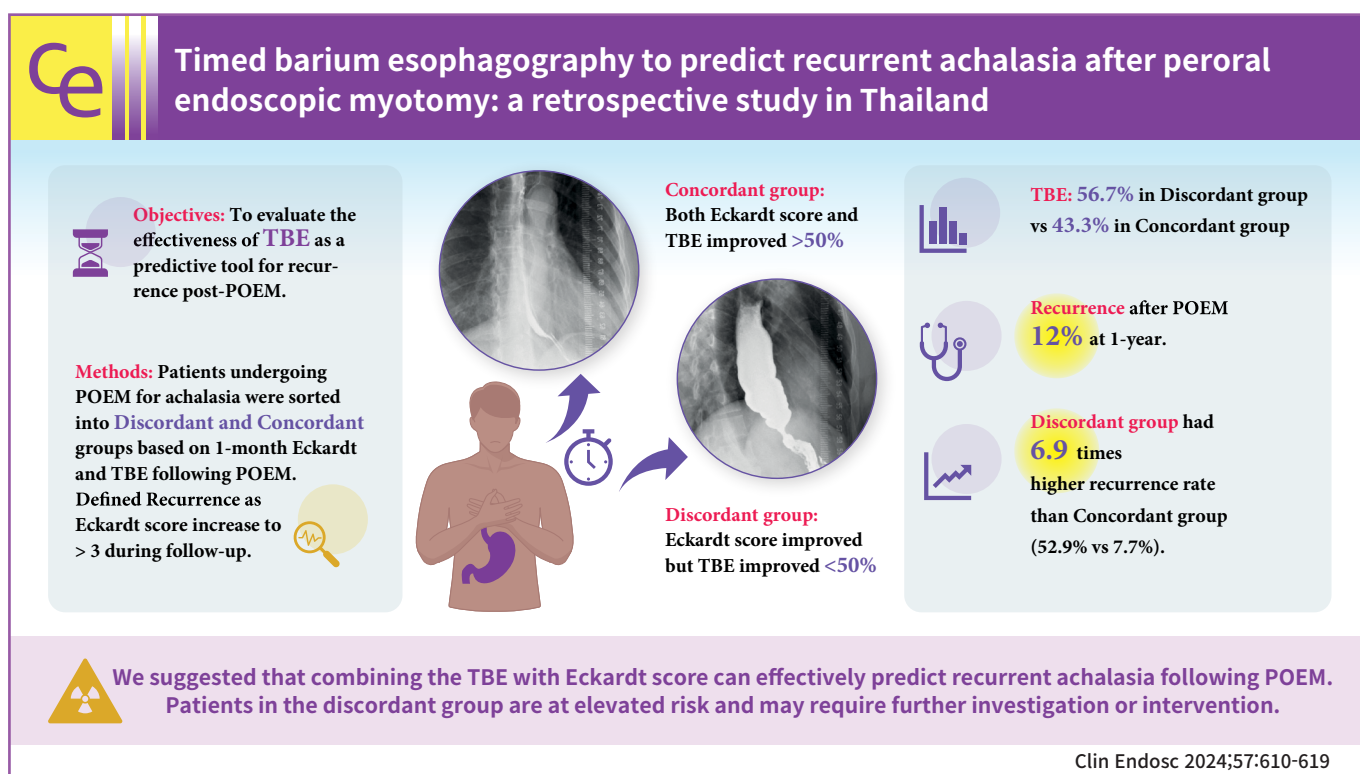# ORIGINAL ARTICLE

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CLINICAL ENDOSCOPY

Timed barium esophagography to predict recurrent achalasia after peroral endoscopic myotomy: a retrospective study in Thailand

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Timed barium esophagography to predict recurrent achalasia after peroral endoscopic myotomy: a retrospective study in Thailand

Objectives: To evaluate the effectiveness of **TBE** as a predictive tool for recurrence post-POEM.

Methods: Patients undergoing POEM for achalasia were sorted into Discordant and Concordant groups based on 1-month Eckardt and TBE following POEM. Defined Recurrence as Eckardt score increase to > 3 during follow-up.

Concordant group: Both Eckardt score and TBE improved **>50%**

Discordant group: Eckardt score improved but TBE improved **<50%**

TBE: 56.7% in Discordant group vs **43.3%** in Concordant group

Recurrence after POEM **12%** at 1-year.

Discordant group had **6.9** times higher recurrence rate than Concordant group (52.9% vs 7.7%).

We suggested that combining the TBE with Eckardt score can effectively predict recurrent achalasia following POEM. Patients in the discordant group are at elevated risk and may require further investigation or intervention.

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Background/Aims: Achalasia is a rare esophageal motility disease, for which peroral endoscopic myotomy (POEM) has emerged as a promising treatment option; however, recurrence remains a challenge. Timed barium esophagography (TBE) is a useful diagnostic tool and potential outcome predictor of achalasia. This study aimed to determine predictive tools for recurrence after POEM.

