Curriculum for training in peroral endoscopic myotomy (POEM) in Europe (Part II) – Best Practice Techniques: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement

Authors

David J. Tate[1,2,‡], Enrique Rodriguez de Santiago[3,4,5,‡], Michele Montori[1,6], Vikash Lala[7,8,9], Lynn K. Debels[1,10], Eduardo Albéniz[11], Isis K. Araujo[12], Eduardo Guimarães Hourneaux de Moura[13], Alanna Ebigbo[14], Pietro Familiari[15], Paul Fockens[16,17], Henriette Heinrich[18], Oleksandr Kiosov[19], Helmut Messmann[14], Sandra Nagl[14], João Santos-Antunes[20], Amrita Sethi[21], Marcel Tantau[22], Zuzana Vackova[23], Jan Martinek[24], Roy M. Soetikno[25], Ian M. Gralnek[26,27,*], Tony C. Tham[28,*]

Institutions

1 Department of Gastroenterology and Hepatology, University Hospital of Ghent, Ghent, Belgium
2 Faculty of Medicine and Health Sciences, University of Ghent, Ghent, Belgium
3 Department of Gastroenterology and Hepatology, Hospital Universitario Ramón y Cajal, Madrid, Spain
4 Instituto Ramón y Cajal de Investigación Sanitaria (IRYCIS), Madrid, Spain
5 Centro de Investigación Biomédica en Red en el Área temática de Enfermedades Hepáticas y Digestivas (CIBEREHD), Madrid, Spain
6 Università Politecnica delle Marche, Ancona, Italy
7 University of the Witwatersrand, Johannesburg, South Africa
8 Charlotte Maxeke Johannesburg Academic Hospital, Johannesburg, South Africa
9 Wits Donald Gordon Medical Centre, Johannesburg, South Africa
10 University Hospital of Brussels, Brussels, Belgium
11 Gastroenterology Department, Hospital Universitario de Navarra. Navarrabiomed, UPNA, IdiSNA, Pamplona, Spain
12 Endoscopy and Motility Unit, Gastroenterology Department, Hospital Clinic de Barcelona, Barcelona, Spain
13 Gastrointestinal Endoscopy Unit, Hospital das Clínicas of the University of São Paulo Medical School, São Paulo, Brazil
14 Department of Gastroenterology, University Hospital Augsburg, Augsburg, Germany
15 Digestive Endoscopy Unit, Fondazione Policlinico Universitario A. Gemelli IRCCS, Università Cattolica del Sacro Cuore, Rome, Italy
16 Department of Gastroenterology and Hepatology, Amsterdam UMC, Amsterdam, The Netherlands
17 Waikato Hospital, Hamilton, New Zealand
18 Clarunis, Universitäres Bauchzentrum, Basel, Switzerland
19 University Clinic, Zaporizhzhia State Medical and Pharmaceutical University, Zaporizhzhia, Ukraine
20 Gastroenterology Department, Centro Hospitalar S. João, Porto, Portugal
21 Pancreatobiliary Endoscopy Services, Division of Digestive and Liver Disease, Columbia University Irving Medical Center, New York, New York, USA
22 University of Medicine and Pharmacy “Iuliu Hatieganu”, Cluj-Napoca, Romania
23 Department of Gastrointestinal Endoscopy, The Military University Hospital Prague, Prague, Czech Republic
24 Department of Gastroenterology and Hepatology, St. Anne University Hospital, Brno, Czech Republic
25 Clinical Medicine, University of California, San Francisco, California, USA
26 Ellen and Pinchas Mamber Institute of Gastroenterology and Hepatology, Emek Medical Center, Afula, Israel
27 Rappaport Faculty of Medicine, Technion Israel Institute of Technology, Haifa, Israel
28 Division of Gastroenterology, Ulster Hospital, Belfast, Northern Ireland

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‡ joint first co-authorship.

* joint senior authors.

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Corresponding Author
David Tate, MD, PhD, UZ Ghent, C. Heymanslaan 10, 9000 Ghent, Belgium

MAIN RECOMMENDATION

1 A POEM equipment checklist should be used before commencing the procedure to ensure the availability and proper functioning of all necessary materials.

2 A thorough esophageal cleansing before mucosal incision is mandatory. There should be no residual dietary liquid or food in the lumen.

3 Use at least 5–10 mL of lifting agent, which should be injected using a needle at the desired point where the mucosotomy will commence.

4 To create the mucosotomy, the first incision should be made at the site of previous injection with the fewest possible taps on the electrosurgical unit using a cutting mode, with the knife tip at 45–80° to the mucosal surface.

5 After adequate submucosal injection (through a needle or knife), the incision should be extended by 1.5–2 cm in the longitudinal axis from cranial to caudal, in the planned direction of the tunnel.

6 Dissection within the tunnel should be performed using sequential injection of saline and chromic dye (if available using the knife jet function) and dissection with the knife. Pushing the endoscope forward gently against the advancing submucosa–muscularis propria interface is important to facilitate mucosal tunneling.

7 The myotomy should be performed in a cranial to caudal manner, starting 2 cm or more below the caudal extent of the mucosotomy site.

8 ESGE recommends that the myotomy should be extended 2–3 cm distal to the gastroesophageal junction to allow complete disruption of the lower esophageal sphincter.

9 ESGE recommends that POEM can be performed on either the anterior (1–2 o'clock in supine position) or posterior (5–6 o'clock) side.

10 ESGE recommends that the myotomy length should be tailored to the disease being treated, with evidence favoring short esophageal-side myotomy if indicated because of decreased adverse events and procedure times.

11 ESGE recommends the use of through-the-scope clips for mucosal closure owing to their high efficacy and availability, and lower price compared with other closure methods.

12 Mucosal injury during POEM should be proactively sought during the procedure and particularly before completion. Mucosal injury can be represented on a spectrum from whitening of the overlying mucosa to a full-thickness perforation.

13 ESGE recommends performing POEM using low flow CO_2 insufflation.

14 In the absence of adverse events, resume fluids on day 1, soft diet on day 3, and normal diet on day 7 post-POEM.

15 ESGE recommends against the routine use of standard or computed tomography fluoroscopic esophagrams after POEM in asymptomatic patients.

ABBREVIATIONS

AE	adverse event
CT	computed tomography
ESD	endoscopic submucosal dissection
ESGE	European Society of Gastrointestinal Endoscopy
GEJ	gastroesophageal junction
GERD	gastroesophageal reflux disease
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HRM	high resolution manometry
LES	lower esophageal sphincter
OR	odds ratio
OTS	over the scope
POEM	peroral endoscopic myotomy
PPAT	Precision POEM Assessment Tool
PPI	proton pump inhibitor
RCT	randomized controlled trial
TTS	through the scope

Thieme

SOURCE AND SCOPE

This manuscript represents the outcome of a formal Delphi process resulting in an official Position Statement of the ESGE and provides a framework to develop and maintain skills in POEM. This curriculum is set out in terms of the environment for training, the theoretical knowledge and practical skills required for completion of training, and how competence should be defined and evidenced prior to independent practice.

1 Introduction

Achalasia is an esophageal motility disorder, characterized by the failure of the lower esophageal sphincter (LES) to relax properly, associated with loss of peristalsis leading to impaired movement of food and liquid from the esophagus into the stomach [1–3]. The incidence of achalasia is approximately 1.6 cases per 100 000 and it usually presents between the ages of 25 and 60, with men and women equally affected [4]

The treatment of achalasia is aimed at lowering the resting pressure of the LES [5]. Recent European guidelines suggest that peroral endoscopic myotomy (POEM) has comparable efficacy to graded pneumatic dilation and laparoscopic Heller's myotomy, and that treatment decisions in achalasia should be made based on patient-specific characteristics, possible adverse events (AEs), and a local expertise [1, 2].

This second part of this curriculum is focused on the technical act of performing POEM and includes a deconstructed approach that is amenable to standardized training. A competency assessment tool based on the curriculum is also provided at the end of the document. At present, no other such document exists for training in POEM in Europe.

