Introduction

Esophageal diverticula are rare, accounting for <5% of all patients with dysphagia [1]. Most patients are asymptomatic, except for those with diverticula >5 cm [1]. Symptoms are difficult to discern, with motility disorders of the esophagus, but can include dysphagia, regurgitation, chest pain, and aspiration pneumonia [2].

Minimally invasive procedures are becoming popular because of their relatively low risk of adverse events [3]. Submucosal tunneling septotomy by diverticular peroral endoscopic myotomy (D-POEM) is a new technique in which complete septum division can be performed using a submucosal tunneling approach [4]. Recently this technique was used effectively for septotomy in patients with Zenker’s diverticulum (ZD) [5,6]. Direct endoscopic septotomy has been routinely practiced but usually needs repeated sessions to improve the safety and reduce symptom recurrence [7]. D-POEM has the potential advantage of allowing a complete septotomy to be performed in a single session and also reduces recurrence.

We present some technical tricks for the D-POEM technique, along with the 12-month outcomes in patients with symptomatic esophageal diverticula.

Methods

This was a prospective study of patients who had symptomatic esophageal diverticula performed at a tertiary care center from November 2016 to August 2018. The inclusion criterion was age ≥18 years, and severe disease was defined as two or more hospitalizations within 1 year for symptoms related to bronchoaspiration. All eligible patients were offered D-POEM during the tenure of study and were followed up for 1 year (Fig. 1s, see online-only Supplementary material). Symptoms were
scored using a modified Eckardt score [8]. Exclusion criteria were: patients with a recent endoscopy (<3 months) showing evidence of tumor in the esophagus, coagulation abnormalities, decompensated liver disease, anesthesia risk, and refusal to give consent. This study was approved by the Institutional ethics committee and all patients gave informed consent.

Physiological evaluation was performed in all patients to rule out associated motility disorders. All patients underwent barium swallow to assess the size of the diverticulum. A post-procedure esophagogram was done in all patients on postoperative day (POD) 2. Adverse events were graded as per the American Society for Gastrointestinal Endoscopy (ASGE) lexicon [9].

Technical success was defined as completion of all of the steps of D-POEM, with achievement of a complete septotomy. Clinical success was defined as a complete or near-complete resolution of symptoms, without need for repeat intervention at follow-up (modified Eckardt score of <3).

Preoperative management and endoscopic procedure
Patients were admitted 24 hours prior to their procedure and received a liquid diet for a day. They were kept nil per os (NPO) from 12 hours prior to endoscopy. Proton pump inhibitors (PPIs), antiemetics, broad-spectrum antibiotics, and premorbid medications (wherever appropriate) were administered an hour prior to the intervention. All procedures were done by a single endoscopist with extensive experience of submucosal tunneling. General anesthesia with endotracheal intubation was used in all patients and the procedure was performed with the patient in a supine position.

Endoscopic tricks and tips
The mucosal entry was made around 4 cm proximal to the septum, in patients with epiphrenic diverticula as well as those with ZD, using a hybrid knife (ERBE). A transparent cap was attached to the endoscope tip. After submucosal entry, dissection was performed towards the septum. For patients with an epiphrenic diverticulum, undiluted indigo carmine was initially injected transluminally into the proximal margin of the septum.

Fig. 1 Illustration of the diverticular peroral endoscopic myotomy (D-POEM) procedure showing: a a diverticulum alongside the esophageal lumen; b the submucosal incision; c exposure of the diverticulum after submucosal dissection; d septotomy being performed from the base of the diverticulum; e the appearance after complete septotomy; f closure of the mucosal incision with clips. Source: Institute of Advanced Endoscopy.
so that it could be identified in the tunnel. The crucial step was to dissect the septum carefully from all around, anteriorly from the mucosa and laterally from the diverticular/esophageal side, until the septal muscle was exposed right to its base. The septum was then divided right to its base. Hemostasis was achieved using hemostatic forceps. Technical success, which was evident by widening of mouth of the diverticulum and shallowing of the septal height, with free passage of the endoscope through the esophageal lumen, was assessed at the end of the procedure. The mucosal incision was closed using standard hemoclips (Figs. 2s–12s; Video 1). The key steps are illustrated in Fig. 1.

Postoperative care

Parenteral antibiotics were administered for 24 hours after the procedure. On POD 1, all patients were initially kept NPO. In the absence of adverse events, liquid oral intake was then initiated, gradually progressing to a soft diet. On discharge, patients were prescribed an oral PPI for 4 weeks. All patients were assessed clinically and endoscopically after 1, 6, and 12 months.

Statistical analysis

Statistical analyses were performed using SPSS 16.0 statistics software (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were used as appropriate. A P value of <0.05 was considered significant.

