Pulsion Diverticulum of the Oesophagus: More than just an Out Pouch

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Abstract Oesophageal diverticulum is divided into two types based on the aetiology: the pulsion and the traction diverticula. Pulsion diverticulum occurs due to increased intraluminal pressure. This can be of three types based on the location along the oesophagus: the Zenker's diverticulum (ZD), the mid-oesophageal diverticulum (MD) and the epiphrenic diverticulum (ED). A PubMed search was conducted for the words 'pulsion', 'diverticulum' and 'oesophagus' for all studies published from January 1980 to March 2013 in the English language. A total of 31 studies were identified, and out of which, five were not included in the review. The pulsion diverticulum of the oesophagus is an uncommon disorder. Its aetiology is related to the motility disorders of the oesophagus. Patients usually present with chest-related symptoms or oesophageal symptoms, which are related to the underlying motility disorder. Evaluation includes barium studies, gastrointestinal endoscopy, CT scan and oesophageal manometry. Surgery is the treatment of choice for symptomatic and large diverticula, although the outcome in asymptomatic patients is unknown. The surgical options include diverticulectomy or diverticulopexy with an adequate myotomy. Most patients with ZD are now treated by using endoscopic techniques, although no randomised trial has shown its superiority over the open technique. Minimally invasive surgery has also been used for patients with MD and ED. Although isolated case series has shown good improvement in symptoms and reduction in mortality with minimally invasive techniques in patients with ED, its role in thoracic oesophageal diverticulum is debated.

Keywords Pulsion · Diverticulum · Oesophagus · Zenker · Epiphrenic

Introduction

Oesophageal diverticulum can be divided into two types: the pulsion and the traction diverticulum. The pulsion diverticulum is a false diverticulum that does not have a muscle coat. This can be pharyngo-oesophageal/Zenker's diverticulum (ZD) when located just above the upper oesophageal sphincter (UES) or the epiphrenic (ED), when located above the lower oesophageal sphincter (LES). The diverticulum is considered to be epiphrenic if its location is within 10 cm from the gastro-oesophageal junction. However, no such anatomic boundary is proposed for ZD, which occurs at Killian's dehiscence. In the absence of a physiological sphincter, diverticulum located in the mid-body of the oesophagus may be pulsion or traction type in nature. The traction diverticulum has all the layers of the oesophageal wall and is a true diverticulum. Mid-oesophageal diverticulum (MD) is also called parabronchial as it is usually located 5–6 cm distal to the tracheal bifurcation [1]. Although earlier thought to be of traction type, recent studies have shown that these are most often pulsion in nature [2–4]. This is because tuberculosis, which is one of the primary causes of traction diverticula, is in decline in the Western world [5]. The most frequent diverticulum identified is the ZD. ED is seen less frequently than ZD [6].

Methodology

A PubMed search was conducted for the words 'pulsion', 'diverticulum' and 'oesophagus' for all studies published from January 1980 to March 2013 in the English language. A total of 31 studies were identified. One study had neither the abstract nor the original article; two studies were animal studies, and one study was in reference to skin tumour. All these five studies were not included in the review. The remaining 26 studies were

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analysed. Most of these were retrospective studies. All studies were reviewed by a single reviewer.

Aetiology

The UES is formed by the inferior pharyngeal constrictors, which has two parts: the upper thyropharyngeus muscle and the lower cricopharyngeus muscle. It is an anatomical sphincter. The LES, on the other hand, is 2–4 cm-long asymmetric high-pressure zone, which is devoid of any circular structure. It is a physiological sphincter. It was first recognised by Mondiere in 1833, who suggested that increased intraluminal pressure caused its formation [7]. This results both from dysmotility of the body wall as well as from altered sphincter pressure.

In ZD, the diagnosis of dysmotility requires evaluation of UES function, which is difficult, because it is short, complex anatomic zone that moves briskly during swallowing. Therefore, pressure measurement equipment must have a very short response time [8]. Hence, the pathophysiology of formation of ZD is not clear. Some have suggested cricopharyngeal ‘achalasia’ or spasm to be the cause, but there are others who oppose this view. Manometric studies performed with water-filled polyethylene tubes have shown that an earlier contraction of the UES with regard to the contraction of the pharynx during swallowing results in the formation of ZD [9]. High-resolution manometry (HRM) yields more accurate pressure measurements in the pharynx. However, till date, there is no study that reports oesophageal function with HRM in patients with ZD. The reduction in cricopharyngeal compliance also appears to play a role. A recent report of a ZD and ED in a patient with cutis laxa, a type of connective tissue disorder, supports the importance of cricopharyngeal compliance [10].

ED, on the other hand, is largely due to the motility disorder of the oesophageal wall [11, 12]. Apparently, normal motility in manometry test in patients with epiphrenic diverticulum might be related to the type of manometric testing used or the intermittent nature of some disorders such as the diffuse oesophageal spasm. Although earlier series used conventional manometry, a recent study has evaluated oesophageal motility with HRM in patients with ED [13]. This involved nine patients, and all of whom had motility disorder. Multiple ED can be found in one fourth of patients [4]. When present, they are either aligned longitudinally or circumferentially along the LES.

