



Per-oral endoscopic myotomy with septotomy for the treatment of distal esophageal diverticula (D-POEM)

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Abstract

Background and aims Epinephric diverticula are frequently associated with esophageal motility disorder. Their management implies surgery, with 15% morbidity and 3% mortality rates. Flexible endoscopy could be an effective and safer approach for treating esophageal diverticulum with motility disorder. We report our experience of seven consecutive cases treated with per-oral endoscopic submucosal septotomy and myotomy (D-POEM).

Methods Seven consecutive patients were referred for symptomatic non-Zenker's esophageal diverticulum. The steps of the procedure were as follows: (i) *analysis of the esophageal anatomy*; (ii) *vertical mucosal incision* just above the upper edge of the diverticulum; (iii) *submucosal tunneling by submucosal dissection*, alongside the submucosal window of the diverticulum and the downstream septum; (iv) *identification of the septum and the diverticular area*; (v) *diverticular septotomy* followed by *antegrade esocardial myotomy* up to 2 cm below the cardia; and (vi) closure of the mucosal incision.

Results Three men and four women aged from 62 to 90 years were treated. Four patients had a diet with adapted texture before the treatment and five patients had weight loss (4 kg to 24 kg). At preoperative evaluation, all had an esophageal motility disorder at high-resolution manometry.

The procedures were successfully performed in all the patients without per-operative complications. During the 30 postoperative days, no significant adverse events occurred. Three months after treatment, six patients (85%) had clinical improvement with complete or partial regression of dysphagia. All the patients stabilized or gained weight after the treatment.

Conclusion The D-POEM technique is a mini-invasive effective and safe technique to treat symptoms due to both esophageal motility disorder and distal esophageal diverticula. It could be a very interesting solution for non-surgical patients in the first time that could be extended to other patients after favorable larger series.

Keywords POEM · D-POEM · Esophagus · Diverticulum · Epinephric · Endoscopic · Myotomy · Septotomy · Marsupialization

Abbreviations

POEM Per-oral endoscopic myotomy
HRM High-resolution manometry
ESD Endoscopic submucosal dissection

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Esophageal diverticulum is a rare esophageal disease, which may be located in the pharyngeal esophagus (Zenker diverticula), in the mid-esophagus or in the distal esophagus. In this last location, they are called epinephric diverticula and are frequently associated with esophageal motility disorder, especially involving the lower esophageal sphincter. Epinephric diverticula has an estimated prevalence of 0.015% [1]. While flexible endoscopic treatment of Zenker's

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diverticula is now adopted and widely practiced, the management of symptomatic diverticula in other locations implies surgery, with 15% morbidity rate [2]. The main complication of such surgery is esophageal leakage with mediastinitis, leading to a mortality rate of 3% [2]. Published clinical success of surgery ranged from 74 to 100% [3]. These high rates of severe complications not allow elderly or non-surgical fit patient to be safely treated. The experience of endoscopic esophageal myotomy (POEM) has led us to consider a less invasive and presumed less morbid endoscopic solution for patient with epinephric diverticula [4]. We developed a new type of POEM to treat patients with epinephric diverticula. We report here our experience of seven consecutive cases treated with per-oral endoscopic submucosal septotomy and myotomy (D-POEM) in order to achieve symptoms relief.

Materials and methods

Patients

Seven consecutive patients were referred for symptomatic pulsion esophageal diverticula located in the mid- or lower esophagus and associated with esophageal dysmotility. The main symptoms reported were dysphagia or dietary retention syndrome (retrosternal pain, regurgitations, etc.), sometimes associated with weight loss. Based on the need for treating both the diverticulum and the esophageal dysmotility, they were proposed to apply submucosal tunneling technique in order to cut the diverticulum septum as well as the esophageal circular muscle (septotomy and myotomy).

The patients underwent a high-resolution esophageal manometry (HRM) and esophagram before as a preoperative assessment (Fig. 1). All of them had refused surgery because of the morbidity and mortality rate; in addition, most of them were old (six patients concerned, 71 to 90 years old). They were clearly informed of the benefits and risks before the treatment; they all gave their oral consent for these endoscopic treatments, and written consent and IRB approval were not needed for this alternative POEM procedure.

Procedure

The procedure was standardized for all patients, based on the experience in esophageal POEM for achalasia in the center. They were performed on patients under general anesthesia and tracheal intubation. A regular or a large channel endoscope was used, with CO₂ insufflation. The dissection device used for the whole procedure was a Triangle Tip Knife (Olympus, Tokyo, Japan).

