Peroral endoscopic myotomy (POEM) for esophageal achalasia*

Authors

Institution
Digestive Disease Center, Showa University Northern Yokohama Hospital

Background: Peroral endoscopic myotomy (POEM) was developed by our group to provide a less invasive permanent treatment for esophageal achalasia.

Patients and methods: POEM was performed in 17 consecutive patients with achalasia (10 men, 7 women; mean age 41.4 years). A long submucosal tunnel was created (mean length 12.4 cm), followed by endoscopic myotomy of circular muscle bundles of a mean total length of 8.1 cm (6.1 cm in distal esophagus and 2.0 cm in cardia). Smooth passage of an endoscope through the gastro-esophageal junction was confirmed at the end of the procedure.

Results: In all cases POEM significantly reduced the dysphagia symptom score (from mean 10 to 1.3; \( P = 0.0003 \)) and the resting lower esophageal sphincter (LES) pressure (from mean 52.4 mmHg to 19.9 mmHg; \( P = 0.0001 \)). No serious complications related to POEM were encountered. During follow-up (mean 5 months), additional treatment or medication was necessary in only one patient (case 17) who developed reflux esophagitis (Los Angeles classification B); this was well controlled with regular intake of protein pump inhibitors (PPIs).

Conclusions: The short-term outcome of POEM for achalasia was excellent; further studies on long-term efficacy and on comparison of POEM with other interventional therapies are awaited.

* These results were reported at DDW 2009 in Chicago (2 June 2009) and at UEGW 2009 in London (25 November 2009).
In S1 achalasia, the esophageal lumen is tortuous but the direction is still downward. The S2 type is an extremely advanced sigmoid form where the esophageal lumen is tortuous and turns upwards. Presence of S2 sigmoid achalasia was considered to be an exclusion criterion. In this very advanced form of achalasia, the maximal tortuosity of the esophageal lumen does not allow smooth food passage except that which occurs by gravity when the patient is upright, and simple myotomy usually does not relieve symptoms; stretching of the esophagus is usually required in addition to laparoscopic myotomy.

The mean age of the patients was 41.4 years, and seven were women and ten were men (Table 1). All the patients completed a questionnaire, to establish their dysphagia symptom score (see below), before and after the procedure.

As a result of the process of establishing the adequate length of myotomy, the 17 consecutive patients in this study fell into two subgroups: in the earlier patients, a relatively short myotomy was done, and in the later patients of the series this was extended to a mean total of 10.4 cm.

Investigations before and after POEM

Dysphagia symptom score. Achalasia symptoms were described as degree of dysphagia, frequency of regurgitation, duration of symptoms, and so on. The patient’s discomfort may be affected by several factors, and no convenient score for comparison before and after treatment existed. To evaluate improvement of dysphagia objectively in a simple manner, a dysphagia symptom score was used. The worst degree of dysphagia just before treatment was scored as 10, and the best condition, before the patient developed achalasia, was scored as zero. The post-procedural degree of dysphagia was scored between 0 and 10 by each patient. Scoring was done before POEM, and after POEM on the day of discharge from hospital and every 3 months subsequently. Changes in this score were analyzed statistically using the Wilcoxon signed-rank test.

Barium swallow and computed tomography (CT) scan. These were done in all cases before POEM. The degree of esophageal dilatation was classified according to the diameter of the esophageal lumen, i.e. grade I (< 3.5 cm), grade II (3.5 – 6 cm) and grade III (> 6 cm). The CT scan also provided information on the anatomical features of structures adjacent to the dilated esophagus and was mainly used to exclude other diseases and to provide orientation information about adjacent structures.

As mentioned, sigmoid-type achalasia was assigned to one of two categories according to the degree of tortuosity of the esophageal lumen seen at barium swallow and/or CT scan. Sigmoid type 1 (S1) shows a tortuous esophagus without U-turns in a proximal direction, and any slice of a CT scan may show an enlarged but only a single lumen. In contrast, the sigmoid type 2 (S2) is characterized by severely tortuous esophagus with U-turns, and a double lumen is identified on some CT slices (Fig. 1). To evaluate mediastinal emphysema after POEM, a CT scan was carried out just after the procedure on the day of operation. On the day following POEM, a barium swallow was done to confirm smooth passage of contrast media through the gastroesophageal junction (GEJ) without leakage.

