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Case Report

A Case of Diffuse Esophageal Spasm Treated with Peroral Endoscopic Myotomy

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The indications for peroral endoscopic myotomy (POEM) have been expanded to include diffuse esophageal spasm (DES). A 67-year-old Japanese man presented with a 4-year history of dysphagia. Endoscopy and upper gastrography revealed abnormal peristaltic movements involving interruption of normal peristalsis, and a diverticulum located at the 2 o'clock esophageal position. High-resolution manometry indicated DES. POEM with a long (15 cm) myotomy was performed for the abnormal contractions, which subsequently disappeared along with dysphagia improvement. Our results suggest that esophageal motility disorders accompanying a diverticulum may be eliminated by POEM without treating the diverticulum itself. We speculate that POEM ameliorates esophageal diverticulum by reducing internal esophageal pressure.

Key words: diffuse esophageal spasm (DES), diverticulum, peroral endoscopic myotomy (POEM), high-resolution manometry (HRM)

Diffuse esophageal spasm (DES) is an interruption of normal peristalsis by multiple, non-propulsive esophageal contractions that are more commonly observed in the middle and lower thoracic esophagus [1]. The diagnosis of DES is based on the imaging appearance on endoscopy and upper gastrography, along with appropriate high-resolution manometry (HRM) findings. Previous studies have suggested that DES occurs due to the loss of inhibitory ganglion neurons [2]. Esophageal motor disorders are closely related with diverticula, which are observed in 3.6% to 7.4% of cases of esophageal motor disorders [3]. The diverticula are caused by an increase in intraesophageal pressure.

Peroral endoscopic myotomy (POEM) has been introduced as the endoscopic equivalent of Heller myotomy for the treatment of achalasia. Recently, the indications for POEM have been expanded to include DES [4,5]. POEM has been suggested as an endoscopic and minimally invasive therapeutic modality for treating DES because it allows for extensive myotomy in the region of the abnormal esophageal contractions. Here, we report a recently encountered case of DES with a diverticulum that was treated successfully with POEM.

Case Report

A 67-year-old Japanese with a 4-year history of dysphagia and food regurgitation presented at our clinic with a complaint of worsening symptoms, including occasional dysphagia, regurgitation and daily chest pain. The Eckardt score was 4 [6]. He had a history of

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ureterolithiasis and had been taking Quercus salicina extract and Tiquizium bromide only. No previous therapy, including calcium channel blockers, dilations, botulinum toxin, or surgery, had been administered. He subsequently underwent endoscopy and upper gastrography, which revealed abnormal peristaltic movements ("corkscrew esophagus") that involved the interruption of normal peristalsis by multiple, repetitive, non-propulsive esophageal contractions in the mid- and lower thoracic esophagus. We also identified a diverticulum located at the 2 o'clock position of the esophagus, approximately 10 cm above the esophagogastric junction (Fig. 1, 2). He underwent HRM (Sandhill Scientific, Highlands Ranch, CO) to examine esophageal motility. A 10-repetition swallowing test revealed a mean integrated relaxation pressure of 9 mmHg (< 15 mmHg). The distal contractile integral was high at 4,724 mmHg/(s·cm) but did not reach 8,000 mmHg/(s·cm), a diagnostic criterion for a hypercontractile esophagus. The distal latency was less than 4.5 sec, and more than 20% of contractions were premature. Therefore, we diagnosed DES based on the Chicago classification (Fig. 3) [7].

