).

Ultimately, when symptomatic, the treatment of an esophageal body diverticulum must be fundamentally tailored on two main parameters (*Figure 1*): the size of the diverticulum (often the largest diverticula are the site of food retention with subsequent regurgitation and/or inhalation) and the underlying motor disorder (achalasia,

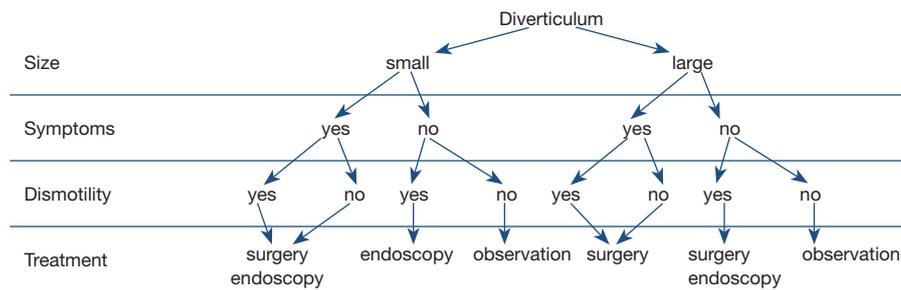


Figure 1 Hierarchical analysis for management of esophageal body diverticula.

Table 1 Suggested preoperative workup for treatment of esophageal body diverticula

Evaluation pathway	Putative findings
Clinical	<ul style="list-style-type: none"> Eckardt Score for symptoms (5)
Upper GI endoscopy	<ul style="list-style-type: none"> Neoplasms exclusion in dysphagia Concomitants organic feature
Barium swallow	<ul style="list-style-type: none"> Size Morphology Location
CT scan	<ul style="list-style-type: none"> Relation with other mediastinal structures
High resolution manometry	<ul style="list-style-type: none"> Motor disorders confirmation
24h esophageal pH-impedance	<ul style="list-style-type: none"> Presence of reflux
Risk assessment	<ul style="list-style-type: none"> ASA score Fitness for surgery

GI, gastrointestinal.

distal spasm, jackhammer esophagus, and/or reflux) which affects patient symptoms and could potentially lead a progression in size of the diverticulum itself.

Before the treatment we anyhow suggest to adopt a path that must clarify all the essential aspect to plan the most correct treatment for each individual patient (Table 1).

Surgical approach

Conventional surgical management consists in diverticulectomy or diverticulopexys, associated or not with a myotomy and/or fundoplication on the basis of the underlying motor disorder; it is associated with good long-term outcomes, although the need for general anaesthesia and the morbidity associated with surgery limits its usefulness, also considering the prevalence among the elderly (6). In particular, surgical management of epiphrenic diverticula

is often more challenging due to the long operation time and high postoperative complication and mortality rates, one meta-analysis showing the rate of complications for epiphrenic diverticula after surgery was 21% (7,8).

There are several controversies in the management of esophageal diverticula, first of all the indication for surgery. Although symptoms are considered by most the main indication (9,10), treating patient presenting with minimal to no symptoms remains questionable, as well as treating large diverticula with associated motor disorders in asymptomatic patients.

Asymptomatic patients or those with minimal complaints and small diverticula need close observation for the development of symptoms, especially patients who are at high surgical risk.

There are significant variations in thoracic esophageal diverticula treatment procedures. A myotomy is typically

done in patients in whom a small diverticulum is not resected, as the pouch will retract if the cause of the increased intraluminal pressure is alleviated (11). The use of routine versus selective myotomy represents another point of the eternal debate. The identifiable esophageal motor disorders in this patient population range from 45% to 100% in the reported rates (2). This significant variation may be partially related both to the suspected intermittent nature of some motility disorders and to the varying technical success of passing the manometry probe. Mechanical or functional obstruction alone or in combination may also cause increased intraluminal pressure and subsequent diverticulum formation (12).

Another controversy is about the distal extent of the performed myotomy. Independently of whether or not an underlying motility disorder is identified, a cardiomyotomy (a long myotomy with extension onto the stomach) is considered by some to be important for complete relief of distal obstruction (13). However, others prefer a more tailored myotomy, basing the distal extent according to the preoperative manometry outcome (9). There is not sufficient data to determine which myotomy is superior. Esophagoscopy, esophagogram and manometry characterize motility abnormalities and influence the management. For example, findings suggestive of achalasia would prompt a laparoscopic approach with distal myotomy that extends past the gastroesophageal junction, and construction of partial fundoplication; the use of video-assisted thoracoscopic surgery (VATS) can then be considered for resection of large diverticula. Patients with normal manometry and esophagoscopy are eligible for diverticulectomy alone, as in case of traction diverticula. In case of convincing evidence of normal motility and LES function with only a mechanical obstruction (i.e., obstruction hiatal hernia of previous fundoplication), diverticulectomy and relief of the distal obstruction without myotomy is performed.

Another discussed topic is if fundoplication should be included in the surgical treatment. Thomas and associates noted no difference in leak rates after myotomy with or without fundoplication (7% *vs.* 8%), but they did report a higher rate of postoperative heartburn when a fundoplication was not performed (16% *vs.* 9%) (14).

