



Results of Laparoscopic Heller Myotomy in Achalasia Patients with Persistent or Recurrent Symptoms After Peroral Endoscopic Myotomy (POEM)

Elise M. Wessels^{1,2} · Gwen M. C. Masclee^{1,2} · Marlies P. Schijven^{2,3,4} · Albert J. Bredenoord^{1,2}

Received: 27 October 2025 / Accepted: 9 July 2026

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2026

Abstract

Introduction Peroral endoscopic myotomy (POEM) is an effective and safe treatment for achalasia. However, in some patients symptoms may persist or recur, requiring additional treatment. The aim of this study was to examine the efficacy and safety of performing laparoscopic Heller myotomy (LHM) in achalasia patients having persistent or recurrent symptoms after POEM. **Methods** This retrospective study includes patients who underwent LHM after they failed on POEM, which was performed between August 2011 and March 2024. Follow-up data were extracted from hospital medical records, and patients completed questionnaires regarding achalasia symptoms and quality of life between March 2024 and August 2025. Primary outcome was treatment success after LHM, defined as Eckardt score ≤ 3 without subsequent retreatment.

Results In total, 22 patients were included (median age 43 years, 50.0% female) of which 21 completed questionnaires. Median follow-up time after LHM in patients who previously failed on POEM was 86 months. Treatment success was observed in three patients (13.6%, $n = 3/22$), with follow-up of 36, 74 and 110 months after LHM. A marked decline in success rate of LHM following POEM was observed over time: approximately 70% after one year and 30% after two years. For patients with treatment failure after LHM, 73.7% required retreatment ($n = 14/19$), predominantly with pneumatic dilation. **Conclusion** LHM following POEM yields only minimal benefit with a rapid loss of success over time. These outcomes suggest limited clinical value of LHM following POEM failure and indicate that alternative strategies may be preferable.

Keywords Achalasia · Peroral endoscopic myotomy (POEM) · Laparoscopic Heller myotomy · Treatment outcome

Abbreviations

Achalasia-DSQoL	Achalasia disease-specific quality of life
APRO	Achalasia patient-reported outcomes
LES	Lower esophageal sphincter
LHM	Laparoscopic Heller myotomy
PD	Pneumatic dilation

POEM

Peroral endoscopic myotomy

RDQ

Reflux disease questionnaire

Introduction

Achalasia is characterized by lack of esophageal peristalsis, accompanied by impaired relaxation of the lower esophageal sphincter (LES), resulting in delayed esophageal emptying. As a consequence, patients may experience symptoms such as dysphagia, regurgitation of undigested food, retrosternal pain, and loss of weight [1]. Primary treatment options for achalasia include pneumatic dilation (PD), laparoscopic Heller myotomy (LHM), and peroral endoscopic myotomy (POEM).

POEM is a minimally invasive procedure where the muscle fibers of the LES and lower esophagus are cut endoscopically by making a submucosal tunnel. Initially reported in 2010, POEM has gained widespread adoption in clinical care for achalasia patients as both first and subsequent

✉ Albert J. Bredenoord
a.j.bredenoord@amsterdamumc.nl

¹ Department of Gastroenterology & Hepatology, University Medical Centers Amsterdam, Amsterdam, The Netherlands

² Amsterdam Gastroenterology, Endocrinology & Metabolism, Amsterdam, The Netherlands

³ Department of Surgery, University Medical Centers Amsterdam, Amsterdam, The Netherlands

⁴ Amsterdam Public Health, Digital Health, Amsterdam, The Netherlands

treatment [2]. Surgical myotomy of the LES and distal part of the esophagus is carried out during LHM and this treatment is also routinely performed for achalasia. As opposed to POEM, a partial, 180 degrees ventral gastric fundoplication is usually constructed in the same session. This was done with the objective of reducing gastroesophageal reflux.

LHM and POEM are known to be relatively safe procedures and highly effective in treating achalasia symptoms at longer-term follow-up of five years [3]. A randomized controlled trial comparing the effect of PD and POEM in treatment-naïve achalasia patients concluded that POEM is more effective than PD after five years of follow-up [4]. PD and LHM as initial treatment are equally effective after five years follow-up, although PD often required re-dilation to maintain treatment effect [5]. Another randomized controlled trial demonstrated that POEM is non-inferior to LHM in achalasia patients, with 65% of the patients being treatment-naïve and 35% having received prior treatment [6, 7].

It is known that treated achalasia patients who need subsequent treatment are at a higher risk of clinical failure [8, 9]. POEM reaches higher effect rates compared to PD in patients who underwent previous LHM [10]. However, treatment success (defined as Eckardt score ≤ 3) of POEM seems to be lower in achalasia patients previously treated with LHM compared to treatment-naïve patients [4, 10]. Conversely, LHM is sometimes considered when POEM fails to alleviate symptoms or when symptoms reoccur, demanding another treatment sequence.

There is little published work on the effects of LHM in achalasia patients who have persistent or recurrent symptoms after POEM. Therefore, the aim of this study is to examine the efficacy and safety of LHM in achalasia patients with persistent or recurrent achalasia symptoms after prior POEM.