He had previously taken acotiamide (300 mg per day) orally for a week but reported that it had had no effect. Therefore, after we obtained informed consent, we decided to perform POEM to resolve the abnormal contractions. A forward-viewing endoscope with an outer diameter of 9.8 mm (GIFQ260J; Olympus, Tokyo), which is routinely employed for upper gastrointestinal examinations, was used with a transparent distal cap attachment (DH-28GR, Fujifilm, Tokyo). A triangle-tip knife (KD-640L; Olympus) was used to dissect the submucosal layer and also to cut circular muscle. A coagulating forceps (Coagrasper, FD-411QR; Olympus) was used to close larger vessels prior to dissection and for hemostasis. Carbon dioxide gas was used for insufflation during the procedure with a CO_2 insufflator (UCR; Olympus). For electrosurgery, a VIO 300D electrosurgical generator (ERBE, Tübingen, Germany) was used, and for final closure of the mucosal entry site, hemostatic clips (EZ-CLIP, HX-110QR; Olympus) were applied. The POEM procedures were done under general anesthesia with positive pressure ventilation. Following submucosal injection of 10 ml saline with 0.3% indigo carmine, we performed POEM in the posterior esophageal wall in the 5 o'clock direction. First, we created a mucosal entry to the submucosal space. We then created a submucosal tunnel under the esophageal mucosa from the middle intrathoracic esophagus to the gastroesophageal junction. A continuous myotomy of 15.0 cm in length was performed longitudinally to include each contraction segment in accordance with the findings of the upper gastrography and HRM, which revealed abnormal peristaltic movements. The sharp tip of the triangle-tip knife was used to catch the circular muscle and lift it up toward the esophageal lumen. The captured circular muscle was cut using a spray coagulation current. The outer longitudinal muscle was endoscopically identified at the esophageal dissected area. In the present case, the function of the esophagogastric junction was normal; therefore, myotomy was not performed in the esophagogastric junction to prevent the occurrence of gastroesophageal reflux disease (GERD) after POEM. The diverticulum was present at the 2 o'clock position of the esophagus. Therefore, POEM was expected to have no effect on the posterior side and was not performed on this side in the present case. The mucosal entry site was closed with about seven hemostatic clips (Fig. 4). There was no bleeding requiring hemostasis treatment with the coagulating forceps during surgery, and there was no severe pneumomediastinum during POEM. The procedure time was 70 min, and the patient was discharged on the fourth day after POEM. Subsequently, the patient's symptoms disappeared, and the Eckardt score decreased to 0. Following POEM, endoscopy and upper gastrography (Fig. 5) showed that the abnormal contractions and the diverticulum had disappeared. Two months after POEM, the Eckardt score remained 0. No recurrence or complications, such as GERD, were observed.

Discussion

The present case of DES was complicated by dysphagia lasting 4 years, and the patient underwent POEM to treat abnormal contractions. DES is associated with pathophysiological mechanisms involving the entire esophageal body. Previous studies have shown the ineffectiveness of pharmacological therapy (calcium channel blockers and nitrates) in relieving dysphagia and chest pain [8, 9]. However, the endoscopic injections of botulinum toxin and pneumatic dilation have both shown some efficacy in treating abnormal contractions despite the need for frequently repeated interventions in