Methods: This retrospective study enrolled achalasia patients who underwent POEM between January 2015 and December 2021. Patients were categorized into two groups using the 1-month post-POEM Eckardt scores and TBE: the discordant group (Eckardt score improved >50%, TBE decreased <50%) and the concordant group (both Eckardt score and TBE improved >50%). Recurrence was defined as a reincrease in the Eckardt score to more than three during follow-up.

Results: Complete medical records were available in 30 patients who underwent POEM. Seventeen patients (56.7%) were classified into the discordant group, while 13 patients (43.3%) were in the concordant group. The overall recurrence rate was 11.9% at 1-year, increasing to 23.8% during the extended follow-up. The discordant group had a 6.87 fold higher recurrence rate than the concordant group (52.9% vs. 7.7%, *p*=0.017).

Conclusions: These results strongly suggest that combining the Eckardt score with TBE can effectively predict recurrent achalasia after POEM. Patients in the discordant group had an elevated risk.

Keywords: Eckardt score; Esophageal achalasia; Peroral endoscopic myotomy; Recurrent achalasia; Timed barium esophagography

INTRODUCTION

Achalasia is a rare disease affecting esophageal motility. The annual incidence of achalasia is approximately 0.5 to 2.8 cases per 100,000 individuals. Its primary characteristics include the absence of esophageal peristalsis, and persistent closure of the lower esophageal sphincter (LES), leading to dysphagia, regurgitation of undigested food, weight loss, and a decreased quality of life.[1] The diagnosis of achalasia primarily relies on endoscopy, manometry, and contrast-enhanced esophagography. High-resolution esophageal manometry (HRM) is the current gold standard diagnostic test, and is widely available in tertiary care hospitals. Other imaging techniques, such as timed barium esophagography (TBE), can also be used for diagnostic purposes.[2-5]

Treatment of achalasia aims to relax the LES, resulting in an improved flow of food and fluids from the esophagus to the stomach. Achalasia can be treated using a medical approach or mechanical relaxation of the LES, such as myotomy. Myotomy is the first line treatment in medically fit patients, which usually results in favorable outcomes. Current operative techniques include surgical Heller myotomy, employing either a laparoscopic or robotic approach, endoscopic pneumatic dilation (PD), and peroral endoscopic myotomy (POEM).[6,7] POEM is becoming more common as the location of the myotomy can be customized, even in cases requiring a high level and long length of myotomy, which may be necessary for the treatment of type III achalasia. As such, POEM can be effectively applied to treat all types of achalasia.[7-11]

Recurrence after treatment remains a significant challenge; however, there is currently no widely accepted definition of recurrent achalasia. In many trials, an Eckardt score >3 is often indicative of recurrence.[3,12,13] The incidence of recurrent achalasia not only depends on the type of achalasia, but also on the procedures performed. Previous studies have identified incidence rates of 8% in a 2-year follow-up after POEM, 20% to 35% in a 5-year follow-up after PD, and 20% in a 5-year follow-up after laparoscopic HM (LHM).[12,14,15]

For post-treatment assessment, clinical scoring methods, such as the Eckardt score, are widely used to assess disease severity and to serve as follow-up tools.[4] In addition, TBE is a potentially effective predictive tool as it is generally available and provides a time-related functional evaluation.[16,17] However, there have been few studies examining the utilities of TBE as a follow-up tool after treatment of achalasia.[3,18,19] In terms of follow-up after PD, TBE and Eckardt score are commonly used to monitor patients, and can be useful predictors of treatment outcomes, including recurrence.[3,20,21] There is currently limited evidence to predict outcomes after POEM.[18,22] Therefore, we conducted this study in order to validate TBE as one of follow-up tools to predict disease recurrence in achalasia patients who were treated with POEM.

METHODS

This retrospective study enrolled patients diagnosed with achalasia who were treated with POEM at Siriraj Hospital, the largest tertiary care hospital in Thailand. Patients who underwent POEM between January 2015 and December 2021 were

identified using an electronic documentation system. The exclusion criteria included patients with persistent achalasia, defined by the Eckardt score consistently >3 after POEM, those with incomplete data (i.e., lacking TBE or Eckardt scores before or after POEM, or loss of follow-up within one year), and those who had received prior treatment at other hospitals.