Methods

Study Design and Patient Selection

This retrospective cohort study was performed between March 2024 and August 2025. All consecutive patients undergoing POEM in the Amsterdam Medical University Centers between August 2011 and March 2024 were screened for eligibility. Patients who underwent LHM after POEM were contacted by telephone to request study consent. Informed consent was signed by all included patients. Subsequently, data on questionnaires were collected by surveys using Castor Electronic Data Capture (EDC), and data regarding achalasia treatment and follow-up were extracted from medical records.

Adult patients diagnosed with achalasia in our center were included when they underwent LHM after clinical

failure following POEM. Both procedures had to be technically successful, and follow-up time had to be at least one year after LHM.

POEM Procedure

Patients undergoing POEM adhered to a liquid diet three days before the day of the procedure to ensure the esophagus was empty. POEM was performed by experienced interventional endoscopists under general anesthesia with endotracheal intubation. All patients received perioperative antibiotics and esomeprazole intravenously. The following steps were carried out during the procedure: incision of two centimeters in the mid-esophagus to enter the submucosal space (1), creation of a submucosal tunnel approximately two to three centimeters beyond the LES (2), circular and partly full-thickness myotomy of the LES and distal esophagus (3), followed by closure of the submucosal mid-esophageal incision with endoclips (4). After the procedure, a liquid and soft diet was advised for two weeks, along with proton-pump inhibitors for at least two weeks.

Laparoscopic Heller Myotomy

Patients undergoing LHM also adhered to a liquid diet three days before the procedure. During LHM, patients were positioned in French position and a small caliber gastrointestinal nasal tube was placed. Preoperative antibiotics or esomeprazole were not routinely administered, but patients were given 8 mg of Dexamethasone to potentiate the effects of analgesics and to reduce intraoperative swelling. Five trocars were placed in the abdomen, after which a pneumoperitoneum was created. During laparoscopy, the lesser omentum was opened using the Ultracision harmonic scalpel. After fully mobilizing the distal esophagus on the ventral side, a full-thickness myotomy of both the LES and distal part of the esophagus was performed. An anterior Dor fundoplication was constructed, being a 180 degree partial wrap of the stomach placed on the ventral side of the distal esophagus. The fundoplication was sutured to the ascending limb of the right crus of the diaphragm, thereby constructing a low-pressure valve. Patients were discharged one day post-surgery after an routine scheduled esophagogram ruled out any esophageal leakage. Patients were advised to follow a liquid and soft diet in a frequent, small portion size menu for one week after surgery.

Outcome Measures

Primary outcome was treatment success after LHM. This was defined as having an Eckardt score ≤ 3 without undergoing retreatment after LHM [11]. Treatment failure after LHM was defined as persistent or recurrent achalasia

symptoms with Eckardt score > 3 and/or having undergone retreatment after LHM. In case of treatment failure, the time from the onset of recurrent symptoms with Eckardt score > 3 was used as time point for treatment failure. Treatment failure within three months after LHM was classified as primary failure and treatment failure beyond three months as secondary failure. Secondary outcomes from the general questionnaire were body mass index (BMI), alcohol use (none; 1–7 units per week; > 7 units per week) and smoking (never; past; current) (Supplementary material). Other secondary outcomes were the Eckardt score, the Achalasia Patient Reported Outcomes (APRO) score [12], gastroesophageal reflux symptoms measured by GerdQ [13] and reflux disease questionnaire (RDQ) [14] and quality of life measured by achalasia disease-specific quality of life (Achalasia-DSQoL) [15].

Statistical Analysis

Statistical analysis was performed using SPSS statistics version 28.0. Mean with standard deviation (SD) was presented when continuous variables followed a normal distribution; otherwise, median with interquartile range (IQR) was presented. A Kaplan–Meier survival curve was conducted with treatment success as the event of interest. Data were censored for subjects who had clinical success without retreatment at the last follow-up when the questionnaire was completed.

Results

Patient Selection

In total, 481 POEM procedures were performed between August 2011 and March 2024. A total of 52 patients were excluded because POEM was not successful ($n = 13$), age was below 18 years ($n = 31$) or POEM was performed for an indication other than achalasia ($n = 8$). Out of the 429 remaining patients, 24 underwent LHM after POEM. Two patients remained unresponsive despite multiple attempts to contact them via telephone. Hence, informed consent was signed by 22 patients and all questionnaires were completed by 21 patients (Fig. 1).

Patient Characteristics

Of all included patients, 50.0% were female ($n = 11/22$) and 50.0% were male ($n = 11/22$). Achalasia was classified as type 1 in 5 patients ($n = 5/22$, 22.7%), as type 2 in 11 patients ($n = 11/22$, 50.0%) and as type 3 in 6 patients ($n = 6/22$, 27.3%). About half of the patients underwent pneumatic dilation before POEM ($n = 12/22$, 54.5%). Besides, two

patients received botulinum toxin injections before POEM ($n = 2/22$, 9.1%). Median follow-up time between POEM and LHM was 20.5 months. More than half of the patients had symptom recurrence within six months after POEM, indicating early recurrence ($n = 13/22$, 59.1%). Pneumatic dilation was performed between POEM and LHM in 11 patients ($n = 11/22$, 50.0%). One of these patients also underwent re-POEM between POEM and LHM. Median Eckardt score was 6.0 before POEM as well as before LHM (Table 1). Procedure related outcomes are summarized in Supplementary Table 1.