In patients with MD, non-specific oesophageal motility disorders are more common [2, 14]. In these patients, the UES and the LES may be normal on manometry [15]. In recent years, these findings have been termed ‘ineffective oesophageal motility,’ which appears to be a primary hypomotility motor disorder [14, 16, 17]. The finding of normal oesophageal motility in a patient with MD may be due to an alternative aetiology secondary to tuberculosis which may be difficult to prove except for the presence of few adherent lymph nodes

during surgery [18]. Interestingly, MD has also been described secondary to alkali ingestion [19].

Clinical Features

It is important to appreciate that symptoms are often a reflection of underlying oesophageal motor disorder rather than the diverticulum itself [20]. ZD is seen predominantly in the elderly and is always solitary, but it is more symptomatic than ED. A ZD can cause localised swelling of the neck or a pressure-like feeling [21]. Dysphagia to solid food is the predominant symptom in patients with more distally situated diverticulum. That associated with ED may be severe and progressive, whereas dysphagia in MD is usually intermittent and not progressive [14]. Chest-related symptoms suggestive of aspiration, though less frequent, are more common in patients with proximal diverticulum.

Investigations

The evaluation of patient with pulsion diverticulum involves understanding of oesophageal anatomy and physiology. The anatomy is evaluated by upper gastrointestinal endoscopy and CT scan. The understanding of oesophageal physiology has improved with the availability of complex manometric studies. Modern solid-state transducers have recording sites at 1-cm interval as compared to old water-perfused catheters with side holes spaced 4 cm apart. These, along with concurrent fluoroscopy, provide a significant insight into the pathogenesis of diverticulum.

Barium study is particularly useful in patients with multiple diverticula to know their position and orientation in the oesophagus. Upper gastrointestinal endoscopy is essential for patients being planned for endoscopic treatment. It helps to diagnose other gastro-oesophageal abnormalities like hiatus hernia or gastroesophageal reflux, which are not infrequent in these patients. A CT scan is more useful in patients with traction diverticulum. It helps to diagnose the mediastinal complications associated with the diverticulum. It is also useful in diagnosing post-operative complications.

However, the key modality for evaluating a patient with diverticulum is manometry. A 24-h ambulatory oesophageal manometry study has better sensitivity and is helpful when the stationary examination is negative. However, passing the manometric probe can be difficult at times, when endoscopic insertion must be tried.

Indications for Treatment

The treatment of oesophageal diverticulum depends upon the presence of symptoms, its position and nature (pulsion or

traction) (Table 1). Diverticula in asymptomatic patients are largely incidental findings. Asymptomatic patients have been followed up to determine outcome; however, these numbers are small [11, 22–26]. Currently, there are insufficient data in the literature to help predict the natural history of asymptomatic patients [5]. In the era of open surgery, complications after surgery were common, and mortality was not infrequent [11]. Hence, it was thought that operation was not warranted in those with minimal symptoms as progression was less likely [20]. However, these recommendations need revision in the era of modern surgical management with better anaesthetic monitoring, better intensive care facilities and minimally invasive surgery.

When evaluating a patient with oesophageal diverticula, the rare possibility of malignant change should be considered. It is critical to assess carefully for pulmonary symptoms. Evidence of aspiration, even in the absence of oesophageal symptoms, is an absolute indication for operative intervention [5]. Chronic diverticular stasis with bacterial overgrowth causes localised inflammation and ulceration and may predispose to haemorrhage or perforation. Transmural inflammation may cause peridiverticular adhesion to adjacent structures, predisposing to fistula and abscess formation. This may lead to life-threatening complications in case of MD [27]. Altorki suggested that all pulsion diverticula of mid-thoracic oesophagus with minimal oesophageal dilatation should be considered for operative management [28]. For ED, a large size

(>5 cm) or a symptomatic diverticulum is an indication for operation [29].

Treatment

The principals of surgery include diverticulectomy or diverticulopexy and an adequate myotomy. Although two stage operations have been described, a single procedure is preferred [30]. Diverticulectomy involves excision of the diverticula. Diverticulopexy involves suturing an inverted diverticulum in the retropharyngeal space to the anterior longitudinal ligament of the cervical spine. This minimises the complication of post-operative leak. However, due to the high rate of recurrence, it is not accepted widely [31]. A small ZD is as well treated by myotomy alone. Diverticulectomy without a myotomy is associated with higher incidence of post-operative leak and persistent and recurrent symptoms [5, 11]. With better detection of oesophageal dysmotility, it may be possible to minimise the myotomy by correlating it with the manometric findings [32]. A fundoplication should be added to ED if there is preoperative evidence of reflux, or the sphincter is destroyed during surgery. ED developing above a diseased sphincter in a diseased oesophagus has been treated by oesophagectomy [33]. Oesophagectomy has also been performed in a patient with MD with a high suspicion of malignancy [34].