Esophageal manometry. Esophageal pull-through manometry was done in all cases before and after the procedure using the Polygraf ID (Medtronic Functional Diagnostics, Denmark). According to the manufacturer’s data, the normal range for lower esophageal sphincter (LES) pressure with this device is from 14.3 mmHg to 34.5 mmHg. The normal LES pressure found using this device in five healthy Japanese volunteers in our hospital was 23.5 mmHg on average, ranging from 13.2 to 33.5 mmHg. The paired Student’s t test was applied to analyze manometry data from before and after POEM.

Equipment used for POEM

A forward-viewing endoscope of outer diameter 9.8 mm (GIF-H260; Olympus, Tokyo) which is routinely employed for upper gastrointestinal examination, was used with a transparent distal cap attachment (MH-588, Olympus). A triangle-tip knife (KD-640L; Olympus) was used to dissect the submucosal layer and also to divide circular muscle bundles. 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 CO2 insufflator (UCR; Olympus). For electrosurgery a VIO 300D electrogenerator (ERBE, Tübingen, Germany) was used, and for final closure of the mucosal entry site, hemostatic clips (EZ-CLIP, HX-110QR; Olympus) were applied.

Table 1 Clinical and operative data for 17 patients who underwent peroral endoscopic myotomy (POEM) for esophageal achalasia.

<table>
<thead>
<tr>
<th>Patient details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Women</strong>: men</td>
<td>7 : 10</td>
</tr>
<tr>
<td>Age, mean, years (range)</td>
<td>41.4 (18 – 62)</td>
</tr>
<tr>
<td>Duration of symptoms, mean (range)</td>
<td>8.4 years (6 months – 30 years)</td>
</tr>
<tr>
<td>Type of achalasia, n</td>
<td></td>
</tr>
<tr>
<td>Nonsigmoid</td>
<td>12</td>
</tr>
<tr>
<td>Sigmoid (S1*)</td>
<td>5</td>
</tr>
<tr>
<td>Degree of dilatation</td>
<td></td>
</tr>
<tr>
<td>Grade I</td>
<td>3</td>
</tr>
<tr>
<td>Grade II</td>
<td>11</td>
</tr>
<tr>
<td>Grade III</td>
<td>3</td>
</tr>
<tr>
<td>Operating details, mean (range)</td>
<td></td>
</tr>
<tr>
<td>Operating time, minutes</td>
<td>126 (100 – 180)</td>
</tr>
<tr>
<td>Postoperative hospital stay, days</td>
<td>4.8 (3 – 8)</td>
</tr>
<tr>
<td>Length of submucosal tunnel, cm</td>
<td>12.4 (7 – 18)</td>
</tr>
<tr>
<td>Myotomy length, cm</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8.1 (3 – 15)</td>
</tr>
<tr>
<td>Esophageal</td>
<td>6.1 (2.5 – 12)</td>
</tr>
<tr>
<td>Gastric</td>
<td>2.0 (0.5 – 3.0)</td>
</tr>
</tbody>
</table>

*S1 subcategory of sigmoid achalasia; see ‘Patients’ section for description.

As mentioned, sigmoid-type achalasia was assigned to one of two categories according to the degree of tortuosity of the esophageal lumen seen at barium swallow and/or CT scan. Sigmoid type 1 (S1) shows a tortuous esophagus without U-turns in a proximal direction, and any slice of a CT scan may show an enlarged but only a single lumen. In contrast, the sigmoid type 2 (S2) is characterized by severely tortuous esophagus with U-turns, and a double lumen is identified on some CT slices (Fig. 1).

Fig. 1 Subclassification of sigmoid-form achalasia. a Sigmoid type 1 (S1): the esophagus is significantly dilated and tortuous, but only a single lumen is seen on any computed tomography (CT) slice. b Sigmoid type 2 (S2), the esophagus is very dilated and tortuous and some CT slices show a double lumen.
POEM procedure

The procedures were done with the patient under general anesthesia with positive pressure ventilation and with higher pressures than those generated by endoscopic CO₂ insufflation. The UCR CO₂ insufflator (Olympus) was used with a regular insufflation tube (MAJ-1742; Olympus), which maintained CO₂ insufflation at a constant rate of 1.2 liter/minute.

Creation of the submucosal tunnel. Submucosal injection was done first at the level of the mid esophagus, approximately 13 cm proximal to the GEJ. About 10 ml saline with 0.3% indigo carmine was injected. A 2 cm longitudinal mucosal incision was made on the mucosal surface to create a mucosal entry to the submucosal space (dry cut mode, 50 W, effect 3) (Fig. 2 a).