Peroral endoscopic myotomy

During the procedure, the patient was placed in the supine position under general anesthesia. After a full endoscopic examination, a mixture of 0.3% indigo carmine solution and normal saline solution was injected to create a cushion for mucosal entry via an endoscopic needle. A 2-cm vertical mucosal incision was created as an entry point, typically at 2 o'clock in anterior myotomy and at 5 o'clock in posterior myotomy, using a triangular-tip knife (Olympus). After the scope tip approached the submucosal layer, a straight submucosal tunnel, one-third the width of the circumference, was created downward using a non-touching technique with spray coagulation. The tunnel passed over the esophagogastric junction (EGJ) and extended approximately 3 cm into the proximal stomach. Subsequently, selective circular myotomy was performed, starting 2 cm distal to the mucosal entry. Muscle dissection was then performed along the esophagus, extending at least 8 cm above the EGJ, and continuing for a minimum of 2 cm distal to the EGJ. In cases of type III achalasia, a tailored myotomy length was implemented according to the preoperative manometry. Hemostatic clips were used to close the mucosal entry sites.[23]

Following POEM, patients were observed overnight and gradually transitioned to a liquid diet on postoperative day (POD) 1, soft diet on POD 2, and regular diet on POD 3.

Eckardt score

The Eckardt score is a subjective assessment tool which can be used to classify the severity of symptoms and follow-up of patients with achalasia. Interviews were conducted every visit, before and after treatment, to record total symptom scores, including dysphagia, regurgitation, retrosternal chest pain, and weight loss. The frequency of each symptom was rated on a scale of 0 to 3, with a maximum possible score of 12 points.[1,8-10,21]

Timed barium esophagography

The TBE method involves barium ingestion, followed by several sequential radiographs taken at 0, 1, 2, and, 5 minutes in the erect and left posterior oblique positions. Patients were required to withhold from consuming food and fluids the night before the procedure. After ingestion of a fixed volume (150 mL) of a low-density barium sulfate suspension (45% weight by volume; Solotop 140 mg/300 mL) within 15 to 20 seconds, sequential radiographs were captured and used for qualitative and quantitative interpretation.[2,5,16,17] (1) Quality evaluation: In the normal population, the esophagus typically empties the barium suspension within 1 minute for most individuals, and in less than 5 minutes for everyone. Therefore, residual barium in the esophagus beyond 5 minutes was suggestive of achalasia. (2) Quantity evaluation: The height of the barium column was measured at intervals >5 cm at 1 minute and >2 cm at 5 minutes, suggestive of achalasia. Additionally, a reduction of more than 50% in the post-treatment height in the same time interval was defined as successful treatment.

All patients underwent TBE and Eckardt score assessments before undergoing POEM. Esophagogastroduodenoscopy findings, such as the position of the EGJ, mucosal opening, mucosal myotomy, and esophagitis characteristics were also recorded. Following POEM, patients were scheduled for radiographic monitoring of disease response using TBE and clinical assessment using the Eckardt score at one-month post-POEM. Subsequently, clinical evaluations were performed every three months during the first year, and annually thereafter. "Recurrent achalasia" denoted cases in which there was a rise in the Eckardt score to more than 3 after an initial improvement following the POEM. Patients with an Eckardt score >3 without relief following POEM were classified as having "persistent achalasia", and were excluded from this study.[12,13,22]

The patients were divided into two groups based on the 1-month post-POEM Eckardt score and TBE: the discordant and the concordant groups. The discordant group comprised patients whose Eckardt scores improved by more than 50%, while the 1-month postoperative TBE results showed a decrease in barium height of less than 50% compared with that before POEM. The concordant group included patients whose post-POEM Eckardt scores and TBE results showed a significant improvement of >50% compared with those before treatment (Fig. 1).

