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Comparison of peroral endoscopic myotomy between de-novo achalasia and achalasia with prior treatment

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Abstract

Peroral endoscopic myotomy has been recognized as an effective treatment for patients with achalasia. Prior treatment may affect the outcome of subsequent treatment. We aimed to compare the safety and efficacy of POEM in treatment-naive patients vs. those with prior treatment failure. We retrospectively analyzed the data of achalasia patients who underwent POEM from November 2011 to January 2018. A comparative analysis was performed between De-Novo (DN) and Prior Treatment Failure (PTF) cases. Technical and clinical success, adverse events, operative time for POEM, hospital stay were compared between the two groups Overall, 209 patients with achalasia underwent POEM during the studied period, including 113 patients (54%) in the DN group and 96 patients (45%) in the PTF group. The baseline characteristics of the DN and PTF groups were not significantly different except for duration of disease. The PTF group had longer disease duration than the DN group. (7.92 ± 9.28 vs 4.45 ± 5.67 years, respectively, $p = 0.005$). Both groups were technically successful. Operative time was longer in the PTF group than that in the de-novo group, but the difference was not significant. The occurrence rates of complications were similar in both groups. Changes in the Eckardt score were comparable in the DN and PTF cases. IRP and LES pressure decreased after POEM. After 6 months, more patients suffered from reflux symptoms in the PTF group, but DeMeester score and endoscopic evaluation were not significantly different POEM is safe and equally effective for patients with prior treatment failure as well as de-novo patients up to 6 months post treatment.

Keywords Esophagus · Achalasia · Peroral endoscopic myotomy · Failure · De-Novo

Achalasia is a rare motility disorder of the esophagus due to enteric neuron damage of the lower esophagus sphincter (LES). Neuronal loss cause dysphagia, respiratory symptoms, weight loss, chest pain, and regurgitation as a consequence of absence of peristalsis and impaired relaxation of LES [1]. Current treatment modalities do not cure achalasia as they cannot repair the neuronal loss. All treatment modalities aim to control symptoms. These modalities include pneumatic balloon dilation (PBD), botulinum toxin injection (BTI), Heller myotomy (HM), and peroral endoscopic myotomy (POEM) [2]. POEM has been recognized as an effective treatment for patients with achalasia [3]. LHM is superior to PBD and BTI in terms of its long-term outcomes. It is comparable to POEM in the terms of long-term outcomes, and POEM has the advantage of being a less invasive modality and having shorter hospital stay and less postoperative pain [4].

As POEM emerged as a new method for achalasia, some patients received other treatment modalities before the POEM era. Prior treatment modalities may affect the outcome of POEM [5]. It is required to reach the submucosal space for myotomy during the process of POEM. Prior interventions may affect this space, and it may become a technically demanding and complex process. Previous studies investigated the effects of prior interventions on POEM outcomes [5, 6]. However, the influence of previous treatment on subsequent management is not well known. We aimed to compare the safety and efficacy of POEM in De-Novo patients (DN) vs. those with prior treatment failure (PTF).

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Materials and methods

This study was conducted retrospectively at a single tertiary medical center. Past medical records were reviewed. Patients who underwent POEM between November 2011 and March 2018 were included in the study. Patients who did not provide informed consent and patients under 18 years of age were excluded from the study. 4 patients were not included in the study as they did not give informed consent. Local ethics committee approved the study (CHAMC). Two groups were created based on prior intervention for achalasia treatment (DN and PTF). A comparative analysis was performed between the two groups. Technical and clinical success, adverse events, and operative time for POEM were compared between the two groups.

Two groups were created based on prior intervention for achalasia treatment (DN and PTF). A comparative analysis was performed between the two groups. Technical and clinical success, adverse events, and operative time for POEM were compared between the two groups.

The patients were diagnosed with achalasia and other esophagus motility disorders after being evaluated with esophagogastroduodenoscopy, high-resolution manometry, and timed barium esophagograms. The demographic characteristics of the patients (age, sex, previous medical history, etc.), their duration of disease, prior treatment for achalasia and achalasia subtypes were recorded. Eckardt scores were used for the pre-POEM period and 6 months after POEM for symptom evaluation. LES pressure, IRP (Integrated Relaxation Pressure), and DCI (Distal contractile integral) were evaluated with HRM (Insight G3 HRiM, Sandhill). Differences between the values before and 6 months after POEM were analyzed.