Then, a technique similar to endoscopic submucosal dissection (ESD) was used to create a submucosal tunnel downwards, passing the GEJ, and about 3 cm into the proximal stomach (Fig. 2 b). The width of the submucosal tunnel was made to extend to about half of the circumference of the tubular esophagus. Spray coagulation mode (50 W, effect 2) was applied to dissect the submucosal layer. Larger vessels in the submucosa were coagulated using the forceps in soft coagulation mode (80 W, effect 5).

Dissection of sphincter muscle. Dissection of the circular muscle bundle was begun at 3 cm distal to the mucosal entry, approximately 7 cm above the GEJ (Fig. 2 c). The sharp tip of the triangle-tip knife was used to first catch single circular muscle bundle and then to lift them up toward the esophageal lumen. The captured circular muscle bundle was cut by spray coagulation current (50 W, effect 2). Division of the sphincter muscle was continued from the proximal side towards the stomach until the endoscope passed through the narrow segment of the LES (Fig. 2 d). When the tip of the endoscope reached the stomach region, the submucosal space suddenly became wider. Muscle layer cutting was continued for approximately 2 cm distal to the GEJ. After dissection of the circular muscle bundles, outer longitudinal muscle layer was intact. The expected end point of myotomy is 2 cm distal to the GEJ. Closure of mucosal entry: the mucosal incision is closed using hemostatic clips.

Fig. 2 a Entry to submucosal space. After submucosal injection, a 2 cm longitudinal mucosal incision is made at approximately 13 cm proximal to the gastroesophageal junction (GEJ). b Submucosal tunnelling. A long submucosal tunnel is created to 3 cm distal to the GEJ. c Endoscopic myotomy is begun at 3 cm distal to the mucosal entry point, and is carried out in a proximal to distal direction to a total length of 10 cm. d Long endoscopic myotomy of inner circular muscle bundles is done, leaving the outer longitudinal muscle layer intact. The expected end point of myotomy is 2 cm distal to the GEJ. e Closure of mucosal entry: the mucosal incision is closed using hemostatic clips.
the myotomy, smooth passage of an endoscope through the GEJ with minimal resistance was confirmed by conventional endoluminal endoscopy.

**Closure of mucosal entry.** The mucosal entry site, usually 2 cm long, was closed with about five hemostatic clips (Fig. 2e). Successful closure of the mucosal entry was confirmed by the endoscopic appearance. At the end of the procedure, the endoscope was again inserted into the natural lumen down to the stomach, to confirm smooth passage through the GEJ.

**Results**

Between September 2008 and December 2009, POEM was performed in 17 consecutive patients (seven women, ten men; mean age 41.4 years, range 18–62), as mentioned, with confirmed achalasia including 12 nonsigmoid and 5 sigmoid cases (see Table 1). Duration of symptoms ranged from 6 months to 30 years with an average of 8.4 years. First case was done on September 8, 2008.

In all 17 patients in whom endoscopic myotomy was attempted, it was successfully performed as planned. A mucosal bleb was easily created by submucosal injection and the cap-fitted endoscope was easily introduced into the submucosal area through the mucosal incision (Fig. 3 a). Submucosal dissection was uneventfully completed in all cases, using the triangle-tip knife for the planned length (Fig. 3 b). The length of submucosal tunnel was 12.4 cm on average (7–18). In two cases cardiac mucosa was penetrated during the dissection procedure, with a hole from the submucosal space to the esophageal lumen at the distal esophageal end of the submucosal tunnel, because cardiac mucosa is relatively thinner than esophageal mucosa. This submucosal penetration did not induce any clinical complications.

After creation of the long submucosal tunnel down to the GEJ, endoscopic myotomy was begun at 3 cm distal to the mucosal entry (Fig. 3 c). In all cases, myotomy of circular muscle bundles was successfully carried out to the expected length with no specific complications (Fig. 3 d). The level of the LES and the exact position of GEJ were endoscopically identified and dissection of the circular muscle was done through these levels. The myotomy was extended to at least 2 cm on the stomach side. Substantial reduction of LES tonus was confirmed by passing an endoscope through the lumen of the esophagus. Minor bleeding occurred during cutting of the muscle, and was easily controlled by endoscopic coagulation. Finally, the proximal mucosal entry site was successfully closed using hemostatic clips (Fig. 3 e, Video 1).