Results

This study included 25 patients (18 men [72%]; median age 61 years [range 48–88]) (Table 1). One patient had had a previous endoscopic septotomy for ZD 2 years before enrolment. The median time of hospitalization was 5 days (range 4–10). All but five patients were able to consume liquids at POD 1, eat solid food beginning on POD 2, and were discharged at POD 5.

Five patients (20%) complained of odynophagia and neck pain on POD 1, and therefore feeding was delayed by 24 hours. Four patients (16%) had chest pain and two (8%) had persistent vomiting, which subsided with conservative treatment. The mean (standard deviation [SD]) Eckardt Score improved significantly from baseline 13.2 (1.0) to 3.2 (1.4) at 12 months (P<0.001) (Table 2). Three patients were lost to follow-up at 1 year (Fig. 1s). There were no serious adverse events seen or reported in the perioperative period or during the entire year of follow-up.
Discussion

Using this novel technique (D-POEM), we successfully treated patients with large symptomatic esophageal diverticula. Direct endoscopic septotomy has been practiced with good results in symptomatic patients with a ZD; however, it could not be applied to patients with an epiphrenic diverticulum owing to the fear of serious adverse events, such as leaks and mediastinitis. Simultaneous performance of POEM with submucosal tunneling and endoscopic septotomy was reported in a patient with an epiphrenic diverticulum with underlying achalasia cardia [10]. Direct endoscopic septotomy for ZD can also be associated with a risk of leakage (4.8% of patients) and recurrence (12.8%), along with a procedure abandonment rate of 7.7% [3, 7]. The recurrence rate after direct septotomy has been postulated to be directly proportional to the depth of septal muscle division. Surgical diverticulectomy has been practiced for ZDs, as well as for epiphenic diverticula; however, it can be associated with an increased operative time and increased hospital stay, along with substantial morbidity and mortality [11, 12].

In patients with a ZD, as well as in those with an epiphenic diverticulum, the symptoms are predominantly due to functional obstruction of the esophageal lumen. This is due to the food entering the diverticulum, causing pressure on the septum, which in turn occludes the esophageal lumen. In an epiphenic diverticulum, there can also be an additional component of a non-relaxing lower esophageal sphincter. With the D-POEM technique, because it is a submucosal tunneling approach, the septal muscle can be safely divided right to its base. This not only relieves the esophageal lumen obstruction but, in those with an epiphenic diverticulum, it simultaneously relaxes the lower esophageal sphincter through division of the circular muscle.

The two main difficulties with this technique however are locating the septum submucosally in patients with an epiphenic diverticulum and closure of the mucosa in patients with a ZD. The first problem of locating the septal muscle in an epiphenic diverticulum can be overcome by injecting non-diluted indigo carmine into the septum base before the procedure. This can then be identified within the tunnel as a bluish tinge. In patients with a ZD, mucosal closure can be difficult as the pharyngeal mucosa is usually thin compared with the esophageal mucosa and the edges of the mucosal incision usually separate widely because of the submucosal injection. The lack of working space in the pharynx further adds to the complexity. Therefore, there is a risk of inadequate closure or tearing of the mucosa while performing the closure. Use of a double-mouth clip, especially the type that closes gently without a sudden click, has helped us to overcome this difficulty. In addition, the clips used in Zener’s submucosal tunneling septotomy can contribute to the foreign body sensation, this can be overcome by using clips that have a shorter shaft. There have been six published reports of D-POEM for esophageal diverticula [4, 5, 13 – 16]; however, none of these studies have looked at medium- or long-term follow-up. A systematic review of direct endoscopic septotomy for 813 patients with ZD demonstrated that recurrence rates increased with larger sample size [17]. In comparison, none of our patients who underwent the D-POEM procedure had recurrence over the study period of 1 year. POEM for ZD has been termed Z-POEM, and for epiphrenic diverticulum as E-POEM; however, as the technique for diverticular septotomy using the submucosal tunneling technique remains the same in both cases, it is proposed these should both be termed D-POEM.

This study does have its limitations as the results are from a single center and procedures were done by a single endoscopist. Also, computed tomography scans were not done following D-POEM. Nevertheless, the results of this study suggest good technical and clinical success rates, with no serious adverse events, and promising medium-term results.

D-POEM appears to be a safe procedure for patients who have symptomatic esophageal diverticula. It can be a safer and robust alternative to direct septotomy for ZD and a good non-surgical solution for patients with epiphenic diverticula. Multicenter studies with larger numbers are however needed to further validate our results.

Acknowledgments

We thank Mr. Sehajad Vora for his multipurpose contribution in all the cases and for production of this manuscript.

Competing interests

None

References