DI (Distensibility index) and CSA (Cross-sectional area) were evaluated with an EndoFlip® probe (Endoluminal Functional Lumen Imaging Probe; Crospon, Galway, Ireland) before POEM. DeMeester score (normal < 14.7) and total acid exposure % (normal < 4.2) were measured by 24-hour pH monitoring before and 6 months after the procedure.

POEM was performed by experienced therapeutic endoscopists in an operating room. All patients received general anesthesia. POEM was performed as described in previous studies [3, 7]. It consisted of four steps similar to previous techniques. The mucosa is lifted with submucosal injection, mucosal incision is enlarged vertically, a submucosal tunnel is created by dissection of submucosal fibers and myotomy, and the entry site is closed with clips. Myotomy approach was decided by the experienced endoscopist (JYC).

Intraoperative parameters were recorded. Operation time was defined as time between beginning of the mucosal incision and placement of the last clip for mucosal incision closure. Orientation of the POEM approach (posterior or anterior), length of esophagus myotomy and stomach myotomy, submucosal tunnel length, and extent of myotomy were compared between the two groups. Nil per Os (NPO) days and hospital stay were other parameters that were assessed. After the patients were discharged, they were followed up for 6 months. Clinical symptoms were assessed with Eckardt scores, while gastroesophageal reflux symptoms were assessed with GERD-Q questionnaire before and 6 months after POEM. GERD-Q is a 6-item, easy to use questionnaire that was developed primarily as a diagnostic tool for GERD. For patients with a total GERD-Q score of nine or more 92% had an objectively verified GERD [8]. 24-h pH monitoring, EndoFlip®, esophageal HRM, and endoscopy were performed after 6 months. The functional luminal imaging probe (FLIP) is catheter-based system which is used to measure esophagogastric junctıon distensibility index (DI). DI measurements correlate with symptom burden. Furthermore it can be used to visualize the distention mediated esophagus peristaltism and categorize achalasia [9].

Differences in the Eckardt scores were measured by subtracting the mean pre-POEM Eckardt score from the mean post-POEM Eckardt score. Differences in LES pressure were measured by subtracting the mean pre-POEM LES pressure from the mean post-POEM LES pressure. Differences in IRP were measured by subtracting the mean pre-POEM IRP values from the mean post-POEM IRP values.

Adverse events were classified into two groups (major adverse events and minor adverse events) according to the information reported by a previous study [5]. Major adverse events were described as hemodynamic instability, necessitating premature termination of the procedure, major bleeding requiring blood transfusion (intraoperative), and mucosal injuries that could not be closed with regular hemostatic clips. Minor adverse events were defined as gas-related events that could be managed with needle decompression and mucosal injuries that could be comfortably closed with regular hemostatic clips. Postoperative complications like pleural effusion, atelectasis, delayed bleeding were also recorded.

Technical success was defined as successful completion of the entire POEM procedure. clinical success was defined as a post-POEM Eckardt score of ≤ 3.

Statistical analysis was performed with SPSS ver. 22 (SPSS. Inc., Chicago, IL, USA). The continuous variables are expressed as mean ± standard deviation (SD). The categorical variables are expressed as percentages. The distribution of the variables was analyzed by the Kolmogorov–Smirnov method. Student's *t* test or Mann–Whitney *U* test were used for continuous variables where appropriate. The categorical variables were compared by Chi-squared test

and Fischer test where appropriate. A p value of < 0.05 was considered statistically significant.

Results

A total of 209 patients were included in the study. 113 (54%) patients received de-novo POEM, and 96 (46%) patients underwent POEM after failure of previous treatment. The baseline characteristics of patients can be seen in Table 1. There were no significant differences between the two groups except for duration of disease. The PTF group had longer disease durations than the DN group (7.92 ± 9.28 vs. 4.45 ± 5.67, respectively). Type II achalasia was the most common subtype of achalasia in the DN group (48, 42.5%), while Type I was the most common subtype in the PTF group (43, 44.8%). Both groups had the same rate of the sigmoid type of achalasia.