Treatment Success After LHM

As can be seen in Fig. 2, only three patients had treatment success during last follow-up after LHM and nineteen patients had treatment failure. Thus, treatment success at last follow-up is 13.6% ($n = 3/22$). Primary treatment failure was observed in 6 patients ($n = 6/22$, 27.3%), while secondary treatment failure occurred in 13 patients ($n = 13/22$, 59.1%) (Fig. 3). A rapid decline in treatment success is observed after LHM, with treatment success of approximately 70.0% one year after LHM and 30.0% two years after LHM (Fig. 4).

Follow-up time of the patients with treatment success was 36, 74, and 110 months after LHM. All three patients had an Eckardt score of 3 at the last follow-up. Other characteristics and outcomes of these three patients are summarized in Supplementary Table 2.

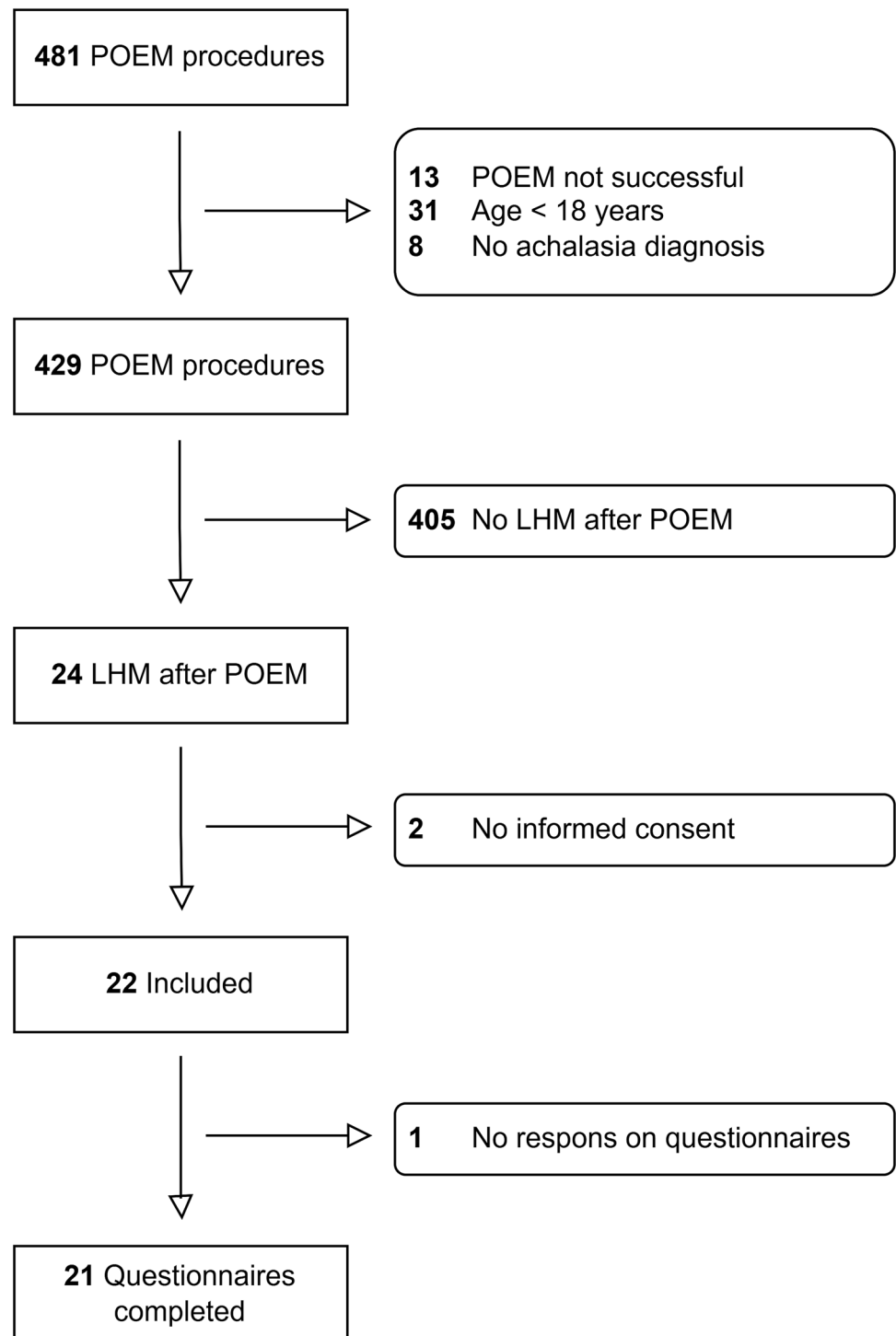
Retreatment After LHM

In total 15 out of the 19 patients with treatment failure underwent retreatment after LHM (78.9%). In four patients, retreatment had to be performed within one year after LHM; in another three patients, between one and two years after LHM; in six patients, between two and three years after LHM; and in two patients, more than three years after LHM. Pneumatic dilation was the most performed retreatment. Besides, three patients underwent re-POEM, three patients re-LHM, one patient botulinum toxin injections and one patient esophagectomy. Of the patients with treatment failure who did not undergo retreatment, all four patients had treatment failure within two years after LHM (Fig. 2). A detailed overview of treatment success and retreatment can be found in Supplementary Fig. 1.