Other collected information included sex, age, body mass index, signs and symptoms, symptom duration, endoscopic findings, achalasia type, and POEM operative details. The data were analyzed and compared between the discordant and the concordant groups. Statistical analysis was performed using the chi-square test and Fisher's exact test, as appropriate, for qual-
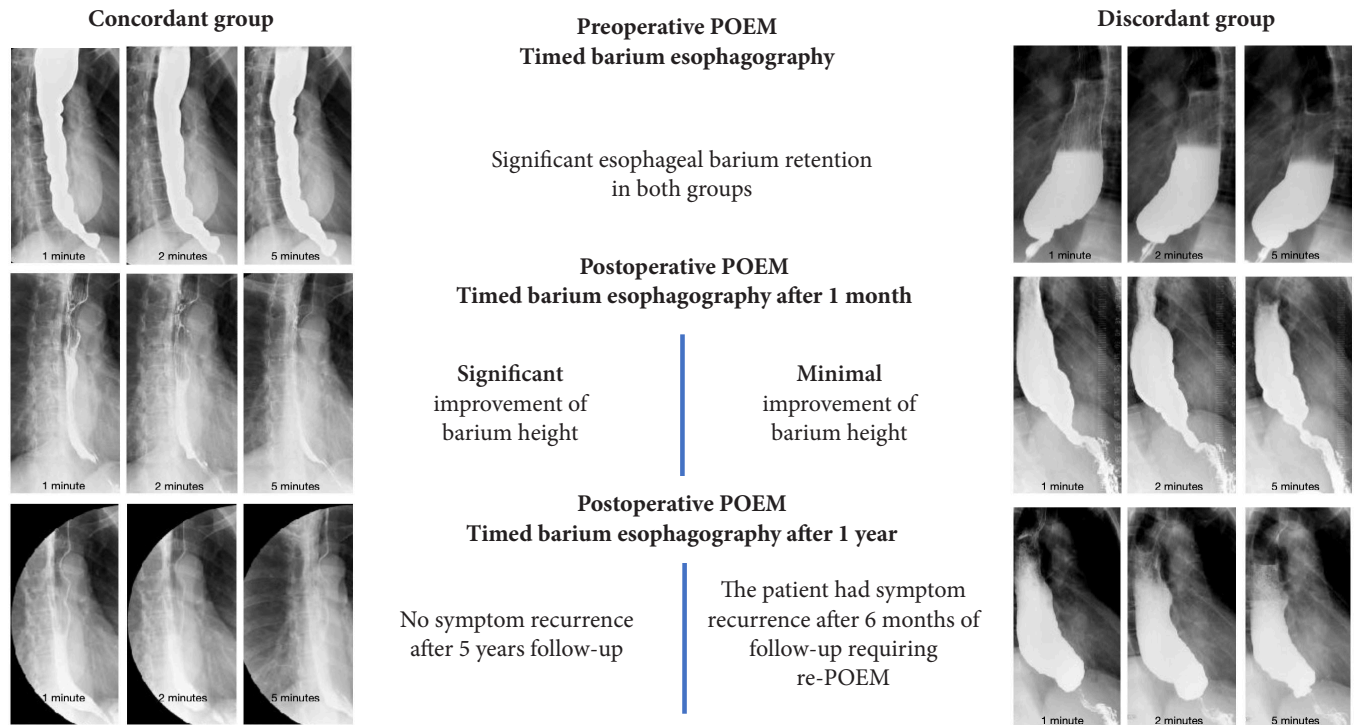
Fig. 1. Timed barium esophagography (TBE) outcomes after peroral endoscopic myotomy (POEM). The concordant group: 1-month post-operative TBE results showed a significant improvement of more than 50% compared to those before the treatment. The discordant group: 1-month postoperative TBE results showed a decrease in the barium height of less than 50% compared to those before treatment.

itative data, and the independent t-test for quantitative data. Odds ratios (ORs) and binary logistic regression were used to analyze the risk factors for recurrent achalasia. All data were analyzed using IBM SPSS ver. 26.0 data (IBM Corp.). Statistical significance was set at $p<0.05$ significant.

Ethical statements
The study protocol was approved by the Institutional Review Board (IRB) of the Faculty of Medicine Siriraj Hospital, Mahidol University (no. 347/2565 [IRB4]; COA no. 648/2022). Patient informed consent was waived due to the retrospective study design, and because the data were used only for research purposes. The study, which relied on a review of electronic medical records, adhered diligently to the principles outlined in the Declaration of Helsinki, and was conducted with attention to ethical conduct.

RESULTS

Demographic data
Over a period of six years, 42 patients with achalasia were treated with POEM. Thirty patients had complete records of preoperative and postoperative TBE and Eckardt scores. Most patients were women (17/30, 56.7%). The types of achalasia were classified using HRM based on the Chicago Classification version 3.0. Type II achalasia (15/30, 50.0%) was the most common, followed by type I (9/30, 30.0%), type III (3/30, 10.0%), and sigmoid achalasia (3/30, 10.0%). The longest symptom onsets were regurgitation (median duration, 365 [60, 1,095] days) and dysphagia (median duration, 180 [90, 730] days). The most common symptoms were dysphagia (27/30, 90.0%), weight loss (27/30, 90.0%), and regurgitation (15/30, 50.0%). The patient characteristics of the two groups (discordant and concordant) were similar, as shown in Table 1. Dysphagia, regurgitation, and weight loss were more severe in the discordant group; however, these differences were not statistically significant ($p=0.873$, 0.215, and 0.710, respectively).