Previous treatments can be seen in Table 2. 17 patients (17.7%) received two or more treatment modalities, while 79 (82.3%) received one treatment modality. The majority of the patients received either BTI or PBD. None of the patients received non-pneumatic balloon dilatation. All patients received pneumatic balloon dilatation above 30 mm or 35 mm in the PBD group. The numbers of the sessions for the BTI group were not classified.

The processes of esophageal HRM evaluation and 24-hour pH monitoring before the POEM procedure may be seen in Table 3. The LES pressure in the DN group was significantly higher than the PTF group (37.70 ± 17.81 vs. 26.44 ± 19.19, respectively). The IRP values of the DN group were significantly higher than the PTF group (31.24 ± 20.25 vs. 20.31 ± 13.18, respectively). There were no significant differences with respect to the DeMeester scores and total acid exposure times between the groups. The DI and CSA values were determined with EndoFlip®. The PTF group had significantly higher DI values in comparison to DN group (3.56 ± 3.29 vs 1.66 ± 1.17, respectively). PTF group had significantly higher CSA values in comparison to the DN group (95.13 ± 77.66 vs. 95.13 ± 77.66, respectively).

Technical success was 100% for both groups. None of the patients' procedures were interrupted prematurely due to adverse events. There was no significant difference between the submucosal tunnel lengths in the groups. The total length

Table 2 Previous treatments

Previous treatment, *n* (%)	PTF group (*n* = 96)
Botulinum toxin injection (BTI)	33 (34.4)
Pneumatic balloon dilatation (PBD)	37 (38.5)
Laparoscopic heller's myotomy (LHM)	2 (2.1)
Peroral endoscopic myotomy (POEM)	7 (7.3)
Botox + PBD	9 (9.4)
Botox + PBD + POEM	1 (1.0)
Botox + POEM	2 (2.1)
PBD + LHM	3 (3.1)
PBD + POEM	2 (2.1)

Table 1 Baseline characteristics of patients

	DN group (*n* = 113)	PTF group (*n* = 96)	*p* value
Sex (M:F)	54: 59	44: 52	0.778
Age, year	43.19 ± 14.95	44.19 ± 16.41	0.701
Height, cm	164.12 ± 9.03	164,14 ± 9.63	0.804
Weight, kg	60.93 ± 12.16	61.93 ± 14.71	0.885
BMI, kg/m^2	22.61 ± 3.70	22.66 ± 3.84	0.916
Duration of disease, year	4.45 ± 5.67	7.92 ± 9.28	***0.005****
Eckardt score	6.42 ± 2.35	6.39 ± 2.65	0.322
Sigmoid type of achalasia, *n* (%)	8 (7.6)	10 (11.6)	0.393
Diameter of dilated esophagus, cm	3.63 ± 1.23	3.65 ± 1.63	0.718
Esophagus width > 6 cm *n* (%)	3 (2.6)	7 (7.3)	0.118
Achalasia subtype, *n* (%)			
Type 1	37 (32.7)	43 (44.8)	0.132
Type 2	48 (42.5)	34 (35.4)	
Type 3	16 (14.2)	9 (9.4)	
DES	2 (1.7)	1 (1.03)	
Jackhammer	2 (1.7)	1 (1.03)	
EGJOO	8 (7.2)	7 (7.3)	
Nutcracker esophagus	0	1 (1.03)	

BMI body mass index, *DES* Diffuse esophagus spasm, *EGJOO* Esophagogastric junction outflow obstruction, *PTF* Previous treatment failure, *DN* De-Novo

Table 3 Comparison of HRM, 24-hour PH monitoring, and endoflip (before POEM)

	DN group ($n=113$)	PTF group ($n=96$)	p value
High resolution manometry (HRM)			
LES pressure, mmHg	37.70 ± 17.81	26.44 ± 19.19	< 0.001*
IRP, mmHg	31.24 ± 20.25	20.31 ± 13.18	< 0.001*
24-hour PH monitoring			
DeMeester score (normal < 14.7)	2.34 ± 5.24	4.49 ± 12.18	0.086
Total acid exposure time, % (normal < 4.2)	1.56 ± 2.86	2.45 ± 4.20	0.253
Endoflip			
DI, mm^2/mmHg	1.66 ± 1.17	3.56 ± 3.29	< 0.001*
CSA, mm^2	95.13 ± 77.66	95.13 ± 77.66	0.004*

