Surg Endosc (2016) 30:335–338
DOI 10.1007/s00464-015-4181-2

DYNAMIC MANUSCRIPT

Giant mid-esophageal diverticula successfully treated by per-oral endoscopic myotomy

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Received: 22 October 2014 / Accepted: 20 March 2015 / Published online: 9 April 2015
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Abstract
Background Surgery is currently the preferred treatment choice for mid-esophageal diverticula, while endoscopic therapy is rapidly establishing itself.
Method We report the first two cases of giant mid-esophageal diverticula presented with dysphagia successfully treated with per-oral endoscopic myotomy (POEM).
Result There were no complications during the procedure and the patients' conditions improved remarkably within short time of recovery.
Conclusion POEM could provide a safe, effective and less invasive treatment of mid-esophageal diverticula if appropriately used. Further studies on long-term efficacy with larger number of cases are necessary.

Keywords Mid-esophageal diverticula · POEM · Endoscopic treatment

Abbreviations

POEM	Per-oral endoscopic myotomy
ESD	Endoscopic submucosal dissection
CO_2	Carbon dioxide
APC	Argon plasma coagulation

Electronic supplementary material The online version of this article (doi:10.1007/s00464-015-4181-2) contains supplementary material, which is available to authorized users.

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Mid-esophageal diverticula are rare entities. Only symptomatic patients should receive treatment. Although surgery is currently the preferred treatment choice, endoscopic therapy is rapidly establishing itself due to its less invasiveness. We report the first two cases of giant mid-esophageal diverticula successfully treated with POEM using a T-type HybridKnife.

Material and method

Case history

The two patients (75- and 79-year-old females) presented with dysphagia and retrosternal pain for 11 and 10 years, respectively. One patient had a loss of weight of 10 pounds and an Eckardt score of 7. The other patient did not suffer from weight loss but had Eckardt score of only 5. Both patients showed worsening of their symptoms over the past two years. Their medical history otherwise was unremarkable. The gastroscopy of the two patients revealed a giant esophageal diverticulum in the middle third of the esophagus, with food impaction in the pouch (Fig. 1A). Barium swallow showed contrast medium in the blind end pouch at the level of mid-esophagus (Fig. 2A).

Procedure of POEM

The endoscopic treatment of the diverticula was performed in both patients, using a technique called per-oral endoscopic myotomy (POEM) which is traditionally performed in the treatment of achalasia. The two patients fasted for 2 days before the operation. After sedation with propofol, a