Questionnaires

The outcomes of the completed questionnaires after LHM are presented in Table 2. Among the patients who completed the questionnaire, median age was 43 years and median BMI was 25.6 kg/m². The median time from LHM to questionnaire completion was 86 months. The median

Fig. 1 Flow chart. LHM, laparoscopic Heller myotomy. POEM, peroral endoscopic myotomy



Eckardt score was 6.0. Gastroesophageal reflux symptoms measured by GerdQ score and RDQ score had median values of 8.0 and 1.9, respectively. The APRO questionnaire showed a mean score of 18.4 and the Achalasia-DSQoL a mean score of 21.2.

Discussion

A rapid decline in treatment success was observed within two years after LHM in achalasia patients who previously

Table 1 Patient characteristics

	N = 22
Sex	
Female	11 (50.0)
Male	11 (50.0)
Achalasia	
Type 1	5 (22.7)
Type 2	11 (50.0)
Type 3	6 (27.3)
Prior to POEM	
Age, years, mean (SD)	39.2 (14.4)
BMI, kg/m ² , mean (SD)	24.4 (3.4)
Prior treatment	14 (63.6)
Botulinum toxin injection	2 (9.1)
Pneumatic dilation	12 (54.5)
LHM	0 (0.0)
POEM	0 (0.0)
Eckardt score, median (IQR)	6.0 (3.0)
High-resolution manometry	
IRP, mmHg, median (IQR)	25.4 (20.8)
Diaphragmatic hernia	1 (4.5)
Timed barium esophagram	
Maximum esophageal diameter, cm, median (IQR)	3.0 (1.6)
Column height after 5 min, cm, median (IQR)	5.1 (8.2)
Sigmoid esophagus	0 (0.0)
Esophageal diverticula	0 (0.0)
Prior to LHM	
Treatment between POEM and LHM	
No	11 (50.0)
Yes	11 (50.0)
Time between POEM and LHM, months, median (IQR)	20.5 (27.5)
Eckardt score, median (IQR)	6.0 (4.0)
Timed barium esophagram	
Maximum esophageal diameter, cm, median (IQR)	3.8 (1.4)
Column height after 5 min, cm, median (IQR)	4.7 (3.3)

Results are presented as *n* (%) unless otherwise stated

IRP integrated relaxation pressure, *LHM* laparoscopic Heller myotomy, *POEM* peroral endoscopic myotomy

failed POEM. Treatment success was approximately 70% one year after LHM, decreasing to a 30% success rate after two years. While initial symptomatic improvement was observed in a substantial proportion of patients, this was not sustained over the long term. These findings indicate that LHM after POEM may provide temporary symptom relief rather than durable symptom control. Due to the high rate of patients with persistent or recurrent achalasia symptoms after LHM, a significant proportion of patients seek additional treatment shortly after LHM, with 60% undergoing retreatment within three years. This study

showed that treatment success of LHM for persistent or recurrent achalasia symptoms following POEM is limited.

Treatment success of LHM after POEM was 13.6% with a median follow-up of 86 months. The European guideline on achalasia states that LHM may be considered after failed POEM, however, they also note that evidence of its effectiveness is limited due to the scarcity of studies and small sample sizes [16]. In a study assessing clinical response to POEM, five patients with clinical failure subsequently underwent LHM, with a relief of achalasia symptoms in only two of these patients. Follow-up time for these patients was not specified in the study [6]. A multicenter retrospective study of Ichkhanian et al. (2021) examining the effect of retreatment after failed POEM concluded that retreatment with LHM demonstrated lowest clinical success compared to re-POEM, PD and conservative treatment. Out of the 99 patients with clinical failure after POEM (Eckardt > 3), 70 underwent retreatment (71%), including 7 LHM, 33 re-POEM and 30 PD. In total 29% of the patients had an Eckardt ≤ 3 within one year after LHM (*n* = 2/7) compared to 76% after re-POEM (*n* = 25/33) and 60% after PD (*n* = 18/30) [17]. Another multicenter study of van Hoeij et al. (2018) on the effect of retreatment after POEM concluded that 45% of the patients achieved treatment success (Eckardt ≤ 3) at least six months after retreatment with LHM (*n* = 5/11), 63% after re-POEM (*n* = 5/8) and 20% after PD (*n* = 3/15) [18]. Treatment success in our study was considerably lower compared to the other studies. This may be explained by the smaller number of patients undergoing LHM after POEM in the other studies. Furthermore, follow-up time in our study was longer than one year after LHM and recurrent achalasia symptoms with or without retreatment was frequently observed between one and three years after LHM.