DI Distensibility index, *CSA* Cross-sectional area, *LES* Lower esophageal sphincter, *IRP* Integrated Relaxation Pressure

of myotomy, esophageal length of myotomy, and stomach length of myotomy did not differ significantly between the DN and PTF groups. The mean operation time was longer in the PTF group than the DN group. However, the difference did not reach the significant level (76.52 ± 32.27 vs. 74.08 ± 31.93, respectively). Orientation of myotomy did not differ significantly between the groups. The anterior approach was the most common approach (64 patients (56.6%) in the DN group, 56 patients (58.3%) in the PTF group), but the difference was not significant. The mean values of days spent in hospital until discharge, and the mean days NPO were similar between the two groups (Table 4).

Distribution of adverse events was similar in both groups. 52 (46%) patients had adverse events due to procedures in the DN group, while 66 (68.7%) patients suffered adverse events in the PTF group (Table 5). Gas-related events, major bleeding that requiring transfusion, mucosal injuries are perioperative complications, while pleural effusion, atelectasis, delayed esophageal hematoma are all postoperative complications which were detected after follow-up x-ray and endoscopy. Major bleeding that requires blood transfusion was the most common major adverse event in both groups. 2 of the 113 (% 1.7) patients had bleeding requiring blood transfusion in TNF group, 4 of the 96 (% 4.1) patients in PTF group had bleeding requering blood transfusion. There was no mucosal injury that could not be closed with standard clips. One patient's mucosal injury had to be repaired with a stent and detachable snare. None of the procedure had to be terminated.

There was no difference in the mean of minor adverse events between DN and PTF groups Gas-related events were the most common minor adverse events in both groups (Table 5). Pleural effusion, pneumonia, delayed esophageal hematoma, and mucosal injury that could be closed with regular hemostatic clips were the other minor complications that did not affect the outcome of the procedure (Fig. 1). One patient's procedure was ceased temporarily. This patient's procedure was changed to Open POEM because of severe

Table 4 POEM procedural data

	De-Novo group ($n=113$)	PTF group ($n=96$)	p value
Technical success, n (%)	113 (100%)	96 (100%)	NA
Submucosal tunnel length, cm	11.84 ± 2.57	11.90 ± 2.35	0.924
Length of myotomy, cm			
Esophagus	7.22 ± 2.27	7.11 ± 1.97	0.630
Stomach	1.81 ± 0.59	1.82 ± 0.54	0.979
Extent of myotomy, n			0.204
Full thickness	15	18	
Selective inner circular	98	78	
Orientation of myotomy			0.935
Anterior	64	56	
Posterior	49	35	
Other	0	5	
Operation time, minute	74.08 ± 31.93	76.52 ± 32.27	0.539
Duration of NPO, day	5.23 ± 1.51	5.28 ± 1.46	0.884
Hospital stay, day	7.23 ± 1.51	7.28 ± 1.46	0.884

Table 5 Adverse events

	Treatment-naive group ($n=113$)	PTF group ($n=96$)	p value
Adverse event, n (%)	52 (% 46.0)	66 (% 68.7)	0.214
Perioperative complication (within 30 min)	0	0	
Major events	2	4	0.417*
Hemodynamic instability	0	0	
Necessitating premature termination of POEM	0	0	
Major bleeding (requiring blood transfusion)	2 (% 1.7)	4 (% 4.1)	0.417*
Mucosal injuries (could not be closed with regular hemostatic clips)	0	0	
Minor events	50 (% 44)	62 (% 64.5)	0.421
Gas-related events	14 (% 12.4)	19 (% 19.8)	0.277
Pleural effusion	13 (% 11.5)	13 (% 13.5)	0.513
Pneumonia	1 (% 0.08)	5 (% 5.2)	0.096*
Atelectasis	6 (% 5.3)	11 (% 11.5)	0.105
Delayed esophageal hematoma	3 (% 2.6)	2 (% 0.2)	0.999*
Mucosal injury (could be closed with regular hemostatic clips)	12 (% 10.6)	10 (% 10.4)	0.962
Temporary cessation of the procedure (changed to Open POEM because of severe fibrosis)	1 (% 0.08)	0 (% 0)	0.999
Others	0 (% 0)	2 (% 0.2)	0.210