According with Belsey, in patients with achalasia, a partial fundoplication should be fashioned in order to minimize iatrogenic reflux (15). The type of fundoplication is dependent on surgical choice. In patients with impaired motility, a partial fundoplication is better in order to reduce obstructive symptoms; while a complete fundoplication is a

better choice in those patients where a large hiatal defect is diagnosed.

Endoscopic transoral approach

As just said, the surgical approach historically represents the main option for patients with esophageal body diverticula. However, surgery carries the extensive invasiveness and risk of adverse events not always justifiable for the treatment of a disease that remains benign and functional-based. Other challenges are represented by the esophageal anatomy and mediastinal site, hence, a more minimally invasive endoscopic treatment that avoids surgery could be preferred in some cases.

Per-oral endoscopic myotomy (POEM) is a recently-developed endoscopic approach to perform a submucosal myotomy of the circular esophageal muscle layer and of the cardia to improve symptoms in patients affected by achalasia. Its feasibility, safety and efficacy has been demonstrated (16), so this approach recently overcomes his original indications and has been recently applied to treat esophageal diverticula by mean a diverticulectomy with associated esophageal myotomy (17).

Two variants of the procedure have been performed in this setting, the salvage POEM (S-POEM), where the diverticulum is left intact and only myotomy of the LES is performed, and the diverticular POEM (D-POEM), in which a diverticulectomy is performed, with a variable extension of the myotomy. To date there is not an exact indication about when to use the former rather than the latter, although it could be intuitive that patients with esophageal diverticula and motor abnormalities could benefit from S-POEM, while those without motor abnormalities, in which the diverticulum is thought to be the only cause of symptoms, a diverticulectomy would be necessary.

The first case report of a successful treatment of epiphrenic diverticulum by S-POEM dates back to 2015, performed on a patient with no findings of a primary motility disorder at high resolution manometry; a longitudinal endoscopic myotomy on the opposite side to the diverticulum was conducted from the oral to the gastric side and a thick muscle layer, including the LES, was completely dissected (17).

After that, case series on patients with esophageal diverticula and motor abnormalities have been described, all with technical and clinical success (18-21). All 26 cases of patients with epiphrenic diverticula treated S-POEM

are described; 25 of them underwent a complete high resolution manometry study, demonstrating achalasia in 13, esophagogastric junction outflow obstruction in 2, spastic motility disorder without propagating peristalsis in 1, jackhammer esophagus in 6, distal esophageal spasm in 3. In one patient, it was impossible to pass the tip of the catheter through the LES, so achalasia was diagnosed based on symptoms, endoscopy and partial manometric data. All the patients experienced significant symptom improvement, although only 7 were followed up for 24 months (20). Concerning safety, adverse events were reported in 5 patients (19.2%): 4 patients developed pneumoperitoneum which required needle decompression (21,22) and 1 patient developed subcutaneous emphysema (22), but no fatal adverse events occurred.

D-POEM consists in the complete cut of the diverticula septum to improve the emptying of the diverticulum into the esophageal lumen, avoiding food retention. Septotomy is performed through POEM technique, creating a submucosal tunnelling which enables the complete exposure and division of the septum. The myotomy can be extended 2–3 cm beyond the gastroesophageal junction for a complete division of the LES. The first two cases described, were patients with giant midesophageal diverticula presenting dysphagia; D-POEM was performed with very satisfying short-term outcomes (23). Since that, other reports have been published, showing a clinical success ranging between 86–100%, with a significant improvement of symptoms in the medium-term (5 and 12 months) (4,24).

The feasibility, safety, and the efficacy of the D-POEM was recently confirmed by a meta-analysis that showed a technical success of 95%, an incidence of adverse events of 6%, and a mean post-procedure symptom score significantly lower when compared to pre-procedure score (6).

Patient selection with a pre-operative high resolution manometry study of the patients seems to be an important tool for a tailored approach and for optimizing functional outcomes after POEM; for example, in the case series from Orlandini and colleagues, patients with esophageal motility disorders and esophageal diverticula, an S-POEM extending the myotomy to the LES achieved good clinical outcomes with a resolution of symptoms at the 6/8-month follow-up; while in the absence of esophageal motility disorder, a favourable clinical outcome was achieved with POEM performed without including the LES in the myotomy (22).

Moreover, special attention to some manometric profiles, such as jackhammer esophagus or type II and III achalasia, should be given: residual contractions due to uncut fibres,

associated to anatomical vulnerability of the distal wall of the esophagus can predispose to a post-POEM iatrogenic diverticular dilation (17,25,26). In this case, a long myotomy targeting the esophageal body contraction as well, or a posterior endoscopic myotomy may prevent post-POEM diverticulum formation (26).

Conclusions

Surgical treatment of esophageal diverticula has significantly changed with the development of minimally invasive methods which have increasingly replaced open surgery. Recently, the transoral endoscopic approach is gaining more and more ground in the field of esophageal treatment of functional disorders. To date, there are no randomized trials in this field comparing surgery with endoscopy, including clinical efficacy and esophageal motility outcomes in large scale and long period of follow-up. Meantime, the availability of different approaches can help us to tailor the treatment on every single patient in the near future.

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