2 Methods

The methods used to draft this manuscript are as described in the curriculum Part I [6], with the taskforces having the same membership (**Appendix 1s**, see online-only Supplementary material).

The specific PICO questions and search strategies for Part II are available in **Appendix 2s**. Subsequently, taskforces evaluated the available literature (**Table 1s**) using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system. The GRADE system was used to assess the quality of evidence by study outcome and overall certainty, as well as to grade the recommendations. The quality and risk of bias of individual studies were assessed using the ROB-2 scale for randomized controlled trials (RCTs), the Newcastle–Ottawa Scale or Robins-I for observational studies, and the QUADAS-2 tool for diagnostic accuracy studies. Where necessary, the authors performed their own meta-analyses to supplement those previously published (**Appendix 3s**).

The outcomes of each voting round are detailed in **Appendix 4s.** ▶ **Table 1** gives the list of recommendations that finally achieved consensus.

3 POEM preparation

3.1 What is the required equipment? Is a preprocedure checklist required?

1 RECOMMENDATION

A POEM equipment checklist should be used before commencing the procedure to ensure the availability and proper functioning of all necessary materials.
Good practice statement.
Level of agreement 91 %.

The materials needed for POEM are summarized in ▶ **Fig. 1**. No studies to date have specifically assessed the impact of an equipment checklist on POEM outcomes. It is however important to consider that indirect evidence from various medical contexts suggests that the implementation of checklists can yield several benefits, including improved team communication, reduced medical errors, and a potential decrease in the incidence of AEs [7]. As a result, both the ESGE and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) recommend the incorporation of safety checklists into all endoscopic procedures. The verification of the availability and functionality of endoscopy equipment is an integral component of these checklists [7].

3.2 What type of electrosurgical knife is recommended?

2 RECOMMENDATION

The shape of the tip of the electrosurgical knife should be based on local expertise and availability.
Good practice statement.
Level of agreement 94 %.

3 RECOMMENDATION

ESGE suggests using waterjet integrated electrosurgical knives for POEM.
Weak recommendation, very low quality evidence.
Level of agreement 80 %.

Traditionally, POEM has been performed with triangle-tip electrosurgical knives [2]. The use of scissor- and needle-type knives has been reported in several cohorts with excellent results [8, 9]. We did not identify any studies directly comparing the outcomes of POEM based on the shape of the knife's tip. It appears unlikely that the choice of tip shape significantly influences the efficacy or safety of the procedure. As such, this decision should be made based on local expertise and the availability of specific instruments [2].

▶ **Table 1** Table of recommendations.

Recommendation number	Recommendation	Quality of evidence; Strength of recommendation[1]
POEM preparation		
1	A POEM equipment checklist should be used before commencing the procedure to ensure the availability and proper functioning of all necessary materials	
2	The shape of the tip of the electrosurgical knife should be based on local expertise and availability	
3	ESGE suggests using waterjet integrated electrosurgical knives for POEM	Weak; Very low
4	The settings provided by the manufacturer of the electrosurgical unit should be favored, tailored to the specific type of knife and coagulation forceps being used	
5	ESGE suggests that patients adhere to a clear liquid diet for a minimum of 48 hours and abstain from all oral intake (nil by mouth) for at least 8 hours prior to the procedure. This fasting period may be increased according to the amount of esophageal food retention upon upper gastrointestinal endoscopy or the detection of a sigmoid-type esophagus in the previous work-up	Weak; Very low
6	ESGE recommends managing antithrombotic therapy by assessing the patient's thrombotic risk and recognizing POEM as a procedure with a high risk of bleeding	Strong; Low
7	ESGE recommends counseling patients on antithrombotic therapy undergoing POEM about the higher risk of bleeding	Strong; Very low
8	ESGE recommends a single prophylactic antibiotic dose before POEM. The selection and dosage of antibiotics should align with local and national protocols	Strong; Very low
Cleaning and inspection		
9	A thorough esophageal cleansing before mucosal incision is mandatory. There should be no residual dietary liquid or food in the lumen	
10	Any observed obstructive esophageal spastic segment during endoscopy should be documented, with an evaluation of its correlation with HRM and imaging test findings	
11	POEM operators should plan the procedure and aim to identify the following anatomical landmarks: the upper esophageal sphincter, the spine, and the GEJ	
12	POEM operators should clearly distinguish between the anterior and posterior walls of the esophagus before the mucosal incision	
Mucosal incision		
13	Use at least 5–10 mL of lifting agent, which should be injected using a needle at the desired point where the mucosotomy will commence	
14	ESGE suggests the use of saline instead of colloids for submucosal tunneling owing to its lower cost and because a lasting submucosal injection is not generally needed for POEM	Weak; Very low
15	The use of a chromic dye during submucosal tunneling facilitates the identification of vessels and the correct dissection plane	
16	The use of adrenaline in the submucosal solution is not advisable owing to the low risk of severe intraprocedural bleeding during POEM and the potential risk of AEs	
17	To create the mucosotomy, the first incision should be made at the site of previous injection with the fewest possible taps on the electrosurgical unit using a cutting mode, with the knife tip at 45–80° to the mucosal surface	
18	After adequate submucosal injection (through a needle or knife), the incision should be extended by 1.5–2 cm in the longitudinal axis from cranial to caudal, in the planned direction of the tunnel	
Submucosal tunneling		
19	The submucosa should be carefully trimmed at the caudal end of the incision to widen the tunnel opening and facilitate entry	
20	A transparent distal endoscope attachment facilitates access to and dissection of the tunnel. It should be used to protect the mucosa from thermal injury during trimming as mucosal injury may hamper closure	

▶ **Table 1** (Continuation)

Recommendation number	Recommendation	Quality of evidence; Strength of recommendation[1]
21	Dissection within the tunnel should be performed using sequential injection of saline and chromic dye (if available using the knife jet function) and dissection with the knife. Pushing the endoscope forward gently against the advancing submucosa–muscularis propria interface is important to facilitate mucosal tunneling	
22	The distance between the incisors and the GEJ should be assessed before starting the POEM procedure	
23	The following observations are useful to identify the GEJ: (i) the appearance of palisade veins on the mucosal side of the tunnel; (ii) an increased vascularity and presence of "spindle-shaped veins"; (iii) the narrowing of the lumen associated with resistance to endoscope passage, followed by the sudden increase in the submucosal space with the appearance of large perforating vessels ("two penetrating vessels") and oblique gastric muscle bundles ("sling fibers"); (iv) the observation of a dye-stained bulge upon retroflexion in the gastric cardia; and (v) transillumination by a second endoscope	
24	The submucosal tunnel should be extended at least 3 cm distal to the GEJ to allow a gastric myotomy of acceptable length	
25	ESGE suggests using a combination of anatomical landmarks to identify the GEJ (see Recommendation 23), and consideration of the double-scope method in cases of doubt or altered anatomy to confirm the correct extension of the submucosal tunnel into the stomach	Weak; Low
Myotomy		
26	The myotomy should be performed in a cranial to caudal manner, starting 2 cm or more below the caudal extent of the mucosotomy site	
27	The myotomy should be performed using mucosal to adventitial or adventitial to mucosal approaches, or a combination	
28	ESGE recommends that POEM can be performed on either the anterior (1–2 o'clock in supine position) or posterior (5–6 o'clock) side	Strong; Moderate
29	ESGE recommends against performing POEM in the same orientation as a previous surgical or endoscopic myotomy	Strong; Very low
30	ESGE suggests that either a full-thickness or selective myotomy approach is acceptable because of their similar rates of intraprocedural AEs, reflux on post-POEM pH-monitoring studies, and erosive esophagitis, but that full-thickness myotomy may be faster to perform	Weak; Very low
31	ESGE recommends that the myotomy should be extended 2–3 cm distal to the GEJ to allow complete disruption of the lower esophageal sphincter	Strong; Moderate
32	ESGE recommends that the myotomy length should be tailored to the disease being treated, with evidence favoring short esophageal-side myotomy if indicated because of decreased AEs and procedure times	Strong; Very low
33	For types I and II achalasia, ESGE recommends an esophageal myotomy length of 4–7 cm and a gastric myotomy length of 2–3 cm in view of shorter procedure times, similar efficacy, and similar rates of AEs	Strong; Low
34	For type III achalasia and other spastic esophageal motility disorders, ESGE recommends tailoring the length of the myotomy to the length of the spastic segment	Strong; Very low
Mucosal closure		
35	ESGE recommends the use of TTS clips for mucosal closure owing to their high efficacy and availability, and lower price compared with other closure methods	Strong; Low
36	ESGE suggests that OTS clips and endoscopic suturing can be considered if closure with conventional TTS clips fails	Weak; Very low
Adverse events		
37	Prophylactic hemostasis for nonbleeding vessels should be guided by vessel size. Very large vessels that do not hamper tunnel progression should be avoided; vessels up to 1–1.5 mm should be pretreated using the knife, and vessels larger than 1.5–2 mm should be considered for prophylactic treatment using coagulation forceps	
38	Water irrigation should be used to precisely identify the site of bleeding, combined with pressure from the endoscope cap to tamponade bleeding during device exchange. The technique of hemostasis should be determined by the size of the bleeding vessel	