*Fisher exact test was used. Chi-square test was used for the other comparisons

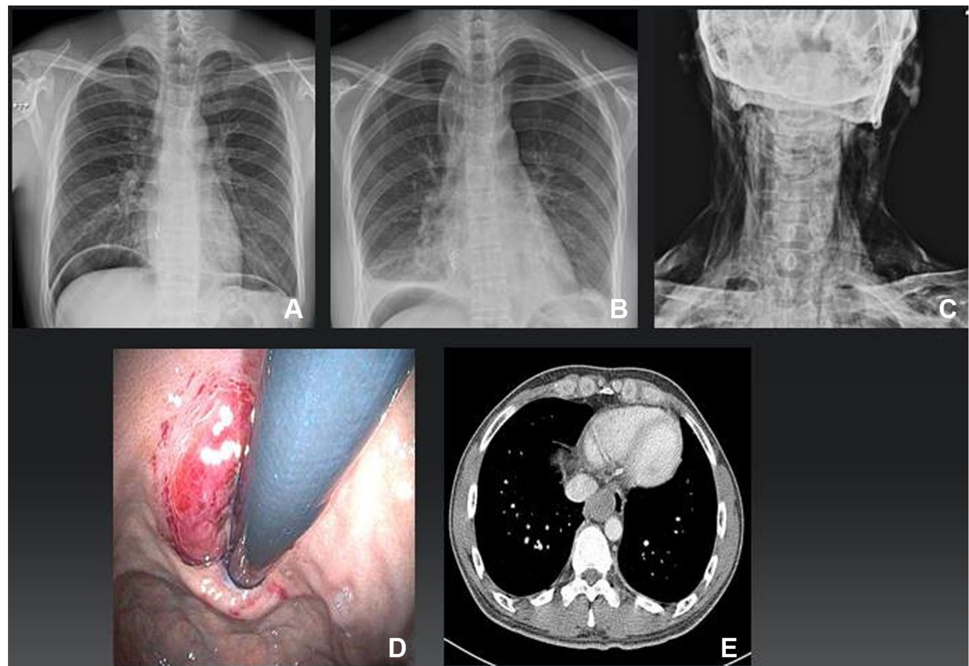

Fig. 1 Adverse events during POEM: **A** Capnoperitoneum, **B** Pleural effusion, **C** Subcutaneous emphysema **D**, **E** delayed esophageal hematoma

fibrosis, and the patient needed conservative treatment for combined gas-related complication (Fig. 2).

The patients were followed up for 6 months. Patients were evaluated with GERD-Q score for gastroesophageal reflux symptoms. There were significantly more patients who had reflux symptoms in the PTF group than in the DN group. 41 patients (36.2%) in the DN group had reflux symptoms, while 47 (49%) patients had reflux symptoms in the PTF group 6 months after POEM. Endoscopic esophagitis, 24-hour pH monitoring did not correlate well with the patients' symptoms. The DeMeester scores and total acid exposure times were similar between the groups.