The steps of the procedure were as follows (video 1): (i) *analysis of the esophageal anatomy*, including the diverticulum features and a measurement of the distance between



Fig. 1 Pretreatment esophagogram demonstrating the lower esophageal diverticulum and the stagnation of contrast upstream of the LES

dental incisors and cardia and the diverticulum; (ii) *vertical mucosal incision* (Endocut Q: Effect 1, Erbe VIO 200D) just above the upper edge of the diverticulum, in parallel with the window opening of the diverticulum, after submucosal injection of hydroxyethylamidon mixed with indigo carmine (with a 25G needle). Length to the EGJ was not standardized because the mucosotomy was always realized at 1 cm of the upper edge of the diverticulum (diverticulum could have variable size and length to the EGJ); location was usually in the posterior direction but could be adapted according to the position of the diverticulum window; (iii) *submucosal tunneling by ESD* (Swift Coagulation: Effect 2, 35W, VIO 200D, Erbe), alongside the submucosal window of the diverticulum and the downstream septum, then pursued three centimeters below the cardia; (iv) *identification of the septum and the diverticular area* (which does not contain circular myofibers), once the tunnel completed (Fig. 2); (v) *diverticular septotomy* performed by cutting all the circular muscular fibers, followed by *antegrade esocardial myotomy* up to two centimeters below the cardia (Fig. 3); and (vi) closure of the mucosal incision with endoclips (Instinct, Cook Medical).

Follow-up

Patients were kept fasting for 24 h, and were then authorized to resume liquid diet at postoperative day 2, mixed diet for the following week and finally normal diet. Adverse events were recorded during the procedure and within the 30 days after. Patients had a clinical evaluation at 3 months, 6 months, and 1 year after the procedure. At 3 months, an esophagram was realized.

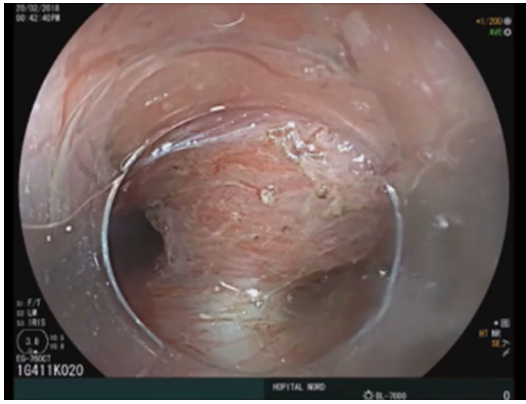


Fig. 2 Endoscopic view of the diverticulum's septum inside the submucosal tunnel, before septotomy

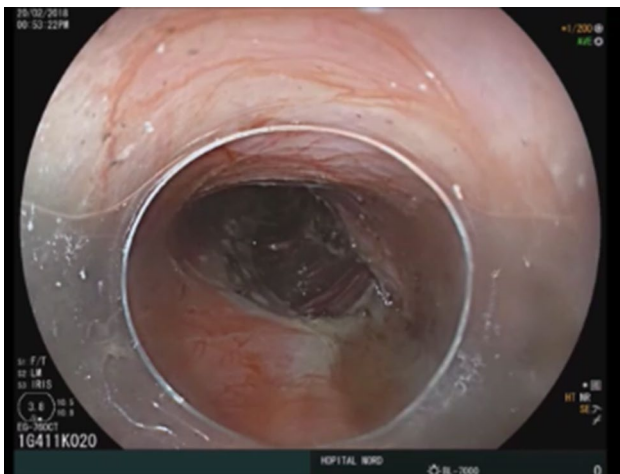


Fig. 3 Endoscopic view of the diverticulum's septum inside the submucosal tunnel, after the septotomy and the anterograde myotomy

Results

Patients' characteristics

Three men and four women aged from 62 to 90 years were treated between October 2017 and November 2018. Their symptoms had been evolving for 1 to 15 years. All patients had dysphagia at each meal, two had already benefited from esophageal myotomy by POEM downstream to the diverticulum and without septotomy few months ago but still had retention symptoms. For these two patients, POEM were realized by our team, always with the posterior way as we used to do. One patient had benefited from botulinum toxin injection in the lower esophageal sphincter (LES) 2 years ago. Moreover, three patients had retrosternal pain during or after meals and four patients

had regurgitations and one had dyspnea (blockpnee) during meals. Finally, four patients had a diet with adapted texture (mixed or exclusively liquid) before the treatment and five patients had weight loss (4 kg to 24 kg).

At preoperative evaluation, we obtain complete results of HRM for only two patients: one with Jackhammer's esophagus and distal esophageal spasm and one with type III achalasia (Chicago classification v3.0). One patient had a technical failure of HRM and other four patients had incomplete measure with HRM due to the impossibility for the probe to cross the EGJ. Among these four patients, we did not have measurement of the LES but we could definite approximative achalasia subtype with the measurements of the manometry of the esophageal body. With these partial data, we concluded that one patient had a close to type I achalasia and three patients a close to type II achalasia.

One patient had alcoholic cirrhosis with previous band ligation (Child–Pugh A, with prothrombin rate of 84% at the procedure time). Two patients had antiplatelet aggregation treatment or anticoagulant treatment that was discontinued for the endoscopic procedure.