Endoscopic findings revealed that 50% of patients had esophagitis. The EGJ was located at 41.63±3.21 cm from incisor and POEM procedure was performed with a mean myotomy length of 11.23±4.09 cm, as shown in Table 1. Preoperative TBE showed mean barium height of 10.81±4.48 cm at 1 minute and

Table 1. Baseline patient characteristic

Characteristic	Total patient (*n*=30)	Discordant group (*n*=17)	Concordant group (*n*=13)	*p*-value
Sex				0.721
Male	13 (43.3)	8 (47.1)	5 (38.5)	
Female	17 (56.7)	9 (52.9)	8 (61.5)	
Age (yr)	46.63±17.58	49.35±19.28	43.08±15.08	0.342
Weight (kg)	51.62±8.8	49.77±9.06	54.05±8.17	0.192
Height (m)	1.61±0.09	1.59±0.09	1.62±0.09	0.446
Body mass index (kg/m^2)	20.01±3.03	19.57±3.10	20.63±2.94	0.351
Symptoms				
Dysphagia	27 (90.0)	15 (88.2)	12 (92.3)	1.000
Regurgitation & chest pain	15 (50.0)	9 (52.9)	6 (46.2)	0.713
Weight loss	27 (90.0)	15 (88.2)	12 (92.3)	1.000
Aspiration	2 (6.7)	2 (11.8)	0 (0)	0.492
Onset of symptoms (day)				
Dysphagia	180 (90–730)	180 (90–730)	288 (15–548)	0.867
Regurgitation & chest pain	365 (60–1,095)	365 (150–1,277)	213 (48–821)	0.456
Weight loss	90 (60–365)	90 (30–365)	90 (60–319)	0.943
Aspiration	242 (120–242)	242 (120–242)	0 (0)	N/A
Eckardt score				
Dysphagia				0.873
0	0 (0)	0 (0)	0 (0)	
1	4 (13.3)	2 (11.8)	2 (15.4)	
2	6 (20.0)	3 (17.6)	3 (23.1)	
3	20 (66.7)	12 (70.6)	8 (61.5)	
Regurgitation				0.215
0	3 (10.0)	2 (11.8)	1 (7.7)	
1	6 (20.0)	4 (23.5)	2 (15.4)	
2	8 (26.7)	2 (11.8)	6 (46.2)	
3	13 (43.3)	9 (52.9)	4 (30.8)	
Retrosternal chest pain				0.084
0	7 (23.3)	6 (35.3)	1 (7.7)	
1	11 (36.7)	7 (41.2)	4 (30.8)	
2	6 (20.0)	1 (5.9)	5 (38.5)	
3	6 (20.0)	3 (17.6)	3 (23.1)	
Weight loss				0.71
0	4 (13.3)	2 (11.8)	2 (15.4)	
1	5 (16.7)	4 (23.5)	1 (7.7)	
2	10 (33.3)	5 (29.4)	5 (38.5)	
3	11 (36.7)	6 (35.3)	5 (38.5)	
Total score	8 (6–9)	8 (6–9)	8 (6–11)	0.483
Endoscopic finding				
EGJ position (cm)	41.63±3.21	41.35±3.50	42.00±2.88	0.250
Esophagitis	15 (50.0)	11 (64.7)	4 (30.8)	0.065
Mucosal opening (cm)	30.6±4.78	31.12±4.12	29.92±5.63	0.731
Myotomy (start) (cm)	32.4±4.30	32.53±3.74	32.23±5.10	0.349
Myotomy (end) (cm)	43.63±3.46	43.18±3.45	44.23±3.52	0.833
Myotomy length (cm)	11.23±4.09	10.65±3.06	12.00±5.20	0.337
Achalasia type				
Type I	9 (30.0)	6 (35.3)	3 (23.1)	0.691
Type II	15 (50.0)	8 (47.1)	7 (53.8)	1.000
Type III	3 (10.0)	1 (5.9)	2 (15.4)	0.565
Sigmoid achalasia	3 (10.0)	2 (11.8)	1 (7.7)	1.000

Values are presented as number (%), mean±standard deviation, or median (range).

EGJ, esophagogastric junction; N/A, not applicable.

10.26±4.36 cm at 5 minutes, as shown in Table 2.

Eckardt score and timed barium height improvement relationship

After POEM, a 100% improvement in clinical symptoms according to the Eckardt score was observed in all cases. However, the majority of patients (17/30, 56.7%) showed <50% improvement in barium emptying, and were therefore classified into the discordant group based on both Eckardt score and TBE improvement. The remaining patients (13/30, 43.3%) achieved both symptom resolution and >50% improvement in TBE, and were categorized into the concordant group. TBE parameters, including width and height at each time point (1, 2, and 5 minutes), showed significant improvement in the concordant group compared to the discordant group, as shown in Table 2. Analysis of the correlation between these two groups regarding the incidence of recurrence, defined by a reincrease in the Eckardt score >3, revealed a recurrence rate approximately 6.87 times higher in the discordant group compared to the concordant group (9/17 [52.9%] vs. 1/13 [7.7%], p=0.017).

Long term outcome

Our total cohort comprised 42 achalasia patients who underwent POEM, with 12 cases excluded due to the absence of pre-operative TBE. The incidence of 1-year recurrent achalasia at our institute was 11.9% (5/42 patients).