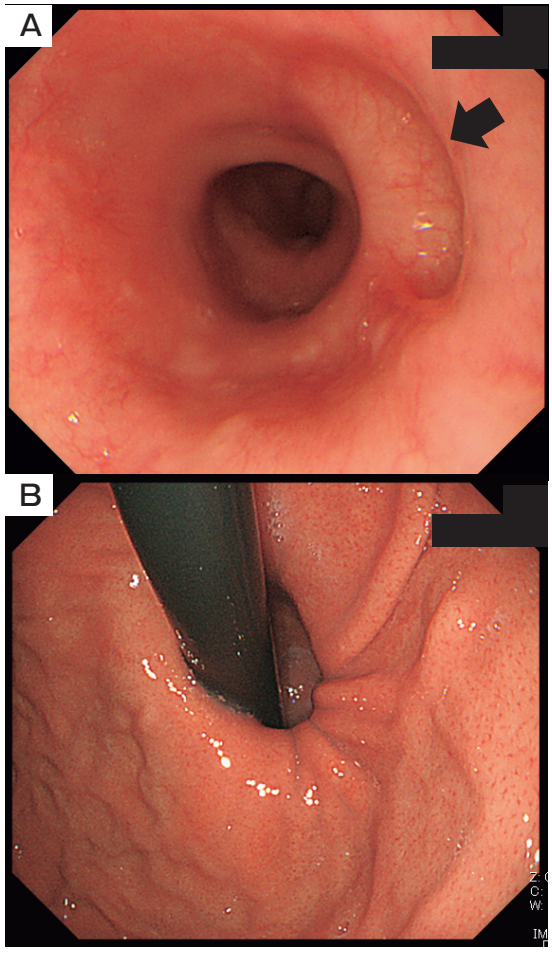

Fig. 1 Endoscopic images before peroral endoscopic myotomy. A continuous abnormal peristaltic movement in the mucosa was observed along the entire esophagus. A diverticulum was located at the 2 o'clock position of the esophagus, approximately 10 cm above the esophagogastric junction (black arrow) (**A**). An esophageal hiatal hernia was also present (**B**).

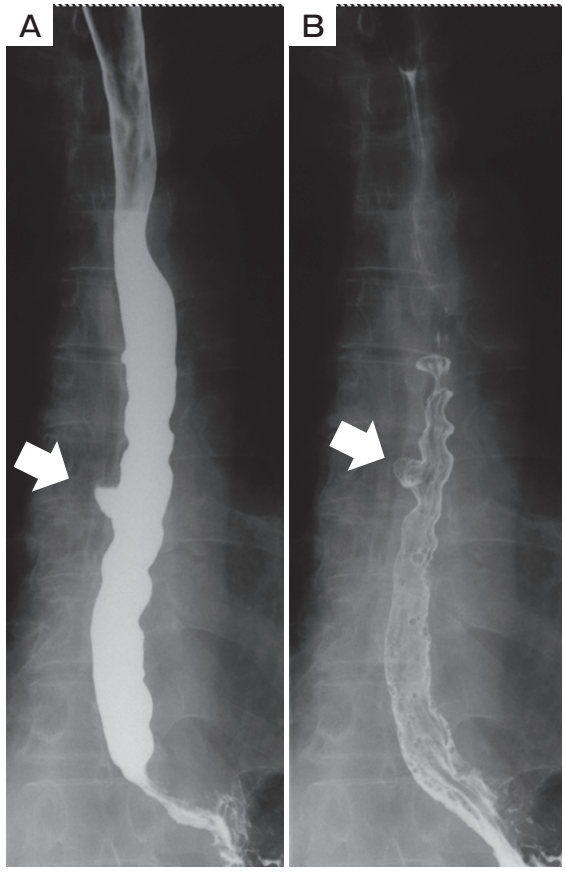

Fig. 2 Upper gastrography image. Spastic contractions occurred along the entire esophagus; however, barium retention was not seen at the esophagogastric junction (**A**). Strong muscular contractions resulted in the stagnation of barium in the middle of the esophagus (**B**). The diverticulum was located on the front side of the esophagus (white arrow).

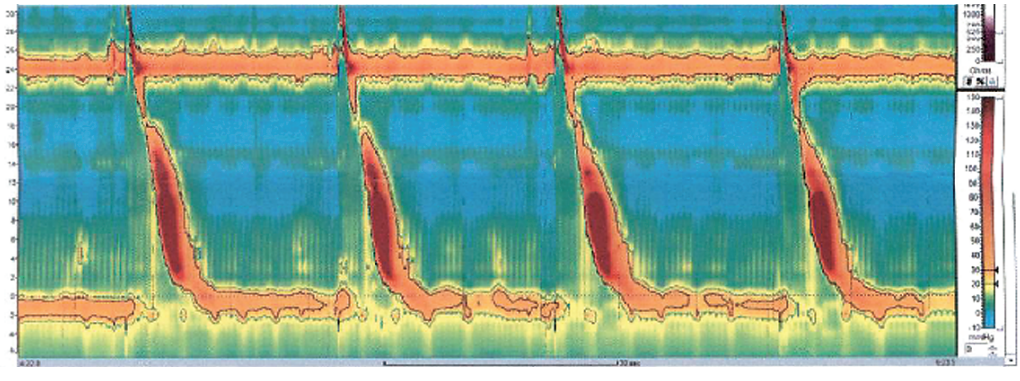

Fig. 3 High-resolution manometry image. Premature contractions were observed on every swallow, with a normal lower esophageal sphincter.