▶ **Table 1** (Continuation)

Recommendation number	Recommendation	Quality of evidence; Strength of recommendation[1]
39	Mucosal injury during POEM should be proactively sought during the procedure and particularly before completion. Mucosal injury can be represented on a spectrum from whitening of the overlying mucosa to a full-thickness perforation	
40	Any suspected current or potential mucosal perforation during POEM should be considered for endoscopic treatment	
41	ESGE recommends performing POEM using low flow CO_2 insufflation	Strong; Low
42	A high index of suspicion for gas-related AEs is required during POEM, which include (in order of frequency observed from high to low) capnoperitoneum, capnothorax, and capnomediastinum	
43	Drainage of capnoperitoneum using needle decompression is required if hemodynamic or respiratory compromise occur during the procedure. Subcutaneous emphysema invariably resolves spontaneously and does not require treatment	
Are there technical adaptations required for difficult POEM procedures?		
44	ESGE suggests creating a second tunnel in an alternative orientation when poor mucosal lifting impedes the initiation of the tunnel	Weak; Very low
Postoperative care		
45	In the absence of AEs, resume fluids on day 1, soft diet on day 3, and normal diet on day 7 post-POEM	
46	ESGE recommends the use of paracetamol and/or NSAIDs as first line for POEM post-procedural pain, with the consideration of opioids if the initial approach fails	Strong; Low
47	ESGE recommends against the routine use of standard or CT fluoroscopic esophagrams after POEM in asymptomatic patients	Strong; Very low
48	ESGE suggests favoring the use of a CT esophagram with oral water-soluble contrast over a standard fluoroscopic esophagram in symptomatic patients with suspected post-procedural AEs	Weak; Very low

AE, adverse event; CT, computed tomography; GEJ, gastroesophageal junction; HRM, high resolution manometry; OTS, over the scope; NSAID, nonsteroidal anti-inflammatory drug; TTS, through the scope.
[1] Recommendations with no quality of evidence or strength of recommendation given were not suitable for GRADE assessment and are based on good practice statements.

Waterjet integrated knives that aim to decrease procedural time and improve safety have been developed. A systematic review, complemented by a meta-analysis incorporating data from seven studies, indicated that the waterjet function led to reduced procedural duration, fewer instrument exchanges, decreased use of coagulation forceps, and a lower burden of AEs [10]; however, it is essential to acknowledge that this meta-analysis included two studies that were exclusively published as abstracts and presents significant methodological concerns. Moreover, the sole available RCT also exhibited a high risk of bias [11], so the certainty of the evidence was downgraded from high to very low (**Table 2s**). Our search did not yield any relevant studies subsequent to the publication of this meta-analysis [12].

3.3 What are the recommended electrosurgical settings?

4 RECOMMENDATION

The settings provided by the manufacturer of the electrosurgical unit should be favored, tailored to the specific type of knife and coagulation forceps being used.
Good practice statement.
Level of agreement 94 %.

Only one retrospective study, encompassing 1826 patients, has explored the influence of electrosurgical energy settings on POEM outcomes. In a secondary and multivariable analysis, the authors observed that using a current mode other than spray coagulation for myotomy or tunneling was associated with a heightened incidence of AEs (odds ratio [OR] 3.09; $P = 0.02$) [13]. The choice of electrosurgical unit settings typically hinges

Patient ID:	
Date:	
Material	
High-definition endoscope with waterjet irrigation	☐
Electrosurgical unit	☐
CO_2 insufflator +/– low/ultralow flow tube	☐
Submucosal injection solution	Saline ☐ Chromic dye ☐
Saline or sterile water	☐
Transparent distal cap attachment*	☐
Injection needle (23–25G)	☐
Electrosurgical knife	☐
Coagulation forceps	☐
Rotatable hemoclips	☐
Other closure devices**	☐
Capnoperitoneum decompression	Veress needle /16–18G intravenous catheter ☐ Sterile gauzes ☐ Sterile gloves ☐ Saline ☐ Antiseptic solution ☐ Syringe ☐ Sterile fenestrated drape ☐
Signature:	

▶ **Fig. 1** The ESGE suggested peroral endoscopic myotomy (POEM) equipment checklist.

on factors such as the brand and model of the electrosurgical unit, the type of knife employed, and the operator's preferences. A compilation of the most frequently encountered settings in the published literature is presented in ▶ **Table 2** [14].

3.4 What is the recommended duration of fasting before POEM?

5 RECOMMENDATION

ESGE suggests that patients adhere to a clear liquid diet for a minimum of 48 hours and abstain from all oral intake (nil by mouth) for at least 8 hours prior to the procedure. This fasting period may be increased according to the amount of esophageal food retention upon upper gastrointestinal endoscopy or the detection of a sigmoid-type esophagus in the previous work-up.
Weak recommendation, very low quality evidence.
Level of agreement 94 %.

Achalasia patients often show esophageal stasis, even after the 6–8 hours of fasting that is generally recommended before anesthesia induction [15], which may hinder mucosal evaluation, and interferes with the procedure and raises the risk of aspiration. There are however no RCTs that have addressed different fasting periods before POEM.

In a retrospective study, patients were maintained for 48 hours on a low residue diet, fasted from solids for 24 hours, and allowed only clear liquids for 2 hours before POEM, with a low rate of AEs [16]. Fasting time is highly variable between the published series and usually ranges between 8 and 48 hours [17, 18]. Different approaches have been shown to improve esophageal cleansing, such as the induction of emesis by the fast drinking of carbonated beverages, or drinking warm water (60 °C) in the evening before the procedure [19].

Inoue et al. recommended an endoscopic examination prior to POEM to evaluate the amount of retained residues in order to decide the fasting period, which should be a "few days," especially for patients with sigmoid esophagus [20]. A previous gastroscopy to clean the esophagus may be useful [21]; however, this approach increases the burden of care and may not be necessary if patients are kept on a clear liquid diet for 48 hours before POEM, or for 3–5 days for those who have had large amounts of food retention in previous endoscopies [22, 23].

▶ **Table 2** Electrosurgical settings for peroral endoscopic myotomy (POEM).

POEM steps	Electrosurgical settings
Mucosal incision	Dry cut, 50 W, effect 3
	Endocut Q, effect 2, cutting duration 3, cutting interval 3[1]
	Endocut I, effect 2
	PulseCut Fast, 120 W, effect 2[2]
Submucosal dissection/ tunneling	Spray Coagulation, 50 W, effect 2
	Spray Coagulation, 40 W, effect 2[2]
	Swift Coagulation, 35–50 W, effect 3–5
	Swift Coagulation, 70 W, effect 3–4[1]
Myotomy	Spray Coagulation, 50 W, effect 2
	Endocut Q, effect 2
	PulseCut Fast, 120 W, effect 2[2]
	Swift Coagulation, 70 W, effect 3–4[1]
Hemostasis	Soft Coagulation, 80–100 W, effect 5
	Soft Coagulation, 50 W, effect 5[2]

[1] Recommended by the manufacturer for HybridKnives I and T types.
[2] Recommended by the manufacturer (Olympus Corp., Tokyo, Japan) for the ESG-300 and the Triangle-tip Knife.