Procedure and follow-up

The procedures were successfully performed in all the patients without per-operative complications. The length of hospitalization was 3 to 8 days after the endoscopic treatment. During the 30 postoperative days, no significant adverse events occurred. No patient had symptoms evocating leaks or pleura effusion. Only one patient had fever during 48 h after D-POEM, successfully treated by antibiotics. In our protocol, we did not realize systematic esophagogram during the week after the endoscopic intervention. In our practice, esophagogram was realized only if complication was suspected following clinical or biological examinations.

Three months after treatment, six patients (85%) had clinical improvement with complete or partial regression of dysphagia. One patient, previously treated by POEM without efficacy did not improve, still suffering from chest pain. All the patients stabilized or gained weight after the treatment. Particularly, the patient with greater weight loss (24 kg) gained 9 kg in 3 months following the procedure, after resuming a normal diet (only liquid diet before treatment). The other patients have resumed normal diet within 3 postoperative months.

Regarding the post-treatment esophagograms, all demonstrated an improvement of the esophageal clearance. The persistence of a smaller diverticulum, but without remaining septum, was observed on all esophagograms (Fig. 4).



Fig. 4 Post-treatment esophagogram demonstrating an improvement of the esophageal clearance, the persistence of a diverticulum, but without remaining significant septum

Discussion

The standard management of a symptomatic esophageal diverticulum is the surgical approach. Currently, there is no consensus regarding the optimum technique for the surgical treatment of such diverticula (open surgery vs laparoscopic surgery, abdominal vs thoracic approach, diverticulectomy vs diverticulopexy, systematic associated myotomy or not, etc.) [2]. Open surgery is associated with high morbidity and significant mortality. Brandeis et al. summarized the major studies of surgical treatment, calculating a pooled mortality rate of 6% in open technique and a leakage rate of 10% (0–20%) [3]. In their recent review and meta-analysis, Chan et al. reported a global morbidity of all surgical techniques of 21% with a staple line leak rate up to 13% and mortality rate of 6% [2].

The endoscopic submucosal technique for treating lower esophageal diverticula is a very recent therapeutic strategy, which benefits from the great development of submucosal therapeutic endoscopy. This POEM variation technique has been firstly described by our team in 2018, with technical and clinical success [5]. However, to our knowledge, there are only one short series and three clinical cases published to date. Conrado et al. reported another case in which the patient had complications like subcutaneous emphysema, mild pleural effusion and pain, with a spontaneous favorable evolution [6]. In two other case reports, authors describe clinical success without

complications using the same technique [7, 8]. In other published series, authors included four patients with non-Zenker's esophageal diverticulum and, with a technique similar to ours, they achieved 100% of clinical success [9]. In our report, we did not encounter any significant complication within 30 days after the endoscopic procedure suggesting that the flexible endoscopic treatment of esophageal diverticula, in the same way as POEM, is a safe technique.

Esophageal diverticula, being mainly associated with esophageal dysmotility, is mandatory to associate esophageal myotomy with diverticular septotomy, in order to optimize the chance to achieve relief from symptoms. Indeed, among our patients, two had already undergone esophageal myotomy by a POEM few months ago but unsuccessfully. One of them finally improved only after complementary procedure with septotomy. Thus, adding diverticulum's septotomy induces a collapse of the diverticulum that helps in addressing symptoms due to food retention into the diverticulum. For these patients, precedent endoscopic myotomy did not induced more difficulties to realize the procedure but we have only two patients in these cases, so these short series are not sufficient to conclude that history of ineffective treatment with "standard" POEM is a predictive factor for D-POEM failure.

After these first series of D-POEM we could recommend some important points to obtain technical and clinical success with the least possible complications: starting the mucosal incision at least 1 cm above the upper edge of the diverticulum, often taking the endoscope out of the tunnel (in the esophageal lumen) to make sure to follow the lateral edge of the diverticulum, making an antero-grade septotomy followed by a myotomy of the entire height of the esophageal muscular circular layer located below the septum and prolonging this myotomy under the cardia, as for a standard POEM. We did not realize systematic postoperative esophagogram, but it could be an interesting way to decrease the length of stay and to precociously detect any leaks before refeeding patients, especially for the first cases you treat.

The limitations of our study are the small size and the heterogeneity of our population, but it is a pilot study and the first series for this rare disease. Another limitation is the lack of complete results of HRM before treatment. These results are very common in the real life for patients with esophageal non-Zenker's diverticula because of the winding of the probe inside the diverticulum. A solution could be to put the probe of manometry during a gastroscopy, but this is an invasive and not so easy solution. Finally, our evaluation was done at 3 months, a longer-term evaluation of the symptoms would be interesting to judge the durability of clinical efficacy in the patients we treated.

Conclusion

The D-POEM technique, which allows for performing both diverticular septotomy and esocardial myotomy with only one mucosal access is a mini-invasive effective and safe technique to treat symptoms due to both esophageal motility disorder and distal esophageal diverticula. Larger studies and comparison with standard of care are required to validate these promising preliminary results, especially given the high morbidity and mortality rates of surgical treatment. It could be a very interesting solution for non-surgical patients in the first time, and this technique could be expanded to all patients if good results will be confirmed.

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Compliance with ethical standards

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