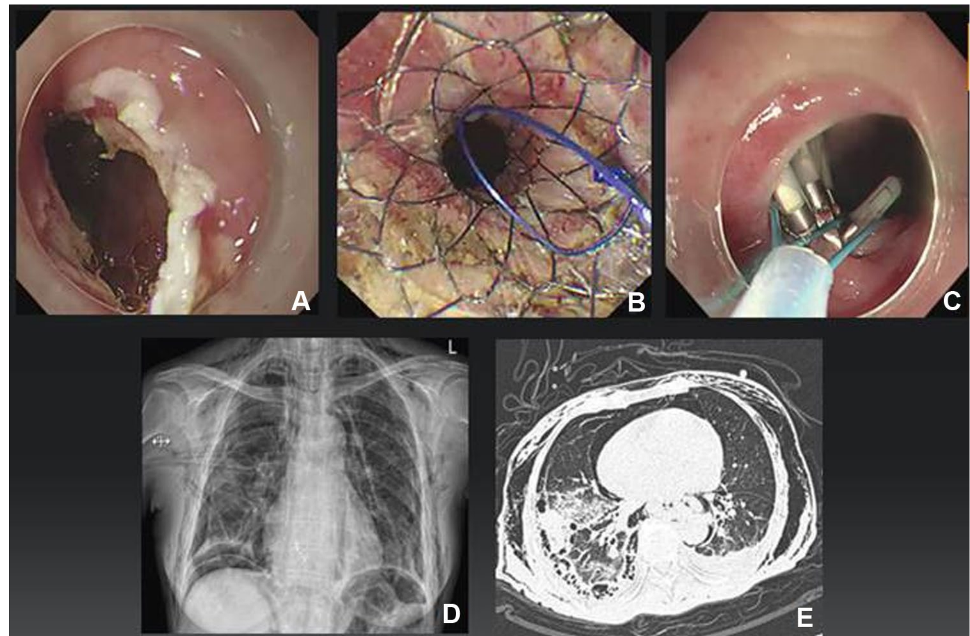

Fig. 2 Adverse events during POEM: **A, B, C** Tunnel perforation treated with esophageal stent and detachable snare **D, E** Combined gas-related complication treated with conservative treatment

Table 6 Incidence of GERD after procedure (6 month later)

	De-Novo group (n = 113)	PTF group (n = 96)	p value
Clinical symptoms (Yes: No), n	41: 71	47: 46	0.045*
Esophagitis by endoscopy (Yes: No), n	14: 99	18: 78	0.204
LA classification			
Normal	55	45	0.190
Minimal change	20	15	
A to D	33	29	
24-h PH monitoring			
DeMeester score (normal < 14.7)	10.78 ± 12.64	16.35 ± 21.50	0.086
Total acid exposure time, % (normal < 4.2)	4.27 ± 5.80	4.87 ± 4.69	0.253

Distribution of esophagitis was also similar between the two groups (Table 6).

The DN and PTF groups had similar clinical success levels. There was no significant difference. 107 (94.6%) patients' Eckardt scores were equal to or smaller than 3 in the DN group, and 91 (94.7%) patients' Eckardt scores were equal to or smaller than 3 in the PTF group at the 6-month follow-up. The differences in the Eckardt scores before and after POEM were similar between the two groups (Table 7). LES pressure and IRP values were measured 6 months after POEM. LES pressure and IRP decreased in both groups after POEM. Differences in LES pressure and IRP were analyzed for both groups. The DN group's difference in LES pressure was significantly higher than that in the PTF group (22.88 ± 18.17 vs. 8.83 ± 18.10, respectively). The DN group's difference in IRP was significantly higher than that in the PTF group (18.02 ± 21.92 vs. 7.32 ± 14.21, respectively).

Discussion

This study revealed that there was no statistically significant difference in the clinical outcomes, adverse events, and technical success levels between the PTF and DN groups.

The effect of prior interventions on POEM outcome is matter of debate. Endoscopic submucosal surgery is a new concept that enables decreasing the complications of conventional surgery and laparoscopic surgery, and it has many advantages over them [10]. POEM is derived from this concept that uses the submucosal area for myotomy of the distal esophagus which causes symptoms in achalasia. Inflammation is an inevitable consequence of the prior interventions. Submucosal fibrosis due to inflammation may preclude the operator to create a submucosal tunnel and perform myotomy easily, but it has been shown that high clinical success can be achieved in patients with prior HM in case report series [11, 12].