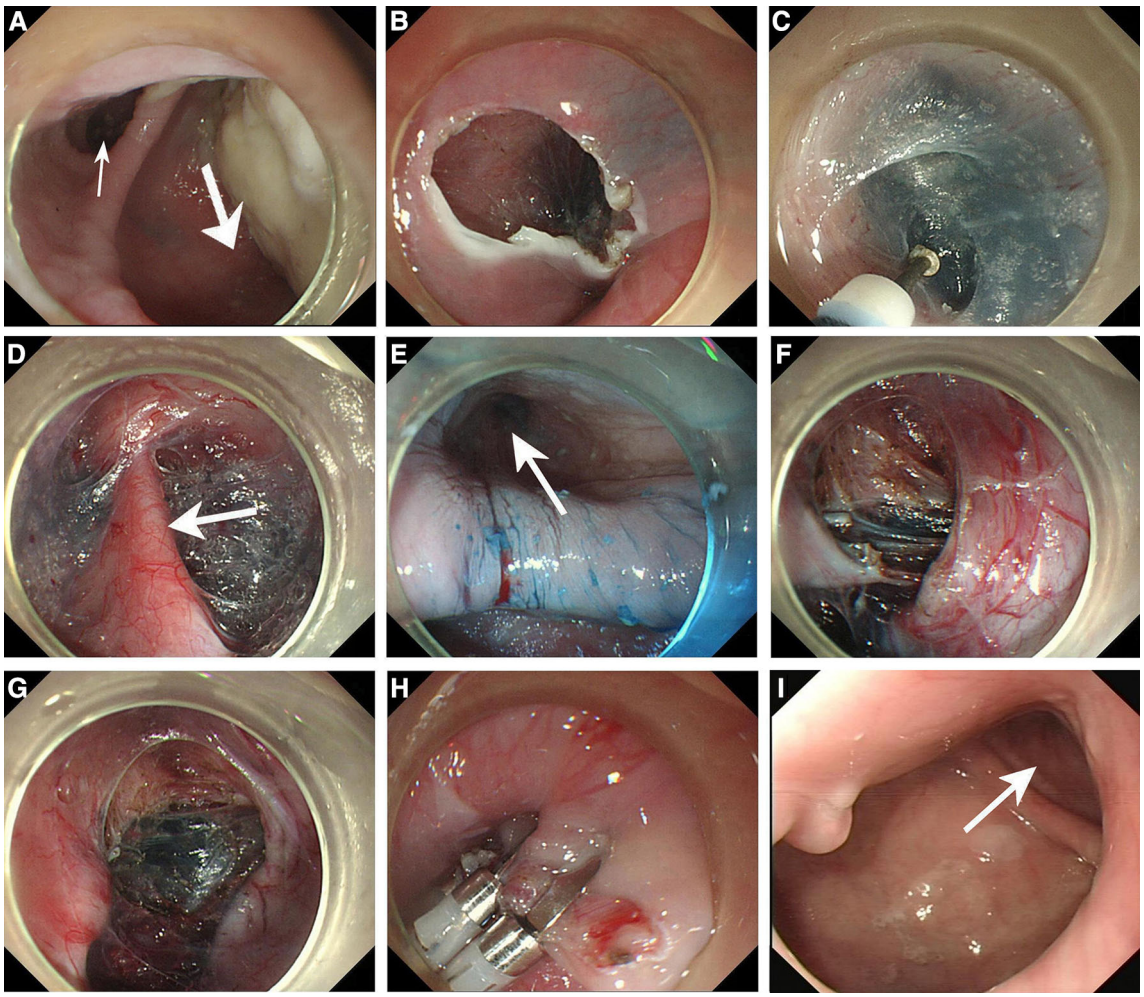

Fig. 1 Endoscopic features. **A** A giant mid-esophageal diverticulum with food impaction (*thick arrow*). **B** Transverse mucosal incision was made. **C** Creation of a submucosal tunnel with HybridKnife. **D** Separation was completed (*arrow points to the muscle between the diverticulum and esophageal lumen*). **E** Observation of the esophageal cavity during procedure (*arrow points to the esophageal lumen*). **F** Cutting the muscle layer. **G** Completion of endoscopic myotomy. **H** Closure of mucosal entry. **I** Recheck gastroscopy 20 days later (*arrow points to the esophageal lumen*)