3.5 How should antithrombotics be managed?

6 RECOMMENDATION

ESGE recommends managing antithrombotic therapy by assessing the patient's thrombotic risk and recognizing POEM as a procedure with a high risk of bleeding.
Strong recommendation, low quality evidence.
Level of agreement 97 %.

7 RECOMMENDATION

ESGE recommends counseling patients on antithrombotic therapy undergoing POEM about the higher risk of bleeding.

Strong recommendation, very low quality evidence.

Level of agreement 94 %.

The risk of delayed bleeding associated with POEM is reported to range from 0.2 % to 2.0 % in prospective cohorts, which is consistent with the rates observed after other procedures with a high risk of bleeding [24–27]. It is however worth noting that these estimates are primarily derived from data that included a limited number of patients on antithrombotic therapy or did not adequately consider the impact of such medication on POEM outcomes.

The safety of POEM in patients on antithrombotic therapy has been assessed in five retrospective studies [28–32]. In an international, 1:1 case–control study, which included 126 patients per arm, antithrombotic management exhibited significant heterogeneity, with guidelines adhered to in 76 % of cases. In this study, anticoagulants and clopidogrel were temporarily discontinued in all patients, while aspirin was maintained in 41 % of users without an increased bleeding risk. After adjusting for co-morbidities and previous therapy, the risk of major bleeding was found to be higher in antithrombotic users (5.6 % vs. 0.8 %; $P = 0.03$), although the rate of thrombotic events remained identical in both groups (0.8 %) [28].

Similarly, a single-center study reported an elevated risk of bleeding (10.5 % vs. 1.0 %; $P = 0.04$) and an overall higher rate of AEs (36.8 % vs. 9.0 %; $P = 0.001$) for patients receiving antithrombotics [32]. Shimamura et al. reported the experience of seven high volume centers in Japan (n = 120) [30]. In most procedures (88.3 %), there was adherence to the guidelines established by the Japanese Society of Gastroenterological Endoscopy. Their findings revealed that the risk of bleeding (2.5 % vs. 0.7 %; $P = 0.83$) and antithrombotic events (0.8 % vs. 0 %) were comparable to those observed in patients not receiving antithrombotic therapy.

Nakai et al. developed a risk scoring system, in 467 patients, to predict difficult POEM, defined as a composite outcome of any of the following: procedure time ≥90 minutes, capnothorax, mucosal perforation, or major bleeding [31]. Antithrombotic use emerged as a predictor of difficult POEM; however, this study did not provide a separate subanalysis for major bleeding. Finally, another Japanese group reported a case series involving four patients on antithrombotics for whom POEM proceeded uneventfully [29].

As part of our GRADE process, we conducted a meta-analysis of the available comparative studies using a random-effects model. The analysis revealed an increased risk of major bleeding in this population (OR 5.3, 95 %CI 2.1 %–13.6 %; $I^2 = 0$ %) (**Appendix 3 s**, part A) [28, 30, 32]. The quality of the evidence was downgraded from low to very low owing to imprecision (**Table 3 s**).

In summary, while POEM appears to be generally safe in this population, it is imperative to inform patients about the heightened risk of bleeding, which can occur up to 3 weeks after the procedure [28]. As a result, we recommend managing antithrombotic therapy with careful consideration of POEM as a high risk procedure for bleeding, while also evaluating the patient's thrombotic risk. Our management proposal is based on the current ESGE guidelines and the aforementioned studies (▶ **Table 3**) [28–32]

3.6 Should antibiotics be prescribed perioperatively?

8 RECOMMENDATION

ESGE recommends a single prophylactic antibiotic dose before POEM. The selection and dosage of antibiotics should align with local and national protocols.

Strong recommendation, very low quality evidence.

Level of agreement 89 %.

In 2020, ESGE endorsed the prophylactic use of perioperative antibiotics for POEM, classifying it as a clean–contaminated supramesocolic digestive surgery that warrants antibiotic prophylaxis. The guideline advised healthcare providers to align their choice, duration, and dosage of antibiotics with local or national protocols [2].

Our systematic search identified six relevant studies, including four RCTs [33–36] and two retrospective cohorts [23, 37]. Three of these studies were published between 2021 and 2023. We excluded two RCTs published as abstracts in 2013 [35] and 2017 [36], as they have not been reported in peer-reviewed journals to date.

One retrospective single-center cohort study involving 124 patients found that the application of gentamicin in the submucosal tunnel before myotomy did not reduce the risk of infection; however, the authors reported a lower inflammatory response after POEM [37]. Similarly, a multicenter retrospective French study (n = 226) did not identify any differences in AE occurrence between patients receiving antibiotic prophylaxis (mean duration 4 days) and those who did not [23]. This observational data aligns with the results of a single-center RCT, which compared a single intravenous dose of cefazolin 2 g before POEM with a 3-day antibiotic regimen. The study found no significant differences in positive blood cultures (1.6 % vs. 3.2 %; $P = 0.6$) or inflammatory markers between the two groups [33]. In 2023, Nabi et al. reported a noninferiority RCT comparing single and multiple doses of antibiotic prophylaxis [34]. The results were consistent with the previous RCT, with no statistically or clinically significant differences in infection rates observed between the two groups.

In summary, the two available RCTs did not reveal any significant differences between single and multiple doses of antibiotic prophylaxis [33, 34]. The certainty of the evidence was however downgraded owing to factors such as the absence of reported details regarding allocation concealment, imprecision

▶ **Table 3** Management of antithrombotic therapy for peroral endoscopic myotomy (POEM).

Medication	Low thrombotic risk		High thrombotic risk	
	Withdrawal	Resumption	Withdrawal	Resumption
Vitamin K antagonist	5 days before POEM; Check INR on the day of the procedure (< 1.5)	Usual daily dose on the night of the procedure	5 days before POEM; 3 days before POEM start therapeutic dose of LMWH. Administer the last dose of LMWH 24 hours before the procedure; Check INR on the day of the procedure (< 1.5)	Usual daily dose the night of the procedure; Restart therapeutic LMWH 24 hours after POEM
DOACs (dabigatran, rivaroxaban, apixaban, or edoxaban)	3 days before POEM; 5 days before POEM for dabigatran if eGFR 30–50 mL/minute	48 hours after POEM	3 days before POEM; 5 days before POEM for dabigatran if eGFR 30–50 mL/minute	24 hours after POEM
Aspirin	Continue aspirin[1]	Continue aspirin[1]	Continue aspirin	Continue aspirin
P2Y12 inhibitors (clopidogrel, prasugrel, or ticagrelor)	Monotherapy: 7 days before POEM	48 hours after POEM	Dual therapy: continue aspirin, P2Y12 5–7 days before POEM; Discuss the strategy with a cardiologist and consider postponing POEM until P2Y12 inhibitors can be temporarily withheld (> 6–12 months after insertion of drug-eluting coronary stent or > 1 month after placement of bare metal coronary stent)	24–48 hours

DOAC, direct oral anticoagulant; eGFR, estimated glomerular filtration rate; INR, international normalized ratio; LMWH, low-molecular weight heparin.
[1] In case of cardiovascular primary prophylaxis, consider withholding 5–7 days before POEM and reassess the indication before resumption.

arising from the low number of events and limited sample size, and the potential risk of publication bias (**Table 4 s**). Whether a single dose of antibiotic can be omitted has not been formally addressed and cannot be recommended at this stage.

4 Cleaning and inspection

4.1 What are the first steps during POEM? What anatomical landmarks should be recognized before the mucosal incision?

9 RECOMMENDATION
A thorough esophageal cleansing before mucosal incision is mandatory. There should be no residual dietary liquid or food in the lumen.
Good practice statement.
Level of agreement 100 %.