Table 7 Clinical success, LES pressure, and IRP change (6 months later)

	Treatment-naive group($n=113$)	PTF group ($n=96$)	p value
Clinical success (Eckardt score ≤ 3)	107 (94.6%)	91 (94.7%)	0.978
Eckardt score			
Before POEM	6.42 ± 2.35	6.39 ± 2.65	
After POEM	1.32 ± 1.45	1.37 ± 1.37	
Difference of Eckardt score	5.09 ± 2.37	5.02 ± 2.50	0.822
LES pressure			
Before POEM	37.70 ± 17.81	26.44 ± 19.19	
After POEM	15.38 ± 10.18	15.49 ± 10.46	
Difference of LES pressure	22.88 ± 18.17	8.83 ± 18.10	0.001*
IRP			
Before POEM	31.24 ± 20.25	20.31 ± 13.18	
After POEM	12.11 ± 8.03	11.72 ± 7.29	
Difference of IRP	18.02 ± 21.92	7.32 ± 14.21	0.004*

It was expected that the patients in the PTF group would have longer durations of disease. Previous studies showed that patients with prior intervention had longer disease durations [3, 13]. Our study reiterated these results. Our PTF cohort also had longer disease durations than the DN group.

It may be expected that learning curve can affect technical success because of submucosal fibrosis. One study observed that technical success was 97.6%, while our study's technical success result was 100% [5]. Although there is no significant difference, our hundred percent technical success may be a consequence of experienced endoscopist who performed all the procedures. Neither the study by Nabi et al. [5] nor our study showed significant differences in technical success between the DN and PTF groups One study conducted by Louie et al. reported that only one patient's procedure could not be finished [6]. It seems that learning curve does not have a significant impact on technical success. Other studies also showed near one hundred percent technical success rates [13–16] Submucosal fibrosis and unintentional mucosal extension are the most common reasons of incomplete POEM procedures.

Present study revealed no difference in the operation times between the DN and PTF groups. Our study reiterated the results of some previous studies [14, 17]. Two studies compared outcomes of patients without prior HM and patients with prior HM. Kristensen et al. showed that patients with prior HM had longer operation durations than patients without prior HM [13]. Ngamruengphong's results conflicted those of Kristensen's study. There was no difference with respect to operation times between the groups [16]. Louie et al. showed that operation time of patients with prior myotomy and PBD with over 30 mm or sigmoid esophagus had longer operation times than de-novo patients or patients who previously received treatment with balloon dilatation below 30 mm or BTI and without sigmoid esophagus [6]. Their study compared the outcomes of POEM in three groups. One group was defined as the most complex group. The group's patients had prior myotomy (surgical or endoscopic) and PBD with over 30 mm or with sigmoid esophagus. The group's operation times were longer than the other two groups. Our study created two groups based on prior intervention. The difference between our study and other studies in terms of their results may be explained by this.

Nabi created groups similar to those in this study and showed longer operation durations for their PTF group. The author did not mention the experience of the operator. The difference may be explained by the experience levels of this study's operators [5].

Submucosal tunnel length and length of myotomy was similar between the DN and PTF groups in this study. Most studies that compared de-novo and PTF patient results were similar to this study. There was no significant difference between the de-novo and prior treatment failure patients [5, 6]. However, one study showed that only patients with type III achalasia received longer myotomy procedures. Two studies based on groups in which patients received prior HM or not showed controversial results [13, 16]. One study showed no difference with respect to length of esophageal and stomach myotomy [16]. The other study reiterated this study's result with respect to esophageal myotomy but showed longer length of stomach myotomy for patients without HM [13]. All these results may be interpreted as that only patients without HM need longer stomach myotomy, and patients with type III achalasia need longer myotomy lengths. The POEM operator may be cautious about this issue.

Extent of the myotomy was similar between the two groups. One study also did not find a significant difference between patients with and without HM [16]. The orientation of myotomy (anterior or posterior) is important for late

consequences of POEM like gastroesophageal reflux. POEM has an advantage over HM that the operator can choose the orientation of myotomy, but an HM operator cannot. This orientation selection advantage can also explain the success of the POEM in the PTF patients. Previous studies also did not report a significant difference with respect to the orientation of myotomy [5, 16].

None of the previous studies aimed to investigate the effects of type of achalasia and prior intervention on POEM outcomes together. Only Louie et al. classified patients into sigmoid or non-sigmoid types of achalasia. Sigmoid-type achalasia patients had longer operation times than non-sigmoid-type achalasia patients [6]. Nabı'z et al. reported that type III achalasia is an independent predictor for operation times of longer than 60 min. One study reported that type of achalasia did not have any significant effect on clinical outcomes [16]. The rate of the type of achalasia and sigmoid-type achalasia were similar between the two groups in this study. This may be interpreted as that type of achalasia and esophagus type may have an effect on PTF patients regarding clinical outcomes, technical success, and adverse events.