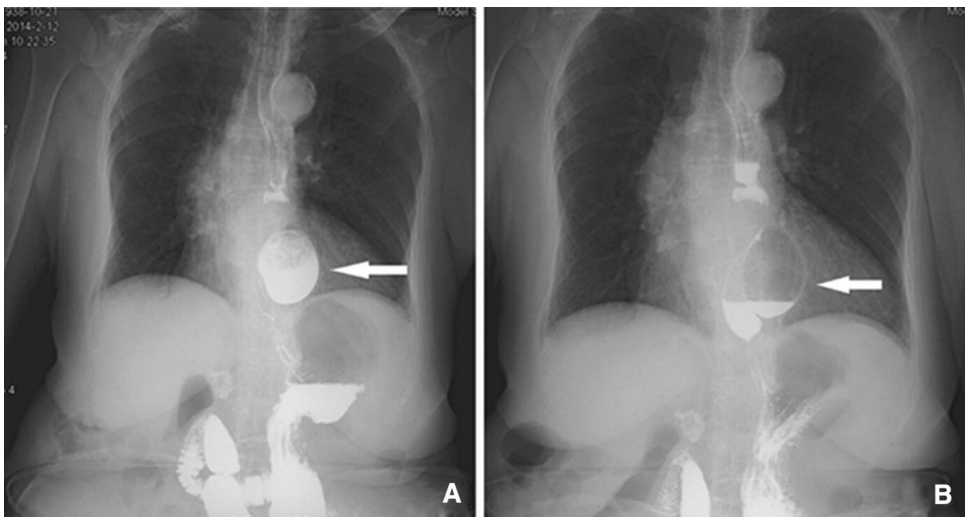

Fig. 2 Double contrast barium swallow esophagram showing mid-esophageal diverticulum. **A** Anteroposterior view. **B** Lateral view

gastroscope was introduced into the esophageal cavity. We removed the residual food in the diverticular pouch with a basket and flushed the pouch by saline. A giant pouch with septal wall between the diverticulum and the main esophageal lumen became clearly visible (video "01. mpg"). Carbon dioxide (CO_2) was used for insufflation during the procedure with an insufflator (UCR, Olympus). A 2-cm transverse mucosal incision was made approximately 5 cm above the diverticulum with a T-type HybridKnife (ERBE, Tubingen, Germany) using Endo Cut Q 3-2-3 (Fig. 1B) (video "01. mpg"). Then, a technique similar to endoscopic submucosal dissection (ESD) was used to create a submucosal tunnel (Fig. 1C) downwards until 2 cm below the diverticulum (Fig. 1D). Repeated jet injection of 0.9 % saline (250 ml) mixed with methylene blue (2.5 ml) by ourselves was performed by the same T-type HybridKnife without exchange of instruments in order to enhance the contrast between the submucosal layer and the muscle layer whenever the submucosal dissection plane became unclear (video "02. mpg"). Vessels identified within the submucosal tunnel were coagulated using T-type HybridKnife in forced coagulation mode (effect 2, 60 W) (video "02. mpg"). Then, the T-type HybridKnife (Endo Cut Q 3-2-3) was used to dissect the muscle layer, including circular muscle and longitudinal muscle part, between the diverticulum and esophageal lumen (Fig. 1F, G) (video "03. mpg") The mucosal entry was then closed with 3/5 hemostatic clips (Fig. 1H). At the end of the procedure, the endoscope was again inserted into the natural esophageal lumen and down to the stomach to confirm smooth passage through the mid-esophagus (video "04. mpg"). The total procedure time was 60 and 50 min, respectively, and there were no adverse effects observed such as bleeding, perforation and pneumothorax.

Result

The two patients reported no dysphagia 1 day after the operation and were discharged 3/2 days later. Endoscopy follow-ups were taken at the 2nd and later the 20th/30th day after treatment (Fig. 1I), and barium meal reexamination at the 22nd/25th day as well. The septal wall slided down significantly, and the barium swallow showed an increased emptying speed of the pouch in both patients (Fig. 2B). The patients' conditions improved remarkably with an Eckardt score of 1.

Discussion

Mid-esophageal diverticulum is also called traction diverticulum, because all layers of the esophageal wall are pulled out, which is considered to be a true diverticulum, as shown in Hadi and Rameh [1]. A giant mid-esophageal diverticulum is uncommon and the majority of patients are asymptomatic [2]. Dysphagia, regurgitation, aspiration pneumonia, weight loss and reflux disease are the most common symptoms. Only symptomatic patients should receive treatment. The gold standard of treatment is surgery [3]. Endoscopic diverticulotomy increased in recent years, but most of these different endoscopic techniques are about Zenker's diverticulum [4]. Only few articles have reported endoscopic treatment of mid-esophageal diverticula. Schubert and colleagues reported a case being treated by endoscopic diverticulotomy using a needle-knife through a flexible endoscope [5]. Most previous endoscopic methods described the use of argon plasma coagulation (APC), needle-knife or Simmons Knife [6, 7]. Although these techniques are regarded as less invasive, faster and better tolerated than conventional surgery and although they show good results, one of the mostly feared complications is the occurrence of perforation during the procedure, which is a potentially life-threatening complication. Because there is no submucosal injection before cutting the septal wall, the possibility of perforation increases.