10 RECOMMENDATION
Any observed obstructive esophageal spastic segment during endoscopy should be documented, with an evaluation of its correlation with high resolution manometry and imaging test findings.
Good practice statement.
Level of agreement 80 %.

11 RECOMMENDATION
POEM operators should plan the procedure and aim to identify the following anatomical landmarks: the upper esophageal sphincter, the spine, and the gastroesophageal junction.
Good practice statement.
Level of agreement 83 %.

12 RECOMMENDATION
POEM operators should clearly distinguish between the anterior and posterior walls of the esophagus before the mucosal incision.
Good practice statement.
Level of agreement 97 %.

POEM can be performed with the patient in either the supine or left lateral position, depending on the operator's preference. It is imperative to spend sufficient time cleansing the esophagus before initiating tunnel creation to prevent contamination of the peritoneum and mediastinum. The endoscopist must ensure that there is no residual dietary liquid or food within the lumen [20].

In a study of 71 patients, there was a discordance of up to 5 cm on average between high resolution manometry (HRM),

esophagram findings, and endoscopy [38]. Therefore, any obstructive esophageal spastic segments should be documented, and their correlation with HRM and imaging test findings assessed. A thorough mucosal inspection both with white-light and image-enhanced endoscopy (narrow-band imaging or image-enhanced endoscopy) is mandatory to rule out pseudoachalasia and neoplastic lesions, especially considering that achalasia patients are at higher risk of squamous cell carcinoma [20].

The scope should be advanced into the stomach to assess the resistance of the gastroesophageal junction (GEJ) and evaluate the gastric cardia. The operator should locate the lesser curvature and then carefully withdraw the scope without altering its orientation to establish clock-face orientation within the esophagus.

POEM practitioners should be capable of identifying the anterior and posterior walls in reference to gastric and esophageal landmarks and gravity. The following anatomical landmarks should be meticulously located and documented: the upper esophageal sphincter, the spine, and the GEJ. With the patient in the supine position, operators should also identify the trachea, the left main bronchus, and the aortic arch [39]. It is worth noting that identifying some anatomical landmarks can be challenging in patients with sigmoid-type or end-stage achalasia. The effect of gravity can be used to determine esophageal orientation considering that fluids tend to accumulate at the 6-o'clock position (i.e. the posterior wall for the supine position and the left lateral wall for the left lateral position). As a final recommendation, it is advisable to plan the incision site approximately 2–3 cm cranial to the myotomy's starting point, with a focus on avoiding areas with thick submucosal vessels or severe inflammation.

5 Mucosal incision

5.1 What is the best submucosal solution for the injection prior to mucosotomy?

13 RECOMMENDATION

Use at least 5–10 mL of lifting agent, which should be injected using a needle at the desired point where the mucosotomy will commence.

Good practice statement.

Level of agreement 89 %.

14 RECOMMENDATION

ESGE suggests the use of saline instead of colloids for submucosal tunneling owing to its lower cost and because a lasting submucosal injection is not generally needed for POEM.

Weak recommendation, very low quality evidence.

Level of agreement 86 %.

15 RECOMMENDATION

The use of a chromic dye during submucosal tunneling facilitates the identification of vessels and the correct dissection plane.

Good practice statement.

Level of agreement 91 %.

16 RECOMMENDATION

The use of adrenaline in the submucosal solution is not advisable owing to the low risk of severe intraprocedural bleeding during POEM and the potential risk of adverse events.

Good practice statement.

Level of agreement 89 %.

There are no comparative studies regarding the use of saline versus colloid, adrenaline versus no adrenaline, or regarding the use, or not, of dye for POEM procedures.

Normal saline is widely used for submucosal injection in the context of therapeutic endoscopy. Colloids have an advantage over saline as their cushion remains for longer, with less need for repeated submucosal injections, which is therefore less time-consuming [40]; however, colloids are generally more expensive than saline solutions and a lasting submucosal injection is not generally needed for POEM. During the tunneling, the tip of the endoscope has a stable position, facing toward the submucosal layer, and most knives have the possibility of performing waterjet submucosal injection during the procedure.

Adrenaline can be mixed into the submucosal injection in a variety of dilutions and clinical settings, such as for endoscopic mucosal resection or endoscopic submucosal dissection (ESD), in order to decrease intraprocedural bleeding and procedural time [41, 42]. Adrenaline has the disadvantage of increasing the risk of post-procedural pain and cardiovascular events [43]. In the esophagus, serious intraprocedural bleeding during submucosal dissection, either during ESD or in the submucosal tunneling during POEM, is rare [44, 45], and no advantage of using adrenaline has been reported.

Dye, namely indigo carmine or methylene blue, is commonly used for better identification of the dissection plane and submucosal vessels [46]. Therefore, it may be used during the mucosal incision and tunneling; although, there is no evidence regarding the efficacy of using dye plus saline versus saline alone with regard to clinical outcomes or AEs.

5.2 How to perform the mucosotomy

17 RECOMMENDATION
To create the mucosotomy, the first incision should be made at the site of previous injection with the fewest possible taps on the electrosurgical unit using a cutting mode, with the knife tip at 45–80° to the mucosal surface.
Good practice statement.
Level of agreement 80 %.

18 RECOMMENDATION
After adequate submucosal injection (through a needle or knife), the incision should be extended by 1.5–2 cm in the longitudinal axis from cranial to caudal, in the planned direction of the tunnel.
Good practice statement.
Level of agreement 91 %.

No RCTs are available comparing different mucosotomy techniques. In the majority of the literature a mucosal incision is performed longitudinally. This type of mucosotomy is favored by the clinical experience of the current expert panel as it facilitates incision closure [47]. Transverse and inverted T-shape mucosal incisions have been described but have not gained widespread acceptance [47]. Access to the submucosa is confirmed by a step movement as the knife passes the muscularis mucosa. The knife should then be withdrawn, and the incision checked to ensure entry has been gained into the submucosal plane.

If the approach to myotomy is anterior, the incision should be extended longitudinally in the 2-o'clock orientation (1–2 o'clock). If the approach to myotomy is posterior, the incision should be extended longitudinally in the 5-o'clock position (5–6 o'clock). This is achieved by gentle pressure on the slightly stretched caudal tip of the incision site using the shaft of the electrosurgical knife and then application of pressure with the endoscope shaft. Use of an insulated-tip knife has been reported to improve safety [48]. The incision length usually ranges between 1.5 and 2 cm, but should be tailored to facilitate access of the endoscope into the tunnel, and may vary depending on the endoscope used [49]. An incision that is too short may result in tearing of the tunnel entrance due to endoscope passage, making closure more challenging while compromising the ability to complete the procedure.

6 Submucosal tunneling

6.1 How to access the tunnel

19 RECOMMENDATION
The submucosa should be carefully trimmed at the caudal end of the incision to widen the tunnel opening and facilitate entry.
Good practice statement.
Level of agreement 97 %.

20 RECOMMENDATION
A transparent distal endoscope attachment facilitates access to and dissection of the tunnel. It should be used to protect the mucosa from thermal injury during trimming as mucosal injury may hamper closure.
Good practice statement.
Level of agreement 80 %.

No studies are available for this step of the POEM procedure. To enter the submucosal space, a conical transparent tunneling cap can be used to burrow under the incision margins at the caudal end of the incision, keeping the mucosa and muscularis propria separated for a safe entry after submucosal injection. Spray coagulation is usually preferred for entry. The endoscope distal attachment can be used to prevent injury to the mucosal entry point.

6.2 How to perform submucosal tunneling

21 RECOMMENDATION
Dissection within the tunnel should be performed using sequential injection of saline and chromic dye (if available using the knife jet function) and dissection with the knife. Pushing the endoscope forward gently against the advancing submucosa–muscularis propria interface is important to facilitate mucosal tunneling.
Good practice statement.
Level of agreement 89 %.