Apart from the three aforementioned studies, only three case reports have been published regarding the effect of LHM after clinical failure of POEM. Two of these case reports describe patients with achalasia type I who achieved treatment success (Eckardt ≤ 3) after retreatment with LHM, with short follow-up periods of four and seven months. In one patient, a series of PD was performed between POEM and LHM, but without relief of dysphagia complaints [19, 20]. The third case report describes a patient who underwent LHM after POEM, but no information of the follow-up is reported [21].

Fibrosis resulting from PD's, especially when combined with botulinum toxin injections, or previous endoscopic myotomy can make LHM more challenging. This is true in particular when an endoscopic myotomy is performed on the anterior side of the esophagus and not on the posterior side [22]. However, no technical difficulties were encountered during LHM in any of the included patients in our study, as we tend to perform POEM on the posterior side of the

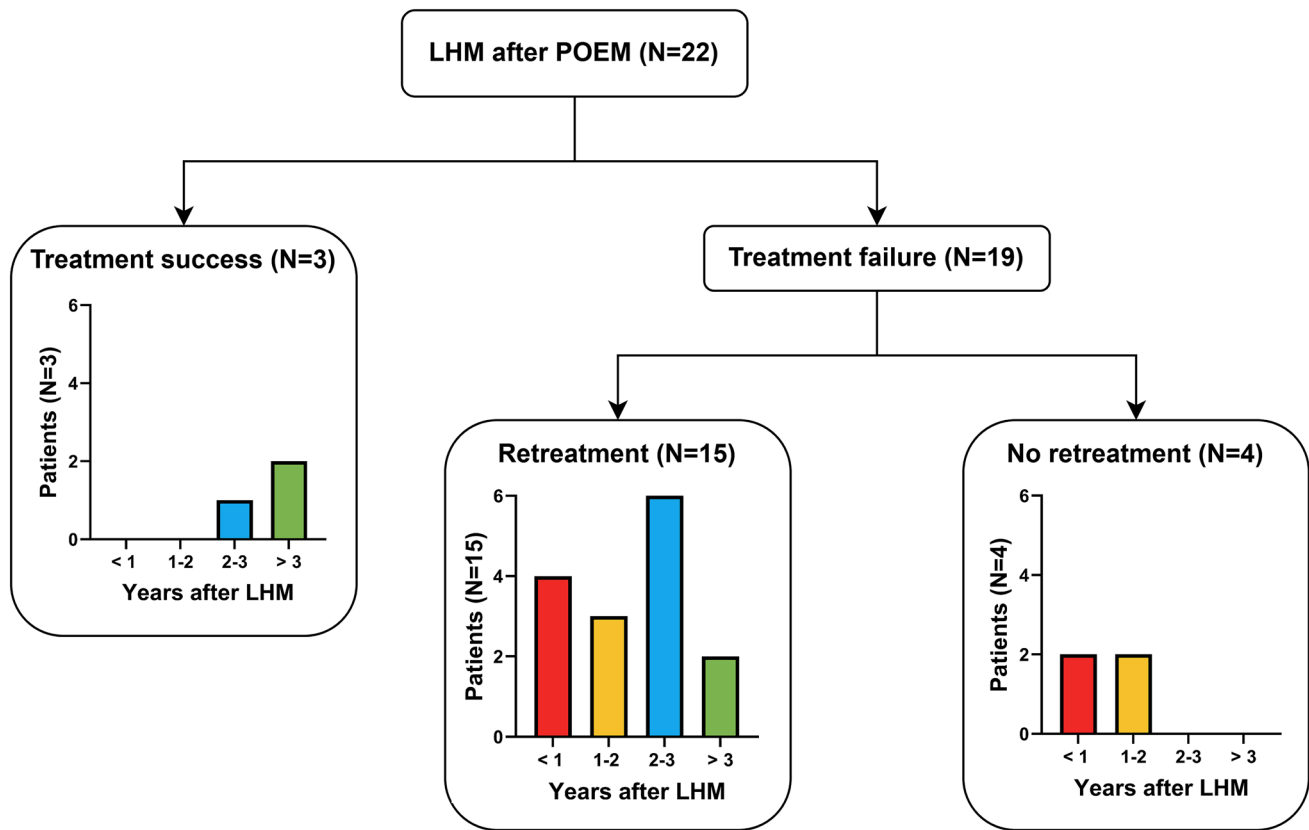


Fig. 2 Treatment success (Eckardt ≤ 3 without retreatment) in patients who underwent laparoscopic Heller myotomy (LHM) after peroral endoscopic myotomy (POEM). For patients with treatment success, the time at last follow-up is outlined which is defined as the time

between LHM and the completion of the questionnaires. For patients with treatment failure, the time to treatment failure is outlined and this is measured from the time of LHM