**Video 1**

This short edited clip shows the key steps of the peroral endoscopic myotomy (POEM) procedure.

The longest myotomy length in our series was 15 cm, with the total length of the myotomy being 8.1 cm on average, being 6.1 cm in the esophagus and 2.0 cm in the stomach (Table 1). The longest myotomy length in our series was 15 cm, with the length of myotomy being measured by difference in insertion depth of the endoscope at the incisors. In that patient, who had sigmoid achalasia, the post-POEM dysphagia symptom score was decreased to zero (complete response) and the high LES pressure from 52.4 mmHg to 19.8 mmHg after POEM, showing significant improvement in both dysphagia and LES pressure just after POEM.

### Table 2: Peroral endoscopic myotomy (POEM): pre-procedure and post-procedure symptom score and lower esophageal sphincter (LES) pressure. Data are mean (range).

<table>
<thead>
<tr>
<th></th>
<th>Before POEM</th>
<th>After POEM</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysphagia symptom score</td>
<td>10</td>
<td>1.3</td>
<td>0.0003*</td>
</tr>
<tr>
<td>LES pressure, mmHg</td>
<td>52.4 (14.2 – 80.5)</td>
<td>19.8 (9.3 – 42.7)</td>
<td>0.0001†</td>
</tr>
</tbody>
</table>

* Wilcoxon signed-rank test
† Paired Student’s t test

The improved condition was maintained without any additional treatment. In five cases the dysphagia symptom score showed zero (complete response) after POEM. Nobody requested any further treatments, even one patient with a dysphagia symptom score of 4. On manometric evaluation, resting pressure decreased from a mean of 52.4 mmHg to 19.8 mmHg after POEM (P = 0.0001, paired Student’s t-test) (Table 2). No serious complications related to POEM were experienced. Even after a mean follow-up of 5 months (range 1 – 16), no patient developed recurrent symptoms of dysphagia. A follow-up endoscopy identified reflux esophagitis (Los Angeles classification B) in one patient (patient 17), whose symptoms were easily controlled with regular dosage of proton pump inhibitors (PPIs).

In the first seven patients in the series, a relatively short myotomy (mean 4.9 cm plus 1.0 cm at the gastric side) was done; this was extended in the ten later patients to a mean total of 10.4 cm (Table 3), which led to better symptom improvement.

In four patients, dissection of the circular muscle induced separation of outer longitudinal muscle bundles and eventually mediastinal tissue was exposed, directly adjacent to the submucosal layer. Pneumoperitoneum occurred in one patient, causing temporary elevation of intraperitoneal pressure; puncture of the abdominal wall using an 18-gauge plastic needle allowed quick recovery from the excessive elevation of abdominal pressure. In 15 cases muscle division was carried out on the anterior wall of the esophagus and in two patients (cases 1 and 3) myotomy was done; this was extended in the ten later patients to a mean total of 10.4 cm (Table 3), which led to better symptom improvement.

In 15 cases muscle division was carried out on the anterior wall of the esophagus and in two patients (cases 1 and 3) myotomy was done; this was extended in the ten later patients to a mean total of 10.4 cm (Table 3), which led to better symptom improvement.

The total length of the myotomy was 8.1 cm on average, being 6.1 cm in the esophagus and 2.0 cm in the stomach (Table 1). The longest myotomy length in our series was 15 cm, with the length of myotomy being measured by difference in insertion depth of the endoscope at the incisors. In that patient, who had sigmoid achalasia, the post-POEM dysphagia symptom score was decreased to zero (complete response) and the high LES pressure from 52.4 mmHg to 20.4 mmHg.

### Table 3: Comparison between earlier (cases 1 – 7) and later (cases 8 – 17) patients in the series of 17 who underwent peroral endoscopic myotomy (POEM).

<table>
<thead>
<tr>
<th></th>
<th>Earlier cases</th>
<th>Later cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>37 (18 – 49)</td>
<td>42 (29 – 62)</td>
</tr>
<tr>
<td>Women: men</td>
<td>4:3</td>
<td>3:7</td>
</tr>
<tr>
<td>Nonsigmoid/sigmoid</td>
<td>6/1</td>
<td>6/4</td>
</tr>
<tr>
<td>Myotomy length, cm</td>
<td>Total, mean (range)</td>
<td>4.9 (3 – 7) – 10.4 (7 – 15)</td>
</tr>
<tr>
<td></td>
<td>Esophageal, mean</td>
<td>3.9 – 8.4</td>
</tr>
<tr>
<td>Dysphagia symptom score</td>
<td>Before POEM</td>
<td>1.5 (1 – 4)*</td>
</tr>
<tr>
<td></td>
<td>After POEM</td>
<td>50.6 (14.2 – 75.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.0 (9.3 – 23.8)‡</td>
</tr>
</tbody>
</table>