No comparative studies are available. Dissection should proceed close to the muscularis propria layer to ensure the mucosal layer is not injured. Superficial injury to the muscle layer is of little consequence as dissection of the muscle will be performed anyway during the myotomy. The scope should be pushed far enough into the submucosal tunnel and against the advancing submucosa–muscularis propria interface to exert gentle force and facilitate dissection using electrosurgical energy in the correct plane.

Precise dissection within the tunnel can be achieved using rotation of the right hand to guide the knife along the muscularis propria. This movement, together with left-handed manipu-

lation of the large and small wheels and 180° scope rotation at the maximum extent of an arch, can help where one side of the tunnel is difficult to access. The use of near-focus technology during tunneling has been shown in one study to reduce intraprocedural bleeding (**Table 5s**) [50]. The creation of multiple tunnel planes should be avoided by even dissection, working from one side of the tunnel to the other in a stepwise purposeful fashion within the tunnel, and periodically checking that the correct plane is being maintained. If one side starts to "lag" behind the other the lagging side (less dissected) should be prioritized for dissection [39].

The tunnel should be wide enough to allow access, even dissection, and easy passage of the scope, which allows a safe myotomy whilst avoiding mucosal injury. The width of the tunnel should be about one-third of the circumference of the esophagus [49]. The direction of the tunnel should be periodically checked. This can be done by withdrawing the scope from the tunnel and checking the appearance of the chromic dye from the esophageal lumen. Care should be taken not to create a dissection plane in the muscularis propria. This is seen endoscopically as muscle above and below the dissection plane. If it does occur, it is advisable to reinject on the mucosal side of all visible muscle, carefully dissect at this interface, and eventually re-enter the submucosal plane.

Mucosal injury is most common whilst tunneling across the GEJ as the tunnel commonly narrows at this point. The following points should be borne in mind to maximize the chances of success.

1. The endoscopist should ensure that the scope is pushed in far enough for the cap to create gentle pressure at the submucosa–muscularis propria interface.
2. Repeated submucosal injections should be used to expand the submucosal space [11].
3. The continuous insufflation of low flow CO_2 may be needed to ensure the mucosa is kept away from the dissection plane. Underwater tunneling can also be considered.
4. The endoscopist should be aware of the dissection plane and avoid creating a plane within the muscularis propria layer.

6.3 How to recognize the gastroesophageal junction

22 RECOMMENDATION

The distance between the incisors and the GEJ should be assessed before starting the POEM procedure.
Good practice statement.
Level of agreement 100 %.

23 RECOMMENDATION

The following observations are useful to identify the GEJ: (i) the appearance of palisade veins on the mucosal side of the tunnel; (ii) an increased vascularity and presence of "spindle-shaped veins"; (iii) the narrowing of the lumen associated with resistance to endoscope passage, followed by the sudden increase in the submucosal space with the appearance of large perforating vessels ("two penetrating vessels") and oblique gastric muscle bundles ("sling fibers"); (iv) the observation of a dye-stained bulge upon retroflexion in the gastric cardia; and (v) transillumination by a second endoscope.
Good practice statement.
Level of agreement 97 %.

A measurement from the incisors to the GEJ should be made in the esophageal lumen before starting tunneling. Nevertheless, there is not a perfect match between intraluminal and intratunnel measurements. A mathematical formula has been proposed to predict the GEJ through the tunnel, using the measurement of this landmark via the lumen and the maximum esophageal dilation point, assessed by a computed tomography (CT) scan or esophagogram [51].

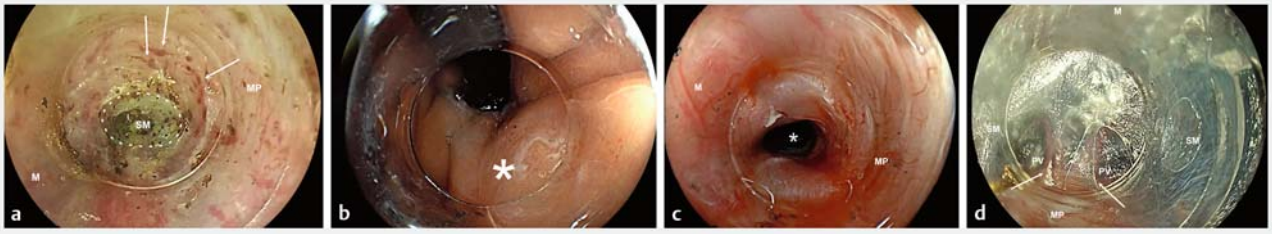
When inside the tunnel, the appearance of palisade veins on the mucosal side of the tunnel, the narrowing of the lumen associated with resistance on endoscope passage, with an increased vascularity and "spindle-shaped veins," followed by the sudden increase in the submucosal space with the appearance of large perforating vessels and aberrant gastric muscle bundles indicates the GEJ [52]. The presence of a dye bulge on gastric retroflexion also indicates the GEJ [53]. Additionally, previous injection of indocyanine green in the cardia can help the endoscopist to recognize the GEJ during the tunneling process [54].

When using a posterior submucosal tunnel approach, the oblique muscles and two penetrating vessels, which branch off the left gastric artery, can be seen in the gastric cardia of some patients indicating the potential correct extent of the submucosal tunnel [55] (▶ **Fig. 2**).

6.4 How far should the submucosal tunnel extend into the stomach and how can this be confirmed?

24 RECOMMENDATION

The submucosal tunnel should be extended at least 3 cm distal to the GEJ to allow a gastric myotomy of acceptable length (see Recommendation 31).
Good practice statement.
Level of agreement 91 %.



▶ **Fig. 2** Important endoscopic appearances correlating with the landmarks of the gastroesophageal junction (GEJ) during peroral endoscopic myotomy (POEM) include: **a** spindle-shaped veins marking the approximate location of the GEJ (arrows) – a narrow submucosal dissection plane with significant submucosal fibrosis is seen in this image (delineated by the dotted line); **b** a dye-stained bulge upon retroflexion in the gastric cardia (*); **c** narrowing of the submucosal tunnel representing the position of the GEJ (diaphragm + lower esophageal sphincter) (*); **d** penetrating vessels (PV) at the GEJ. (arrows).
M, mucosa; MP, muscularis propria; SM, submucosa.

25 RECOMMENDATION
ESGE suggests using a combination of anatomical landmarks to identify the GEJ (see Recommendation 23), and consideration of the double-scope method in cases of doubt or altered anatomy to confirm the correct extension of the submucosal tunnel into the stomach.
Weak recommendation, low quality evidence.
Level of agreement 80 %.

Accurate identification of the LES is vital to ensure complete sphincter disruption, thereby maximizing the clinical efficacy of POEM [56]. The endoscopist should recognize the anatomical landmarks of the GEJ. In the double-scope transillumination technique, a second endoscope (usually a pediatric gastroscope) is passed into the gastric lumen in order to observe, in retroflexion, the light of the first scope inside the submucosal tunnel [57]; this can help to identify the GEJ and guide further gastric myotomy.

In one case series, this technique indicated the tunnel extent to be inadequate in 50 % of patients, and the tunnel was extended a further 1 to 2 cm [57]. An RCT concluded that a second endoscope is useful for ensuring a complete gastric myotomy, also describing a minimal increase in procedural time, without any increased morbidity. The authors suggested that it may be particularly helpful in cases of altered anatomy that can make identification of the GEJ difficult [58].

7 Myotomy

7.1 How to perform the myotomy

26 RECOMMENDATION
The myotomy should be performed in a cranial to caudal manner, starting 2 cm or more below the caudal extent of the mucosotomy site.
Good practice statement.
Level of agreement 80 %.

27 RECOMMENDATION
The myotomy should be performed using mucosal to adventitial or adventitial to mucosal approaches, or a combination.
Good practice statement.
Level of agreement 83 %.

A cranial to caudal (top-down) or caudal to cranial (bottom-up) technique can be used for the myotomy depending on operator preference. The panel favors a cranial to caudal approach when starting out in POEM training, which is the standard approach for the myotomy. The myotomy should be started 2 cm or more below the caudal extent of the mucosotomy site to maintain an adequately protective mucosal flap. The caudal to cranial technique has also been described and could reduce myotomy procedural time, but high quality comparative data are lacking [59]. In this modality, the myotomy is started 2–3 cm caudal to the GEJ at the distal end of the tunnel and continued cranially.