For the 30 patients who met the complete inclusion criteria, all five recurrent cases at one year were categorized in the discordant group, with 60.0% (3/5) classified as type I achalasia and 40.0% (2/5) as type II achalasia. After 1 year of follow-up, the number of recurrences increased to ten cases in total, with 50.0% (5/10) requiring reintervention; all of these cases (100%) underwent re-POEM. The median recurrence duration was 18 months. Interestingly, all patients requiring re-POEM experienced recurrence within 1 year after the first POEM, and all belonged to the discordant group. However, patients with recurrence after 1 year were able to tolerate their symptoms following treatment with proton pump inhibitors, and did not require reintervention. The concordant group demonstrated a longer symptom remission rate than the discordant group (2 vs. 1.73 years). Recurrent achalasia in the concordant group typ-

Table 2. Timed barium esophagogram improvement related to recurrent achalasia

Data	Total patient (*n*=30)	Discordant group (*n*=17)	Concordant group (*n*=13)	*p*-value
Timed barium esophagography at diagnosis (cm)				
Height at 1 min	10.81±4.48	10.41±4.31	11.32±4.83	0.590
Height at 2 min	10.68±4.37	10.49±4.45	10.92±4.43	0.797
Height at 5 min	10.26±4.36	9.87±4.37	10.78±4.46	0.580
Width at 1 min	3.61±1.14	3.74±1.14	3.43±0.92	0.433
Width at 2 min	3.62±1.14	3.70±1.26	3.51±0.99	0.659
Width at 5 min	3.47±1.18	3.62±1.32	3.28±0.99	0.439
Timed barium esophagography at 1 month (cm)				
Height at 1 min	7.67±4.49	10.05±3.50	4.56±3.74	<0.001
Height at 2 min	7.35±4.56	9.85±3.69	4.07±3.40	<0.001
Height at 5 min	6.34±4.19	8.75±3.47	3.18±2.71	<0.001
Width at 1 min	2.43±1.42	3.07±1.05	1.61±1.44	0.003
Width at 2 min	2.34±1.36	2.93±1.09	1.58±1.32	0.005
Width at 5 min	2.16±1.34	2.81±1.04	1.32±1.25	0.001
Timed barium esophagography improvement (%)				
Height improvement at 1 min	26.07	−1.83	62.55	<0.001
Height improvement at 2 min	27.03	−1.94	64.87	<0.001
Height improvement at 5 min	32.37	2.07	72.00	<0.001
Width improvement at 1 min	32.88	16.78	53.93	0.001
Width improvement at 2 min	34.50	19.44	54.19	0.001
Width improvement at 5 min	36.67	20.02	58.45	<0.001
Recurrent achalasia (n, %)	10 (33.3)	9 (52.9)	1 (7.7)	0.017
24 Hours pH monitoring				
Gas reflux	6 in 10	4 in 5	2 in 5	0.524
Acid exposure	1 in 10	0 in 5	1 in 5	1.000

ically occurred several years after POEM, and did not require additional procedures.

Notably, the other five recurrent cases that met the Eckardt score criteria but did not undergo reintervention may raise concerns about the reliability of the recurrence diagnosis. Nevertheless, even after excluding these cases from the analysis, our analyses continued to demonstrate that 38.5% of the discordant group and 0% of the concordant group experienced recurrence after POEM, requiring reintervention, indicating a statistically significant difference (p=0.015). This confirmed that the combined approach utilizing the Eckardt score and TBE could effectively predict recurrent achalasia, possibly necessitating reintervention.

Additionally, some patients underwent 24-hour pH monitoring. The results indicated a trend towards higher gas reflux in the discordant group than in the concordant group (4/5 [80.0%] vs. 2/5 [40.0%], p=0.524) (Table 2). However, the lack of statistical significance may be attributed to the small sample size. Furthermore, we investigated any possible risk factors for recurrent achalasia during the 5-year follow-up period; however, no significant potential risk factors could be identified in the univariate analysis (Table 3).

DISCUSSION

Among the three standard treatment options for achalasia, POEM has emerged as a useful potential alternative, characterized by safety, scarlessness, and applicability to all types of achalasia.[7,11,23] A prior meta-analysis comparing the effectiveness of LHM versus POEM revealed a 93.5% improvement in symptoms for patients undergoing POEM, compared to 91% for those undergoing LHM (p=0.01). However, it should be noted that patients undergoing POEM were more likely to develop esophageal reflux symptoms.[24] The key concept in POEM is the length of the myotomy, which typically extends more than 8 cm above the EGJ, with an additional 2 cm on the gastric side. However, the myotomy length on the esophageal side can be tailored in POEM, particularly in type III achalasia.[11,23] The average myotomy length of 11.23+4.09 cm in our institute correspond to standardized myotomy. All patients who underwent POEM at our hospital exhibited significant improvement in the Eckardt score postoperatively. In terms of recurrence, previous studies have reported a 9.8% incidence of recurrent achalasia after POEM over a 3-year period.[12] In our center, 11.9% of the patients experienced recurrence within 1 year after POEM. The