We report the first two cases of mid-esophageal diverticulum successfully treated by POEM. POEM is a variant of natural orifice transluminal endoscopic surgery. It is an endoscopic method for performing myotomy of the LES and has been widely used for the treatment of achalasia [8]. Compared with other endoscopic diverticulotomy techniques, POEM is an endoscopic tunnel technique and can maintain the completeness of gastrointestinal mucosa better. Even if perforation occurs during the procedure, the mucosal incision can be closed easily, and esophageal fistula, pneumothorax and pyothorax can be avoided [9]. Another potential advantage is that the muscle layer between the esophageal wall and diverticulum can be cut off completely; thus, patients' symptoms would get relieved more notably and diverticula recurrence rates may be lowered theoretically.

There are several issues to be taken into account during the procedure: 1. POEM for mid-esophageal diverticulum is a difficult endoscopic procedure and should be performed by experienced endoscopists. 2. During the tunneling phase, the endoscope should be often withdrawn from the tunnel and inserted into the natural esophageal cavity to see whether the separation is sufficient and confirm its location (Fig. 1E). 3. CO_2 insufflation is critical to achieve a safe POEM. Endoscopic CO_2 insufflation with a controlled gas feed of 1.2 L/min is beneficial to reduce the risks of both mediastinal emphysema and air embolization. 4. Adding methylene blue into the injection solution such as 0.9 % saline is favorable for observing the condition of separating submucosa and muscle layer. Also, injection of methylene blue at the mucosa layer of the septal wall between the esophageal lumen

and diverticulum also provides us with a clear orientation of the septal wall when building the tunnel and cutting the muscle layers(Fig. 1E).

In conclusion, the short-term outcomes of the POEM procedure for mid-esophageal diverticula in two patients were very satisfying. Due to its safety, effectiveness and less invasiveness, it might be an attractive option for treatment of esophageal diverticulum. Further studies on long-term efficacy and comparison of POEM with other endoscopic diverticulotomic techniques with larger number of cases are necessary.

Disclosures Yi Mou, Hongze Zeng, Qiming Wang, Hang Yi, Wei Liu, Dingke Wen, Chengwei Tang and Bing Hu have no conflict of interest or financial ties to disclose.

References

1. Hadi U, Rame C (2007) Giant midesophageal diverticulum presenting as food impaction: case report and review of the literature. Am J Otolaryngol 28:122–125
2. Do Nascimento FA, Lemme EM, Costa MM (2006) Esophageal diverticula: pathogenesis, clinical aspects, and natural history. Dysphagia 21:198–205
3. Thomas ML et al (2001) Oesophageal diverticula. Br J Surg 88:629–642
4. Dzeletovic I, Ekbom DC, Baron TH (2012) Flexible endoscopic and surgical management of Zenker's diverticulum. Expert Rev Gastroenterol Hepatol 6:449–465
5. Schubert D et al (2004) Endoscopic treatment of a mid-esophageal diverticulum. Endoscopy 36:735–737
6. Vogelsang A et al (2007) Endotherapy of Zenker's diverticulum using the needle-knife technique: long-term follow-up. Endoscopy 39(2):131–136
7. Rabenstein T et al (2007) Argon plasma coagulation for flexible endoscopic Zenker's diverticulotomy. Endoscopy 39:141–145
8. Swanstrom LL et al (2012) Long-term outcomes of an endoscopic myotomy for achalasia: the POEM procedure. Ann Surg 256:659–667
9. Wang L et al (2013) Retrospective study of endoscopic submucosal tunnel dissection (ESTD) for surgical resection of esophageal leiomyoma. Surg Endosc 27:4259–4266