* P = 0.0021 (Wilcoxon signed-rank test); nonsigmoid group, before vs. after POEM
† P = 0.038 (Wilcoxon signed-rank test); sigmoid group, before vs. after POEM
‡ P = 0.0002 (paired Student’s t test); nonsigmoid group, before vs. after POEM
§ P = 0.031 (paired Student’s t test); sigmoid group, before vs. after POEM

Downloaded by: Karolinska Institute. Copyrighted material.

Inoue H et al. POEM for esophageal achalasia... Endoscopy 2010; 42: 265 – 271
**Discussion**

To the best of our knowledge, endoscopic myotomy for treatment of achalasia has been reported so far only in a case series published in 1980 [7]. In that study, endoscopic myotomy was done using a modified needle knife to dissect the muscle layer directly through the mucosal layer; visual control of the movement of the needle tip during myotomy was therefore impossible, and thus, perforation or injury to surrounding structures could not be reliably avoided. It was almost three decades before Pasricha et al. [6] reported, in an animal experiment, the possibility of endoscopic myotomy through a submucosal tunnel. When we considered application of this procedure to humans, some improvements in technique were felt necessary for safe performance. One refinement was the application of the ESD technique to create the submucosal tunnel, whereas in the original animal experiment, balloon dilation was used for submucosal tunnelling [6]. The disadvantage of that technique is the inability to position the balloon accurately within the wall layers which, without visual control, may lead to unforeseen damage to esophageal structures. In our technique a submucosal tunnel, on average 12.4 cm long, was created, and because of the precise visual control and established ESD hemostasis techniques, submucosal hematoma and/or abscess were not encountered. Although our series is still small, we believe that these facts suggest that our method of long tunnelling through the esophageal submucosa may be generally regarded as safe.

The second improvement we introduced to this technique was the use of the triangle-tip knife [8] to dissect the circular muscle layer. This knife dissects the inner muscle layer step by step. Dissection of the muscle advances from proximal to distal, keeping a correct dissection plane. All processes can be done under direct endoscopic visual control, which is mandatory for maintaining safety.

The third improvement involves positive pressure ventilation and CO$_2$ insufflation through the endoscope. POEM may have a potential risk of mediastinal emphysema. Positive pressure ventilation with intratracheal intubation should be maintained at higher pressures than those generated by endoscopic CO$_2$ insufflation. This setting seems to reduce the risk of mediastinal emphysema. CO$_2$ gas insufflation through the endoscope is mandatory not only to reduce mediastinal emphysema but also to reduce the risk of air embolization.

One of the major concerns during POEM is how deeply the muscle layer should be divided. In our series muscle cutting was intended only to dissect the circular muscle bundles. After complete division of the circular muscle bundles, the longitudinal muscle bundles were left intact at the limit of the dissected area. We found that all the longitudinal muscle bundles in this series were naturally thin enough to be widely stretched only by mild compression of the endoscope tip. It is not necessary to intend full-layer myotomy in order to achieve a significant reduction of the LES pressure: in our series the high LES pressure typical of achalasia decreased to a normal range without any incision of the outer longitudinal muscle layer.

Another issue for discussion is the myotomy length. In our series, the total length of myotomy was 8.1 cm on average, which seems long enough to achieve complete release of high LES pressure. In surgery, a 7-cm myotomy is generally recommended [4]. As summarized in Table 3, in the earlier patients in the series (cases 1–7), a relatively short myotomy (total 4.9 cm on average) was done, which we later extended to a total of 10.4 cm on average (cases 8–17). As a result, the postoperative dysphagia symptom score was substantially lower in the later patients compared with the earlier ones. Based on these clinical results, we now recommend myotomy to be a minimum of 7 cm with POEM.

One of the attractive features of POEM is that we can control the myotomy length to be as long as we wish. When the patient complains of chest pain because of spasm and/or another high pressure zone identified by manometry (for example, diffuse spasm), a long myotomy of more than 7 cm may be effective. This should be clarified by further study.