Table 1 Patient variables presenting features, success rates and complications of procedures in the different types of oesophageal diverticula

	Zenker's diverticulum	Mid-oesophageal diverticulum	Epiphrenic diverticulum
Demography	Elderly age group; always solitary	Middle age; predominantly solitary	Middle age; predominantly solitary
Presenting features	Symptomatic more often; oesophageal symptoms due to swelling as well as chest symptoms of aspiration	Symptomatic less often; dysphagia which is intermittent and not progressive	Symptomatic less often; severe and progressive dysphagia, if symptomatic
Indication for operation	All diverticula with symptoms of aspiration should be treated.	All pulsion diverticula should be treated.	Large or symptomatic diverticula are an indication for operation.
Procedure	Diverticulopexy, diverticulotomy by rigid or flexible endoscope and diverticulectomy	Open or thoroscopic diverticulectomy	Open or laparoscopic diverticulectomy, myotomy and partial fundoplication
Outcome	Only one comparative series (laser endoscopic diverticulotomy and open diverticulectomy [44]) Swallow test results Normal to near normal outcome for endoscopic procedures in 90 % Normal or near normal outcome for open procedures in 100 %. Only one patient developed aspiration pneumonia, but his treatment modality was not mentioned	Only case reports are available for open group. Minimally invasive surgery (included patients with MD and ED) [18] Morbidity 45 % Mortality 5 % Mean length of stay, 5 days	Open approach [11] Morbidity 33 % Mortality 9.1 % Mean length of stay, 13 days Minimally invasive surgery (included patients with MD and ED) [18] Morbidity 45 % Mortality 5 % Mean length of stay, 5 days
Recurrence of symptoms	Three recurrences in the endoscopic group; none in the open group	Three patients had recurrent symptoms in the minimally invasive series (15 %) [18].	Three patients had recurrent symptoms in the minimally invasive series (15 %) [18].

ZD has been treated by endoscopic or open method. Open method involves incision in the left side of the neck for exposure of the cervical oesophagus, where ZD is located. Endoscopic treatment for ZD has been established through a rigid hypopharyngoscope or a flexible endoscope [35–39]. Endotherapy focuses on releasing the cricopharyngeal spasm by performing a diverticulotomy on the septum by a rigid or a flexible endoscope. Rigid endoscopic methods utilise stapler and CO₂ laser. With a flexible endoscope, dissection is done using needle knife or argon plasma coagulation without stapling. There are no randomised trials comparing the different approaches, and the endoscopist's choice of technique is based upon experience and preference [40].

Minimally invasive surgery has been used in the management of ED and MD. These involve laparoscopic surgery or video-assisted thoracoscopic surgery (VATS) or a combination of two [18]. Right VATS is the preferred approach of choice to the thoracic oesophagus [18]. In these procedures, the diverticulum is dissected free of the surrounding structures and excised with an endostapler. The perfect alignment of the stapler to the longitudinal axis of the oesophagus and the complete resection of the diverticulum is verified by an endoscopy. Additional sutures are placed in the oesophagus according to the surgeon's preference.

Kilic et al. analysed the case series of patients with ED treated by open and laparoscopic surgery [29]. They found only one case of perioperative mortality (1.2 %) which was due to myocardial infarction. There were nine cases of death (6.1 %) in the open series [41]. The leak rates have been high, up to 18 % in open series [11] and 20–23 % in laparoscopic series [18, 42]. Symptom relief appeared to be favourable in patients undergoing minimally invasive surgery, but the follow-up was shorter than that in the open literature [40].

Thoracoscopic treatment has also been performed in patients with MD [18, 34]. However, due to the rarity of disease, the experience is limited.

Although thoracoscopic intervention for malignant diseases of the oesophagus shows a significant lower rate of lung infection, a lower rate of overall complication and a short length of hospital stay [43, 44], this has not been proved convincingly for patients with oesophageal diverticulum. Some authors have suggested that this may be related to the learning curve associated with the procedure [18]. Until there is evidence to prove its superiority, careful selection of the patients for these procedures is of paramount importance.

Conclusion

The pulsion diverticulum of the oesophagus is an uncommon disorder. Its aetiology is related to the motility disorders of the oesophagus. Patients usually present with chest-related symptoms or oesophageal symptoms, which are related to the

underlying motility disorder. Evaluation includes barium studies, gastrointestinal endoscopy, CT scan and oesophageal manometry. Surgery is the treatment of choice for symptomatic and large diverticula, although the outcome in asymptomatic patients is unknown. The surgical options include diverticulectomy or diverticulopexy with an adequate myotomy. Although there is no randomised trial to show its superiority over open methods, ZD is treated in most patients with endoscopic techniques. Minimally invasive surgery has also been used for patients with MD and ED. Few case series have shown reduction in mortality and good improvement in symptom in patients with ED, but with a high rate of post-operative leak. However, no such literature is available for MD due to its rarity. The advantage of minimally invasive surgery in thoracic diverticulum is debated.

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