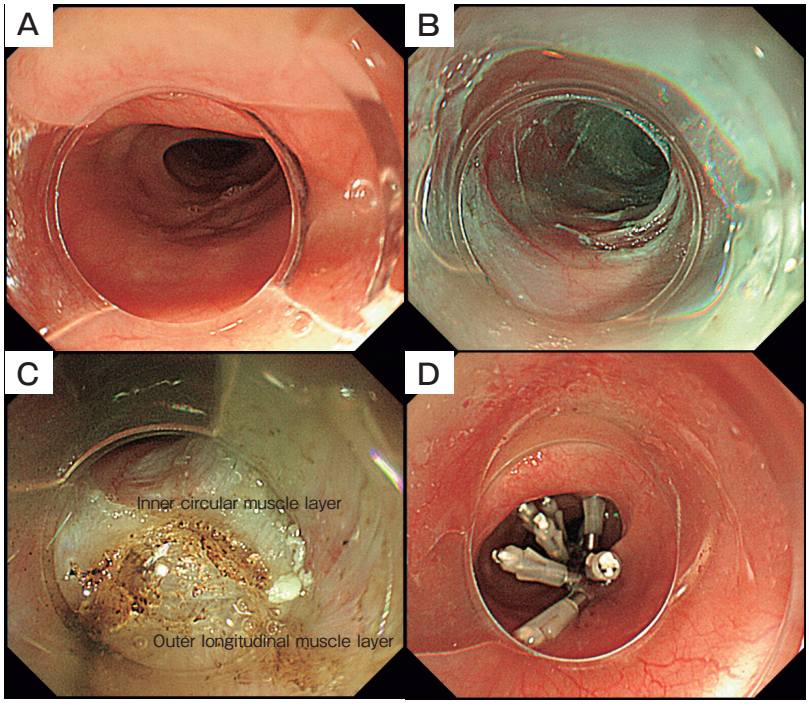

Fig. 4 Peroral endoscopic myotomy images. A submucosal tunnel was created under the esophageal mucosa from the middle intra-thoracic esophagus to the gastroesophageal junction (**A**, **B**). Subsequently, a long myotomy was performed to treat the abnormal contractions (**C**). Endoscopic plication was performed at the entry of the submucosal tunnel (**D**).