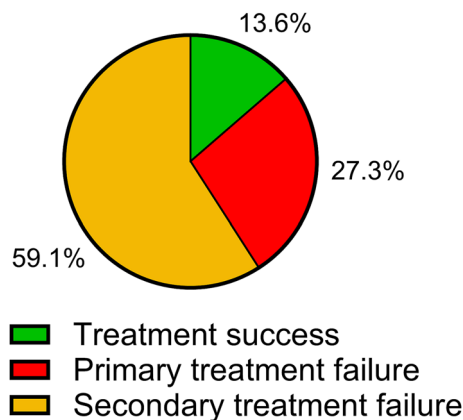


Fig. 3 Laparoscopic Heller myotomy (LHM) after failed POEM in achalasia patients: treatment success, primary treatment failure (< 3 months after LHM) and secondary treatment failure (> 3 months after LHM)

esophagus, and there was no leakage or other major postoperative complications. Considering the high rate of persistent or recurrent symptoms in the short term following LHM in

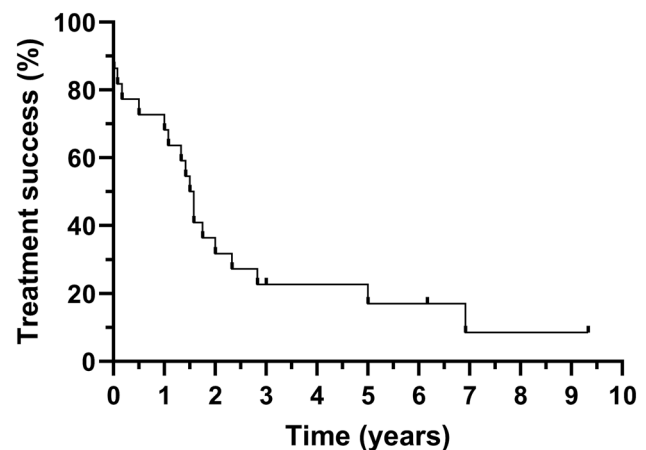


Fig. 4 Treatment success (Eckardt ≤ 3 without retreatment) in patients who underwent laparoscopic Heller myotomy (LHM) after peroral endoscopic myotomy (POEM). The follow-up time starts from the moment of LHM. Patients with treatment success at the moment of the questionnaire and without retreatment after LHM are censored at the follow-up time of the questionnaire (follow-up was ended, assuming no treatment failure had occurred up to that point)

Table 2 Outcomes questionnaire during follow-up after laparoscopic Heller myotomy

	N = 21
Time of follow-up after LHM, months, median (IQR)	86 (37.5)
Age, years, median (IQR)	43 (27)
BMI, kg/m ² , median (IQR)	25.6 (5.3)
Alcohol use	
None	11 (52.4)
1–7 units per week	7 (33.3)
> 7 units per week	3 (14.3)
Smoking	
Never	16 (76.2)
Past	5 (23.8)
Current	0 (0.0)
Eckardt score, median (IQR)	6.0 (4.0)
GerdQ score, median (IQR)	8.0 (3.0)
RDQ score, median (IQR)	
Total score	1.9 (2.7)
Heartburn	2.3 (3.3)
Regurgitation	1.5 (2.5)
Dyspepsia	1.0 (2.5)
APRO score, mean (SD)	18.4 (9.5)
Achalasia-DSQoL score, mean (SD)	21.2 (4.9)

Results are presented as *n* (%) unless otherwise stated

Achalasia-DSQoL achalasia disease-specific quality of life, *APRO* achalasia patient-reported outcomes, *LHM* laparoscopic Heller myotomy, *RDQ* reflux disease questionnaire

patients with failure after POEM, the added benefit of performing LHM after POEM appears to be minimal. Objective assessment of failure after POEM is important and can be done through diagnostic evaluation such as assessing stasis on timed barium esophagram and measuring distensibility of the LES during EndoFLIP. When results of timed barium esophagram and EndoFLIP indicate adequately treated achalasia, a conservative approach is advised, including dietary advice and, if indicated, diagnostic evaluation for gastroesophageal reflux. Gastroesophageal reflux is common after POEM and this can mimic achalasia symptoms such as regurgitation and retrosternal pain. Additionally, longstanding gastroesophageal reflux can lead to complications such as esophageal stricture, Barrett esophagus and esophageal adenocarcinoma, all of which can present with dysphagia symptoms [23]. Another potential mimic of recurrent symptoms is the development of blown-out myotomy which is defined as focal dilation of the distal esophagus and occurs in approximately 30% of the patients after POEM [24].

In cases of objectively confirmed recurrence of achalasia symptoms, such as stasis on timed barium esophagram, re-POEM or PD session seemed to be more favorable options compared to LHM. re-POEM demonstrated good short-term effectiveness, but long-term results are currently lacking

[25, 26]. The procedure may be challenging due to mucosal edema and submucosal fibrosis; however, technical difficulty appeared to be comparable between re-POEM and naive POEM [27]. The reported results on the effectiveness of PD after failed POEM are contradictory. van Hoeij et al. (2018) found a treatment success rate of 20%, while Ichkhanian et al. (2021) reported 60%. A possible explanation for this disparity is that, in the study of van Hoeij et al. (2018), retreatment with PD was limited to a single series using 30 and 35 mm balloons, whereas in the other study multiple sessions and varying balloon diameters were allowed [17, 18]. Interestingly, in the study of Ichkhanian et al. (2021), 11 out of 29 patients treated conservatively also had treatment success with Eckardt ≤ 3 within one year follow-up [17]. This highlights the importance of proper diagnostic evaluation after failed POEM, as well as the need to identify which patients will benefit from treatment and which may be better managed with conservative approach.