There was no significant difference in the adverse events between the PTF and DN groups. The only major adverse event was major bleeding requiring blood transfusion in this study. Previous studies reported various types of major adverse events. Our results reiterated previous studies' findings [6, 14–16]. No study reported a significant difference between groups similar to those in our study with respect to adverse events. The most commonly seen minor adverse events were gas-related events in this study. Most were managed by intraoperative needle decompression for the pneumoperitoneum. Only one patient's procedure was interrupted temporarily because of severe fibrosis. The procedure was changed to Open POEM because of fibrosis, and a stent was inserted after the procedure. There was no complication after the procedure, it was finished successfully. Open POEM was first introduced by Lie group in 2017. Direct peroral endoscopic myotomy without a submucosal tunnel for the treatment of achalasia. Mucosa and submucosa incision, and myotomy were performed simultaneously for this patient [18].

Iatrogenic gastroesophageal reflux disease (GERD) is the most common late sequelae of POEM. One systematic review reported that 19% of patients suffered from GERD symptoms after POEM, but abnormal pH monitoring results were found in 39%, and esophagitis was observed in 29.4% [19]. Their study observed that the risk of iatrogenic GERD after POEM was higher than LHM. One study reported no difference in symptomatic GERD and endoscopic esophagitis between patients with and without HM [16]. Another similar study found that patients with HM had higher rates of GERD symptoms than patients without HM at a 3-month follow-up, but the difference disappeared at 6-month and 1-year follow-ups [13]. Other previous studies that compared de-novo and PTF patients found no significant difference between groups with respect to GERD symptoms, 24-h pH monitoring, DeMeester scores or endoscopic esophagitis [5, 15]. Some studies used scoring systems like the GERD Health-Related Quality of Life Questionnaires (GERD-HRQL). The mean scores of the DN and PTF groups in their studies were similar [6, 14, 17]. This study found controversial result with respect to GERD-Q score. The rate of patients with higher GERD-Q score in the PTF group 6 months after POEM was significantly higher than that in the DN group but there was no significant difference in the DeMeester scores, total acid exposure times, and endoscopic esophagitis between groups.

The overall clinical success rate was 94.7% at the 6-month follow-up. 198 patients' Eckardt scores were equal to or smaller than 3, and there was no significant difference between the two groups. The post-POEM mean Eckardt scores of the two groups decreased in comparison to their pre-POEM Eckardt scores. Furthermore, the differences in the Eckardt scores were similar between the two groups. Previous studies that compared de-novo and prior treatment patients observed similar results [5, 6, 15]. One study evaluated patients with dysphagia, and there was no significant difference in dysphagia symptoms after POEM between the groups. One study found a tendency of symptom recurrence in 1, 2, and 3 years of follow-up. The overall success rate they reported decreased in 1, 2, and 3 years of follow-up [5]

Two studies found controversial results with respect to clinical success. Patients with prior HM were significantly associated with clinical failure after POEM in these studies [13, 16]. One study performed multivariate analysis to find predictors of clinical failure. It was found that prior HM and PBD are independent risk factors for clinical failure [16].

Although the DN group's difference of LES pressure and difference of IRP were significantly higher than those in the PTF group, there was no significant difference in clinical success which was defined as an Eckardt score of 3 or lower. One study observed that the mean values of IRP and LES pressure were similar in both groups, and there was no other study that provided data about differences in IRP and LES pressure.

Conclusion

POEM is safe and equally effective for patients with prior treatment failure as well as de-novo patients up to 6 months post treatment. In the future, large-scale and long-term studies will be required to confirm that POEM can be safe and effective as a treatment of achalasia in comparison to other treatment modalities.

Compliance with ethical standards

Disclosure Abdullah Ozgur Yeniova, In kyung Yoo, Eunju Jeong, and Joo Young Cho have no conflicts of interest or financial ties to disclose.

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