For the initial incision, the tip of the knife should be held against the muscle and a slow controlled incision should be made using sequential single taps on the foot pedal of the electrosurgical unit (▶ **Table 2**) until the knife tip passes through the muscle layer toward the adventitial side, away from the mucosa. It can be helpful to use the cut current (e. g. Endocut Q, effect 2) for this initial step to improve visualization of the

different muscle layers. For selective myotomy, the aim is to place the tip of the knife in the intermuscular space, between the circular and the longitudinal muscle layers. For full-thickness myotomy, once the initial incision is made, an injection into the adventitial side can be used to create a cushion, providing a safety margin to protect against thermal injury to the mediastinal structures.

A mucosal to adventitial or adventitial to mucosal technique can be used to continue the myotomy. The mucosal to adventitial technique is preferred for safety reasons; however, the adventitial to mucosal approach can be used when there is limited adventitial space, which would risk thermal injury to mediastinal structures. For the adventitial to mucosal technique, the knife tip is hooked just behind the muscle fibers and gentle traction is applied toward the mucosal layer. When using this technique, care should be taken to ensure sufficient space between the muscularis propria and mucosa prior to cutting. Similarly, the amount of pressure should be limited to avoid inadvertent injury to the mucosa. For the mucosal to adventitial technique, the knife is extended caudally against the mucosal side of the progressing myotomy edge. In a stepwise fashion, diathermy is applied until the desired depth of myotomy is achieved. Prior injection into the adventitial space is recommended. Care should be taken to preferentially avoid or precoagulate large vessels in the cardia.

After completion, the myotomy should be carefully evaluated to confirm that an adequate length and complete disruption of the LES has been achieved.

7.2 Anterior or posterior myotomy?

28 RECOMMENDATION

ESGE recommends that POEM can be performed on either the anterior (1–2 o'clock in supine position) or posterior (5–6 o'clock) side.

Strong recommendation, moderate quality evidence.

Level of agreement 91 %.

29 RECOMMENDATION

ESGE recommends against performing POEM in the same orientation as a previous surgical or endoscopic myotomy.

Strong recommendation, very low quality evidence.

Level of agreement 100 %.

In their 2020 guidelines, ESGE recommended that POEM be performed in either the anterior (1–2 o'clock in supine position) or posterior (5–6 o'clock) orientation, based on evidence from four RCTs, two of which were published as full papers [60, 61] and two as abstracts [62, 63]. Additionally, the recommendation relied on one systematic review with meta-analysis [64]. Where patients had undergone prior endoscopic or surgical myotomy, it was advised to perform the submucosal tunnel in the other orientation to avoid encountering fibrosis. This suggestion was made based on single-arm studies owing to the lack of comparative data. An alternative approach, POEM at the greater curvature (7–9 o'clock), was also mentioned as being viable, supported by a retrospective study that demonstrated favorable outcomes; however, in this approach, the myotomy abolishes the angle of His and reaches the diaphragm, so attention should be paid to avoiding diaphragmatic muscle dissection [65].

Since then, one of the RCTs initially published as an abstract has been reported as a full paper, providing data on 2-year outcomes [62, 66, 67]. In addition, three new meta-analyses have emerged [68–70]. All available meta-analyses concur that the anterior and posterior routes yield comparable results in terms of technical and clinical success, and gastroesophageal reflux disease (GERD) after POEM. One meta-analysis suggested that posterior POEM may decrease procedural time [69], and this finding was also supported by the most recent updated meta-analysis [68]. Differences in terms of AEs and procedural time yielded conflicting results across studies [60, 61, 64, 67–69].

To provide further clarity on this matter, we conducted a meta-analysis limited to RCTs, using an inverse-variance weighting random-effects model (**Appendix 3 s**, part B). We found that the anterior approach was associated with a higher risk of AEs (risk ratio [RR] 1.60, 95 %CI 1.06–2.43; $I^2 = 0$; $P = 0.03$). Nonetheless, it is important to note that this finding was predominantly driven by an RCT with a small sample size that reported a twofold risk of mucosal injury [60], and it should therefore be interpreted with caution. We did not identify any significant differences in procedure time (weighted mean difference 2.81 minutes, 95 %CI −1.98 to 7.60; $I^2 = 0$; $P = 0.25$).

Two retrospective Japanese studies suggested that preserving the sling or oblique gastric muscle fibers during posterior POEM could preserve the integrity of the angle of His, potentially reducing the incidence of GERD [55, 71]. A subsequent RCT did not however corroborate these findings and showed that sparing the sling fibers had no substantial impact on the risk of developing esophagitis of grade B or higher (31.6 % vs. 25.9 %; $P = 0.54$), the DeMeester scores (41.5 % vs. 38.6 %; $P = 0.83$), symptomatic reflux, or proton pump inhibitor (PPI) use at 1 year [72].

In conclusion, anterior or posterior myotomy can be chosen based on technical ease, operator preferences, tortuosity of the esophagus, the presence of diverticula, and prior surgical or endoscopic interventions. The certainty of evidence was downgraded from high to moderate owing to concerns regarding the risk of bias of the published studies (**Table 6 s**). Although preserving the sling fibers in the posterior approach appears reasonable from a pathophysiological standpoint, the current data remain too inconclusive to warrant a formal recommendation.

7.3 Selective or full-thickness myotomy?

30 RECOMMENDATION
ESGE suggests that either a full-thickness or selective myotomy approach is acceptable because of their similar rates of intraprocedural adverse events, reflux on post-POEM pH-monitoring studies, and erosive esophagitis, but that full-thickness myotomy may be faster to perform.
Weak recommendation, very low quality evidence.
Level of agreement 80 %.

A retrospective study showed that mean procedure times for POEM were significantly shorter with the full-thickness approach (62 vs. 88 minutes; $P<0.01$), with similar symptom relief rates, post-procedural manometry outcomes, and AEs [73]. Another retrospective study reported similar results, with mean procedure times being significantly shorter with full-thickness myotomy ($P=0.02$). There was no increase in any procedure-related AEs after full-thickness myotomy, with similar results also for treatment success (Eckardt score ≤ 3, 96.0 % vs. 95.0 %), post-treatment symptom score and esophageal sphincter pressure, and the overall clinical reflux complication rate (21.2 % vs. 16.5 %; $P=0.38$) [74]. Similar results were found in other studies (**Table 7 s**) [75, 76].

In contrast, a smaller retrospective study, including 56 patients, showed that full-thickness myotomy was a predictive factor for clinically relevant GERD [77]. Despite these findings, a subsequent metanalysis did not find a statistically significant difference between selective and full-thickness myotomy in terms of clinical reflux or pH monitoring outcomes [78].

7.4 What should be the length of the myotomy?

31 RECOMMENDATION
ESGE recommends that the myotomy should be extended 2–3 cm distal to the GEJ to allow complete disruption of the lower esophageal sphincter.
Strong recommendation, moderate quality evidence.
Level of agreement 89 %.

32 RECOMMENDATION
ESGE recommends that the myotomy length should be tailored to the disease being treated, with evidence favoring short esophageal-side myotomy if indicated because of decreased adverse events and procedure times.
Strong recommendation, very low quality evidence.
Level of agreement 89 %.

33 RECOMMENDATION
For types I and II achalasia, ESGE recommends an esophageal myotomy length of 4–7 cm and a gastric myotomy length of 2–3 cm in view of shorter procedure times, similar efficacy, and similar rates of adverse events.
Strong recommendation, low quality evidence.
Level of agreement 97 %.

34 RECOMMENDATION
For type III achalasia and other spastic esophageal motility disorders, ESGE recommends tailoring the length of the myotomy to the length of the spastic segment.
Strong recommendation, very low quality evidence.
Level of agreement 97 %.