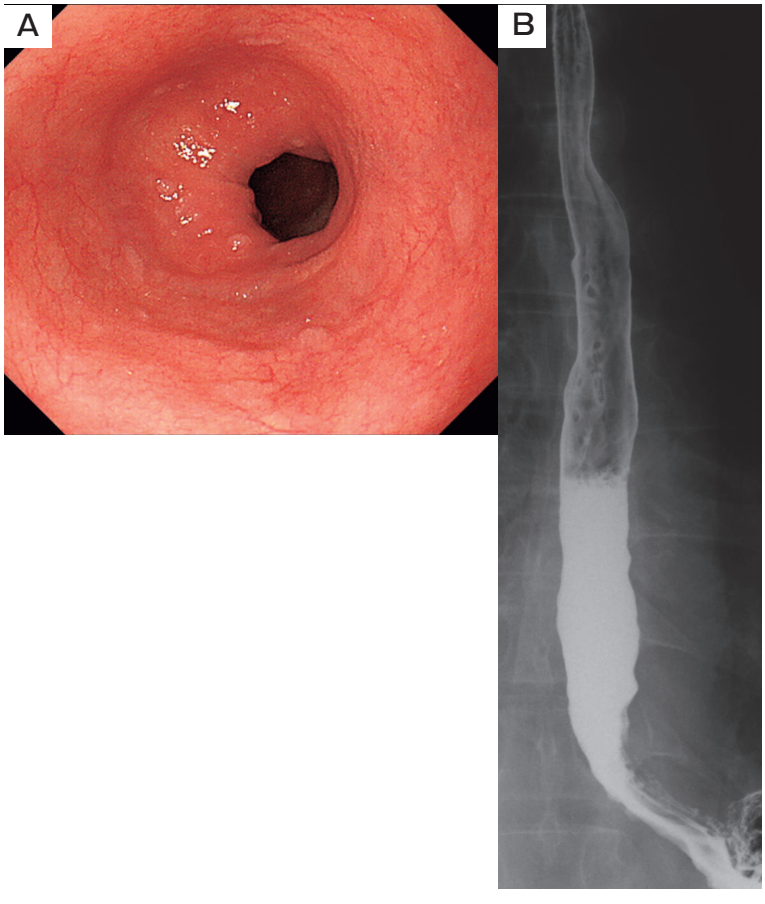

Fig. 5 Endoscopic and upper gastrography image after peroral endoscopic myotomy. The spastic contractions along the entire esophagus disappeared, and the diverticulum was no longer evident (**A**, **B**).

some patients [10]. Treating only the esophagogastric junction is inadequate because DES presents with abnormal peristalsis over a wide extent of the esophagus body. Therefore, we believe that a surgical approach involving an incision of the esophageal musculature is required in the treatment of DES. Leconte *et al.* used Heller myotomy for the treatment of DES in 20 patients and reported relatively better success rates than those for non-surgical modalities [11]. However, the Heller myotomy appears to be limited by the length of the myotomy incision. Recently, POEM has become an appropriate and successful procedure that is not only minimally invasive but also provides an opportunity for extended myotomy in the treatment of DES. Kumbhari *et al.* compared the efficacy and safety of POEM and laparoscopic Heller myotomy in patients with spastic achalasia, including DES [12]; based on the Eckardt score, clinical success was significantly higher in the POEM group (98% vs. 80.8%, $p=0.01$). In a systematic meta-analysis, Muhammad *et al.* reported a clinical success rate of 88% for POEM in the treatment of DES [13]. In another study, Khashab *et al.* reported that POEM improved the symptoms in 100% (9/9) of patients in a retrospective study carried out at multiple centers [14]. In addition, these authors highlighted that the ability to perform extensive myotomy during POEM plays an important role in the management of patients with DES who are refractory to medical therapy.

Regarding adverse events in POEM, a previous study reported a rate of perforation and mucosal damage of 0-7% [15]. However, even if perforation of the mucosal layer is recognized during the procedure, clip closure of the perforated lesion of the mucosal layer will be effective in many cases. The incidence of a gas-related adverse event, namely minor pneumomediastinum, occurred immediately in almost all patients who underwent POEM. However, this was without clinical significance or the need for special treatment and should not be considered an adverse event. Therefore, in POEM, the only gas-related adverse events requiring additional treatment, such as thoracic drainage, are severe pneumomediastinum and severe pneumothorax. Major bleeding occurs infrequently during the procedure, probably because few vessels are encountered in the submucosal tunnel. Almost all bleeding can be treated by endoscopic coagulation. Delayed bleeding after POEM has been reported in 1.1% of POEM patients. GERD occurs frequently and is a logical consequence of the treatment, although it can be easily treated with a proton-pump inhibitor and is not considered an adverse event [16].

An esophageal diverticulum is a false pulsion diverticulum that is thought to be caused by esophageal motor abnormalities such as achalasia, DES, or non-specific esophageal motility disorders [17]. Two reports have suggested that diverticula are formed on the oral side of the gastroesophageal mucosa [17, 18]. In the present case, a diverticulum was observed in the esophagus body, and was speculated to be due to the high pressure induced by DES. However, it is unknown whether the diverticulum was formed only in the body of the esophagus or if it was an epiphrenic diverticulum. If it was a diverticulum caused by pressure, we believe it was a pseudo-diverticulum without a muscle layer. Furthermore, the diverticulum was not large enough to resect in the present case. The strategy used for this case appeared to be correct because upper gastrography carried out after POEM showed that the diverticulum in the esophagus had disappeared.

Our findings in the present case confirm that POEM is effective for the treatment of DES, not only for achalasia. We speculate that POEM would be particularly useful for small esophageal diverticula caused by internal pressure within the esophagus, excluding large pulsion diverticula on the diaphragm or traction diverticula of the tracheal carina.

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