Table 3. Risk factor for recurrent achalasia

Factor	Univariable	p-value
Age (yr)	1.01 (0.96–1.05)	0.777
Sex (male=0, female=1)	1.23 (0.26–5.73)	0.795
Body mass index (kg/m^2)	0.93 (0.72–1.20)	0.562
Symptom		
Dysphagia	0.21 (0.02–2.67)	0.229
Regurgition & chest pain	1.83 (0.39–8.57)	0.441
Weight loss	1.00 (0.08–12.56)	1.000
Aspiration	N/A	N/A
Duration of symptom		
Dysphagia	1.00 (0.99–1.00)	0.857
Regurgition & chest pain	1.00 (0.99–1.00)	0.245
Weight loss	1.00 (0.99–1.00)	0.498
Aspiration	N/A	N/A
Eckardt score		
Dysphagia		
0	1.00	
1	1.50 (0.09–25.39)	0.78
2	1.62 (0.14–18.58)	0.70
3	N/A	N/A
Regurgitation & chest pain		
0	1.00	
1	0.10 (0.01–2.50)	0.161
2	0.07 (0.01–1.73)	0.105
3	0.43 (0.03–5.96)	0.529
Retrosternal chest pain		
0	1.00	
1	0.43 (0.06–2.97)	0.391
2	0.15 (0.01–2.06)	0.155
3	0.15 (0.01–2.06)	0.155
Weight loss		
0	1.00	
1	0.75 (0.03–17.51)	0.858
2	3.00 (0.23–39.61)	0.404
3	1.13 (0.08–15.51)	0.930
Total score	0.92 (0.64–1.31)	0.635
Endoscopic finding		
Tight EGJ position (cm)	0.97 (0.76–1.23)	0.775
Esophagitis	0.55 (0.12–2.55)	0.441
Mucosal opening (cm)	1.03 (0.86–1.21)	0.742
Myotomy start (cm)	1.01 (0.84–1.21)	0.927
Myotomy end (cm)	0.88 (0.69–1.12)	0.298
Myotomy length (cm)	0.88 (0.69–1.12)	0.298
Achalasia type		
Type I	0.58 (0.9–3.60)	0.562
Type II	0.55 (0.12–2.55)	0.441
Type III	1.00 (0.08–12.56)	1.000
Sigmoid achalasia	4.75 (0.38–60.16)	0.229
Timed barium esophagography		
Height at 1 min	1.01 (0.85–1.19)	0.956
Height at 2 min	1.02 (0.86–1.22)	0.829
Height at 5 min	1.00 (0.84–1.20)	0.944
Width at 1 min	1.12 (0.53–2.36)	0.761
Width at 2 min	0.89 (0.45–1.75)	0.729
Width at 5 min	1.02 (0.53–1.95)	0.961

Values are presented as odds ratio (95% confidence interval).
EGJ, esophagogastric junction; N/A, not applicable.

higher preoperative Eckardt scores in our study may have contributed to the higher rate of recurrence compared to that in the previous study. Therefore, the POEM procedure in our hospital was aligned with standardization, particularly in terms of myotomy length and symptom improvement, compared to previous studies.

Because of the variability in outcomes after treatment in patients with achalasia, clinicians and researchers are striving to identify significant influencing factors and effective predictor tools. Predictors of achalasia recurrence would have significant clinical implications for patient management. For example, patients categorized as high risk may benefit from intensified follow-up strategies or proactive management. This includes more frequent clinical assessments and specific investigations, which would allow for early intervention when signs of recurrence are evident. Nevertheless, there is currently no consensus regarding the most important modality for monitoring patients who have previously undergone therapeutic procedures for achalasia. Among the various modalities, the Eckardt score is the most commonly utilized because of its proven effectiveness in clinical assessment and ease of follow-up. However, it is essential to note that the Eckardt score is a subjective assessment that can vary according to patient perception.[4,7,17] The incorporation of additional contrast imaging, such as TBE, may be valuable in making follow-up assessments more accurate due to its objective and quantitative nature. Moreover, TBE is a simple and widely available investigation tool, even in general hospitals.

The integration of multiple modalities, including clinical, radiographic, and manometric investigations, may enhance the predictive capacity of outcome assessments after treatment. Previous studies have successfully employed TBE to predict outcomes after PD, or have utilized various clinical parameters in scoring systems to predict outcomes after POEM. However, there has been limited success in applying TBE for follow-up after POEM.[4,18,20,25] In contrast, our study successfully demonstrated a significant ability to predict recurrence by employing 1-month post-POEM TBE in combination with the Eckardt score to predict the treatment outcome following POEM.