Another interesting issue with the POEM technique concerns identification of the GEJ in the submucosal space. As clear markers for identifying the GEJ, the following indicators should be checked. The first indicator is the insertion depth of the endoscope from the incisors. The position of the GEJ in the lumen of the esophagus itself was therefore recorded accurately before we inserted the endoscope into the submucosal tunnel, since the insertion depth of the endoscope in the submucosal space is almost the same as the accurate position of the endoscope in the true lumen. The submucosal tunnel created ends at least 3 cm distal to the estimated GEJ. The second indicator is a marked increase of resistance when the endoscope approaches the GEJ, followed by a prompt easing when the endoscope passes through the narrow GEJ and enters the stomach submucosal area. The working space in the submucosal tunnel also becomes gradually narrower when the endoscope approaches closely to the LES. At the LES segment, movement of the endoscope is obviously limited with high resistance. Once the endoscope has passed through this narrow segment, the submucosal space promptly widens adjacent to the stomach. The third indicator is endoscopic visual identification of palisade vessels in the submucosal layer. Palisade vessels are located at the distal end of the esophagus. These vessels were endoscopically identified in all cases. Finally, the fourth indicator is a change of vasculature in the submucosal layer. In the esophageal submucosal space few vessels are observed in the submucosal layer, but when the stomach is reached the submucosal vasculature suddenly becomes rich looking like a spiderweb.

Ensuring that the submucosal tunnel stays in line with the esophagus is another issue. When we introduce the cap-fitted endoscope into the submucosal space and then push it, the endoscope tends to advance only in line with the esophagus. The submucosal tunnel has an elliptical cross-section and the round tip of the cap-fitted endoscope tends to move to the center of the ellipse. Another question is on which side myotomy should be done. Anterior myotomy in the 2 o’clock segment in the supine position seems most appropriate, as this leads to the lesser gastric curvature. In contrast, the angle of His angle is located in the 8 o’clock direction. Anterior myotomy potentially avoids damage to the angle of His, which may be a natural barrier to postoperative reflux of gastric content. The related topic of gastroesophageal reflux disease (GERD) should be discussed. In surgical myotomy an antireflux measure, such as a Dor procedure, is also carried out in order to avoid postoperative GERD, since adjacent structures surrounding the distal esophagus are inevitably dissected which may impair natural antireflux mechanisms. With POEM no antireflux procedure is carried out, since the endoscopist never touches surrounding structures. However, complete myotomy potentially may have a risk for post-therapeutic GERD [9]. In fact, in our series one patient complained of mild reflux symptoms with esophagitis of Los Angeles grade B. Therefore, this should...
be further investigated. No evidence of reflux could be found in the other 16 patients.

In this series, a long myotomy with long submucosal tunnelling was done in most of the patients, but none showed clinically manifest mediastinitis. This suggests that the tight closure of the mucosal entry site using the endoscopic clipping device securely avoids the development of severe mediastinitis. Even though minor pneumomediastinum was seen by CT scan just after POEM, it was related to no significant clinical symptoms. This phenomenon is similar to the pneumomediastinum seen post ESD [10].

A major benefit of POEM may be avoidance of the risk of the unexpected and uncontrolled perforation that may occur during balloon dilation [11].

The application of POEM was extended in this series to five consecutive cases of S1 sigmoid achalasia. The dysphagia symptom score was dramatically reduced in all cases. The LES pressure also decreased to the normal range, although it was higher than that of the sigmoid group. This fact suggests that even for sigmoid achalasia, of the S1 type, POEM may be an appropriate treatment. Further evaluation for this subgroup is necessary.

If POEM were not effective, one could proceed to a laparoscopic operation more easily than following failure of laparoscopic surgery, because POEM does not involve adjacent tissue surrounding the esophagus. Reoperation after failure of laparoscopic myotomy often requires open surgery [12, 13].

In conclusion, our initial case series of POEM, a novel less invasive endoscopic procedure for esophageal achalasia, shows good short-term results without serious complications. Long-term results and those from larger series will tell more about its final role in the treatment of achalasia.

Competing interests: None

References
2 Spiess AE, Kahrilas PJ. Treating achalasia: from whalebone to laparoscopy. JAMA 1998; 280: 638
10 Taniya Y, Nakahara K, Kominato K et al. Pneumomediastinum is a frequent but minor complication during esophageal endoscopic submucosal dissection. Endoscopy 2010; 42: 8–14
11 Vantrappen G, Janssens J. To dilate or operate? That is the question. Gut 1983; 24: 1013–1019