When looking at the other treatment sequence of POEM after failed LHM this seems to yield a slightly better reported effect than performing LHM after POEM. A systematic review and meta-analysis including nine studies showed an overall clinical success of POEM of 90.0% (95% confidence interval 83.1–96.8%) in patients with persistent or recurrent achalasia symptoms after LHM [28]. A randomized controlled trial comparing the effect of POEM and PD after failed LHM concluded that POEM was effective in 62.2 and 40% of the patients after one and five years, respectively, whereas PD yielded a considerably lower treatment success, namely 26 and 11% [10, 29]. To maintain treatment effect of PD after LHM, repeated dilation sessions are often needed [30].

Although the sample size is small, this represents the largest cohort examining the effect of LHM after POEM, with follow-up data available for more than one year after LHM. The findings may not be generalizable to all patients, as the cohort may represent a complex subgroup with refractory symptoms. A large proportion of patients completed questionnaires and follow-up after LHM was thoroughly documented in medical records, providing reliable and accurate data for generalizability. Treatment success was defined using patient-reported outcomes and is therefore inherently subjective. However, decisions regarding retreatment were based on shared decision-making supported by objective testing, including timed barium esophagram. Other causes of persistent or recurrent symptoms, such as gastroesophageal reflux or esophageal spasm, were excluded before retreatment was considered. Therefore, patients classified as treatment failures were unlikely to have undergone further retreatment because of other causes that could mimic recurrence of symptoms. Given the low number of patients with treatment success after LHM, we were not able to perform multivariate logistic regression analysis to assess predictive

factors for treatment success of LHM after failed POEM. The outcomes of the questionnaires, except for the GerdQ score, in the three patients with treatment success after LHM appeared to be considerably lower compared to the median values observed in this study, which suggest less achalasia symptoms and better quality of life.

In conclusion, LHM following POEM yields minimal benefit with a rapid loss of treatment effect over time. These outcomes suggest limited clinical value of LHM following failure of POEM, which should be taken into consideration when exploring treatment options in these patients.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10620-026-10123-4>.

Acknowledgment On behalf of the upper motility center, Amsterdam.

Author Contributions EMW and AJB designed the study. AJB supervised the project. EMW collected the data and was responsible for project administration. EMW performed the data and statistical analysis. All authors contributed to the interpretation of the results. EMW wrote the manuscript with input from all authors. All authors had full access to the data and approved the final manuscript.

Data Availability No datasets were generated or analyzed during the current study.

Declarations

Conflict of interest EMW, GMCM, and MPS have nothing to declare. AJB received research funding from Dr. Falk Pharma, Thelial, Sanofi/Regeneron and Side Sleep Technologies (SST) and received speaker and/or consulting fees from Laborie, Medtronic, BMS, Dr. Falk Pharma, Reckitt, Aquilion, Eupraxia, Uniquity, Alimentiv, Aquilion, Sanofi/Regeneron, and AstraZeneca.