In addition to Eckardt scoring, previous authors have conducted studies on several clinical parameters and additional investigations. For patients undergoing PD, younger age, classic achalasia, elevated LES pressure at 3 months post-dilatation, and incomplete obliteration of the balloon waist during PD were all identified significant predictors of a higher risk of recurrence.[20] Following the introduction of POEM, some authors developed a risk-scoring system using independent factors, including the pretreatment Eckardt score, previous treatments, sigmoid-shaped esophagus, and esophageal dilatation greater than grade II. This system predicted poor responders to POEM with an area under the curve of 0.78.[15] Based on more recent research, the risk factors included in the scoring system were preoperative Eckardt score, manometric diagnosis of achalasia, and previous procedures.[25] Therefore, clinical scoring and periprocedural investigations may help predict treatment outcomes, particularly after POEM.

In addition to using clinical predictors, additional radiological parameters were also explored, although publications utilizing TBE to predict outcomes are limited. Nevertheless, one landmark study focused on TBE as a valuable post-PD predictor, revealing that over 90% of individuals with poor TBE emptying experienced treatment failure within one year post-PD.[3] Similarly, our results indicated that TBE at 1-month in conjunction with the Eckardt score had significant value in predicting achalasia recurrence after POEM and categorization into the concordant and the discordant groups. In contrast, a previous study attempting to assess POEM effectiveness using the TBE emptying rate in relation to treatment response or post-procedure reflux failed to identify its utility.[18] On the other hand, no significant correlation between clinical Eckardt score and TBE results were found.[17] Consequently, our perspective emphasizes the necessity of evaluating both clinical and radiological parameters in post-treatment patients. According to our results, we generally advocate the inclusion of TBE as a follow-up tool after POEM, in addition to routine clinical assessment, as it is cost-effective, widely accessible in many hospitals, technically feasible, easily interpretable, and potentially valuable as a predictor. We further contend that TBE offers not only anatomical assessment but also, owing to its time-related nature, provides a functional evaluation of the disease after POEM. As such, TBE could enable early detection of delayed esophageal emptying compared to assessments based solely on patient symptoms. This characteristic renders TBE more accurate when used in conjunction with other clinical parameters during follow-up.

In addition to predicting recurrence, we identified several notable descriptive findings regarding achalasia. In our study, the most common symptoms were dysphagia and weight loss, while aspiration was the least common symptom, occurring solely in the discordant group. These results are consistent with

those of previous studies that reported that dysphagia is commonly accompanied by weight loss.[26-28] Additionally, high Eckardt scores were mainly attributed to dysphagia, regurgitation, and weight loss. Moreover, when the Eckardt score increased in the late phase, as observed in our study in both the discordant and the concordant groups, patients tended to tolerate their symptoms through medical treatment if recurrence occurred after one year. This may indicate milder recurrent symptoms and a reduced need for intervention.

Although our study predicted recurrence using 1-month post-POEM TBE with Eckardt, as mentioned above, several limitations must be considered. First, the data were collected retrospectively from a single center, raising concerns regarding generalization and potential sampling bias. Further, an elevated Eckardt score may result from either recurrence or post-POEM reflux, posing a challenge in differentiation, particularly when patients report symptoms such as retrosternal pain or regurgitation. Considering cost-effectiveness, our current pragmatic approach in developing countries adopts a trial-treatment strategy with proton pump inhibitors. While acknowledging the potential utility of additional 24-hour pH monitoring or repeat HRM for differentiation, future prospective research on recurrence should incorporate these tools to enhance diagnostic precision. Finally, the relatively small sample size limited the statistical power to identify significant risk factors for recurrence. From our perspective, further research with a larger sample size, additional clinical parameters, and a prospective plan may be helpful to better understand and support the predictors and potential risk factors associated with recurrence after treating achalasia.

In conclusion, POEM is effective at improving achalasia symptoms with an acceptable 1-year recurrence rate of 11.9%. Our study explored the predictive tools for recurrence after POEM, employing a 1-month post-POEM combined strategy integrating TBE and routine Eckardt score. Our findings revealed that the discordant group, characterized by a significant improvement in the Eckardt score but a less than 50% decrease in TBE, exhibited a recurrence rate over six times higher than that of the concordant group. These results underscore the significance of utilizing postprocedural TBE in conjunction with the Eckardt score as a valuable predictor of recurrent achalasia necessitating reintervention after POEM. This combined approach may aid in early detection of recurrence and prompt investigation when patients are suspected of experiencing recurrence.

Author Contributions

Conceptualization: TS, CP, CT; Data curation: TS, CP, CT; Formal analysis: TS, CT; Methodology: TS, CP, CT; Project administration: TA, TT; Resources: CP, TA, VC, SL, MM, PA, JW; Supervision: CP, TA, VC; Validation: TS, CP, CT; Visualization: TS, CT; Writing–original draft: TS, CT; Writing–review & editing: all authors.

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