References

- Jeon HH, Kim JH, Youn YH et al. Clinical characteristics of patients with untreated achalasia. *J Neurogastroenterol Motil.* 2017;23:378–384.
- Inoue H, Minami H, Kobayashi Y et al. Peroral endoscopic myotomy (POEM) for esophageal achalasia. *Endoscopy.* 2010;42:265–271.
- Wessels EM, Masclee GMC, Bredenoord AJ. An overview of the efficacy, safety, and predictors of achalasia treatments. *Expert Rev Gastroenterol Hepatol.* 2023;17:1241–1254.
- Kuipers T, Ponds FA, Fockens P et al. Peroral endoscopic myotomy versus pneumatic dilation in treatment-naïve patients with achalasia: 5-year follow-up of a randomised controlled trial. *Lancet Gastroenterol Hepatol.* 2022;7:1103–1111.
- Moonen A, Annese V, Belmans A et al. Long-term results of the European achalasia trial: a multicentre randomised controlled trial comparing pneumatic dilation versus laparoscopic Heller myotomy. *Gut.* 2016;65:732–739.
- Werner YB, Hakanson B, Martinek J et al. Endoscopic or surgical myotomy in patients with idiopathic achalasia. *N Engl J Med.* 2019;381:2219–2229.
- Hugova K, Mares J, Hakanson B, et al. Per-oral endoscopic myotomy versus laparoscopic Heller's myotomy plus Dor fundoplication in patients with idiopathic achalasia: 5-year follow-up of a multicentre, randomised, open-label, non-inferiority trial. *Lancet Gastroenterol Hepatol.* 2025.
- El-Magd EA, Elgeidie A, Elmahdy Y et al. Pre-operative endoscopic balloon dilatation and its impact on outcome of laparoscopic Heller cardiomyotomy for patients with achalasia: does the frequency and interval matter? *Surg Endosc.* 2023;37:7667–7675.
- Liu ZQ, Li QL, Chen WF et al. The effect of prior treatment on clinical outcomes in patients with achalasia undergoing peroral endoscopic myotomy. *Endoscopy.* 2019;51:307–316.
- Saleh CMG, Familiari P, Bastiaansen BAJ et al. The efficacy of peroral endoscopic myotomy vs pneumatic dilation as treatment for patients with achalasia suffering from persistent or recurrent symptoms after laparoscopic heller myotomy: a randomized clinical trial. *Gastroenterology.* 2023;164:1108–1183.
- Eckardt VF. Clinical presentations and complications of achalasia. *Gastrointest Endosc Clin N Am.* 2001;11:281–92vi.
- Wessels EM, Mussies CM, Masclee GMC, et al. Translation and cross-sectional validation of the achalasia patient reported outcomes questionnaire in a Dutch cohort. *BMC Gastroenterol.* 2026;26(1).
- Jonasson C, Wernersson B, Hoff DA et al. Validation of the GerdQ questionnaire for the diagnosis of gastro-oesophageal reflux disease. *Aliment Pharmacol Ther.* 2013;37:564–572.
- Aanen MC, Numans ME, Weusten BL et al. Diagnostic value of the reflux disease questionnaire in general practice. *Digestion.* 2006;74:162–168.
- Frankhuizen R, Heijkoop R, van Herwaarden MA et al. Validation of a disease-specific quality-of-life questionnaire in a large sample of Dutch achalasia patients. *Dis Esophagus.* 2008;21:544–550.
- Oude Nijhuis RAB, Zaninotto G, Roman S et al. European guidelines on achalasia: united European gastroenterology and European society of neurogastroenterology and motility recommendations. *United European Gastroenterol J.* 2020;8:13–33.
- Ichkhanian Y, Assis D, Familiari P et al. Management of patients after failed peroral endoscopic myotomy: a multicenter study. *Endoscopy.* 2021;53:1003–1010.
- van Hoeij FB, Ponds FA, Werner Y et al. Management of recurrent symptoms after per-oral endoscopic myotomy in achalasia. *Gastrointest Endosc.* 2018;87:95–101.
- Aoki T, Ozawa S, Hayashi K et al. Laparoscopic heller myotomy and Dor fundoplication following an unsuccessful peroral endoscopic myotomy. *Surg Case Rep.* 2023;9:106.
- Giulini L, Dubecz A, Stein HJ. Laparoscopic heller myotomy after failed POEM and multiple balloon dilations: better late than never. *Chirurg.* 2017;88:303–306.
- Yheulon CG, Brock PB, Balla FM et al. Laparoscopic heller myotomy and hiatal hernia repair after failed peroral endoscopic myotomy. *J Gastrointest Surg.* 2019;23:1071–1072.
- Patti MG, Herbell FA. Laparoscopic heller myotomy versus peroral endoscopic myotomy for the treatment of achalasia. *Curr Opin Gastroenterol.* 2024;40:314–318.
- Maret-Ouda J, Markar SR, Lagergren J. Gastroesophageal reflux disease: a review. *JAMA.* 2020;324:2536–2547.
- Kuipers T, Ponds FA, Fockens P et al. Focal distal esophageal dilation (blown-out myotomy) after achalasia treatment: prevalence and associated symptoms. *Am J Gastroenterol.* 2024;119:1983–1989.
- Tyberg A, Seewald S, Shariha RZ et al. A multicenter international registry of redo per-oral endoscopic myotomy (POEM) after failed POEM. *Gastrointest Endosc.* 2017;85:1208–1211.
- Zhang ZC, Xu JQ, Liu XY et al. Salvage peroral endoscopic myotomy is a promising treatment for achalasia after myotomy failure. *Gastrointest Endosc.* 2023;98:543–51 e1.
- Ma LY, Guo KY, Liu ZQ, et al. Repeat peroral endoscopic myotomy: technical difficulty and risk factors. *Gastrointest Endosc.* 2024.

28. Huang Z, Cui Y, Li Y et al. Peroral endoscopic myotomy for patients with achalasia with previous Heller myotomy: a systematic review and meta-analysis. *Gastrointest Endosc.* 2021;93:47-56 e5.
29. Wessels EM, Masclee GMC, Bastiaansen BAJ, et al. Long-Term Outcomes of Peroral Endoscopic Myotomy vs Pneumatic Dilation After Prior Laparoscopic Heller Myotomy for Achalasia. *Clin Gastroenterol Hepatol.* 2026.
30. Kumbhari V, Behary J, Szczesniak M et al. Efficacy and safety of pneumatic dilatation for achalasia in the treatment of post-myotomy symptom relapse. *Am J Gastroenterol.* 2013;108:1076–1081.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.