Multiple studies, including RCTs, have addressed the length of the myotomy created during POEM. In general, shorter myotomy length has been shown to induce similar rates of procedural and clinical success in patients with types I and II achalasia, with no increase in AEs or GERD, but with significantly reduced procedural times [79–82]. The majority of studies on POEM describe a gastric myotomy length of 2–3 cm [83, 84]. A longer myotomy length may correlate with increased rates of reflux esophagitis (**Table 8 s**) [58]. Furthermore, endoscopic functional luminal impendence planimetry (EndoFLIP) measurements of progressive gastric myotomy suggest that >2 cm gives no further benefit in terms of GEJ distensibility [85].

EndoFLIP is a technology that measures the distensibility index (area/pressure) of sphincters in the gastrointestinal tract. It is particularly useful when measured pre- and post-POEM to assess the relaxation of the LES after therapy. One uncontrolled study suggested low post-POEM distensibility index values (< 7 mm^2/mmHg) were predictive of clinical failure [86]. Whilst clinically useful in certain cases, this expert panel does not currently recommend the routine use of peri-POEM EndoFLIP owing to cost and availability concerns, and its uncertain benefit in clinically relevant outcomes.

In patients with type III achalasia and other spastic esophageal disorders, myotomy length is often tailored to HRM findings, allowing for tailored myotomy. This has been shown to correlate with improved clinical success in type III achalasia and spastic esophageal disorders (**Table 9 s**) [87, 88].

8 Mucosal closure

8.1 How to close the mucosal incision

35 RECOMMENDATION

ESGE recommends the use of through-the-scope clips for mucosal closure owing to their high efficacy and availability, and lower price compared with other closure methods.

Strong recommendation, low quality evidence.

Level of agreement 100 %.

36 RECOMMENDATION

ESGE suggests that over-the-scope clips and endoscopic suturing can be considered if closure with conventional through-the-scope clips fails.

Weak recommendation, very low quality evidence.

Level of agreement 91 %.

Conventional through-the-scope (TTS) clips are widely used for the closure of mucosal defects (▶ **Fig. 3**). Alternatives such as over-the-scope (OTS) clips and endoscopic sutures have also been described, which require scope withdrawal prior to intervention and are more demanding in terms of skills and training.

A novel TTS suture system for mucosotomy closure (the X-Tack Endoscopic HeliX Tacking System) was evaluated in 35 consecutive patients who underwent POEM [89]. It achieved a 91 % technical success rate, with a mean closure time of 12.4 minutes; however, 17 patients (53 %) required more than two suture systems and three patients (9 %) required additional TTS clips; no AEs were reported. This technique required a longer (12 minutes) suturing time and has a lower success rate (91 %) compared with simple endoscopic clipping, which requires 4–6 minutes and has been described as having nearly 100 % success. Furthermore, this suture system is currently more costly and not widely available [90].

A case–control study comparing endoscopic suturing and conventional TTS clips showed that both techniques offered good clinical results, with adequate and safe mucosal closure [91]. As expected, closure time was shorter with clips compared with suturing (16 vs. 33 minutes; $P = 0.04$). Overall, a cost analysis showed a trend toward lower cost with clips versus endoscopic suturing. The authors suggested that suturing may be most cost-effective for difficult cases where conventional clip closure methods fail.

Another study compared TTS clips with OTS clips for POEM and gastric POEM procedures [92]. The authors reported longer clip placement times (6.5 vs. 3.2 minutes; $P = 0.01$), higher numbers of clips used (5 vs. 1; $P = 0.01$), and more clip-related AEs (21.7 % vs. 13.0 %; $P = 0.01$) in the TTS arm compared with the OTS clip arm; however, the quoted AEs (5/36 in the TTS group) included inability to place the clip (n = 2) and clip dislodgement (n = 3). Technical and clinical clip success occurred in 94.5 % versus 91.7 % of cases ($P = 0.13$), and 91.7 % vs. 100 % ($P = 0.01$) for TTS clips and OTS clips, respectively.

9 Adverse events

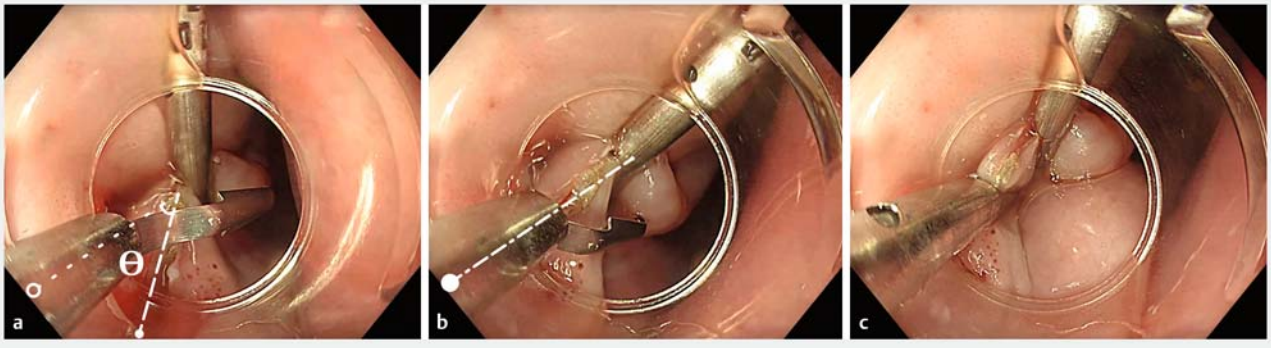
9.1 How to prevent and manage bleeding during submucosal tunneling and when performing the myotomy

37 RECOMMENDATION

Prophylactic hemostasis for nonbleeding vessels should be guided by vessel size. Very large vessels that do not hamper tunnel progression should be avoided; vessels up to 1–1.5 mm should be pretreated using the knife, and vessels larger than 1.5–2 mm should be considered for prophylactic treatment using coagulation forceps.

Good practice statement.

Level of agreement 94 %.



▶ **Fig. 3** Images showing best practice technique for closure of the mucosotomy using through-the-scope clips: **a** the clip (short-dashed line) and mucosal incision (long-dashed line) are not in the same axis, with the clip needing to be rotated anticlockwise by angle θ to achieve optimal closure **b** the clip and the defect are in the same axis after repositioning of the clip (dash–dotted line) and the hilt of the clip is centered on the incision line; **c** good position of the closed clip, leading to edge eversion and symmetrical closure.

38 RECOMMENDATION
Water irrigation should be used to precisely identify the site of bleeding, combined with pressure from the endoscope cap to tamponade bleeding during device exchange. The technique of hemostasis should be determined by the size of the bleeding vessel.
Good practice statement.
Level of agreement 94 %.

Recommendations for bleeding prophylaxis and management are based on the experience of the expert panel consensus owing to the lack of evidence. Small vessels can be treated using coagulation current (e. g. spray coagulation) with a closed knife; larger vessels should be treated using a coagulation forceps with soft coagulation [93]. Caution should be taken to avoid using coagulation current near the mucosal layer to prevent mucosal injury and subsequent full-thickness perforation. Bleeding from the dissected mucosal layer should not be immediately treated as it will stop spontaneously in most cases. Instillation of water into the tunnel or alternative imaging techniques, like red dichromic imaging, can be used to identify the precise location of the bleeding [94]. The submucosal injection solution should not be too dark as this obscures adequate visualization of submucosal vessels.

Any bleeding vessels should be identified and treated prior to tunnel closure. Filling of the submucosal tunnel with water prior to closure helps identify occult bleeding via discoloration of the water; if this occurs, the source should be sought by meticulous examination.

9.2 How to prevent and manage mucosal tears

39 RECOMMENDATION
Mucosal injury during POEM should be proactively sought during the procedure and particularly before completion. Mucosal injury can be represented on a spectrum from whitening of the overlying mucosa to a full-thickness perforation.
Good practice statement.
Level of agreement 97 %.

40 RECOMMENDATION
Any suspected current or potential mucosal perforation during POEM should be considered for endoscopic treatment.
Good practice statement.
Level of agreement 89 %.

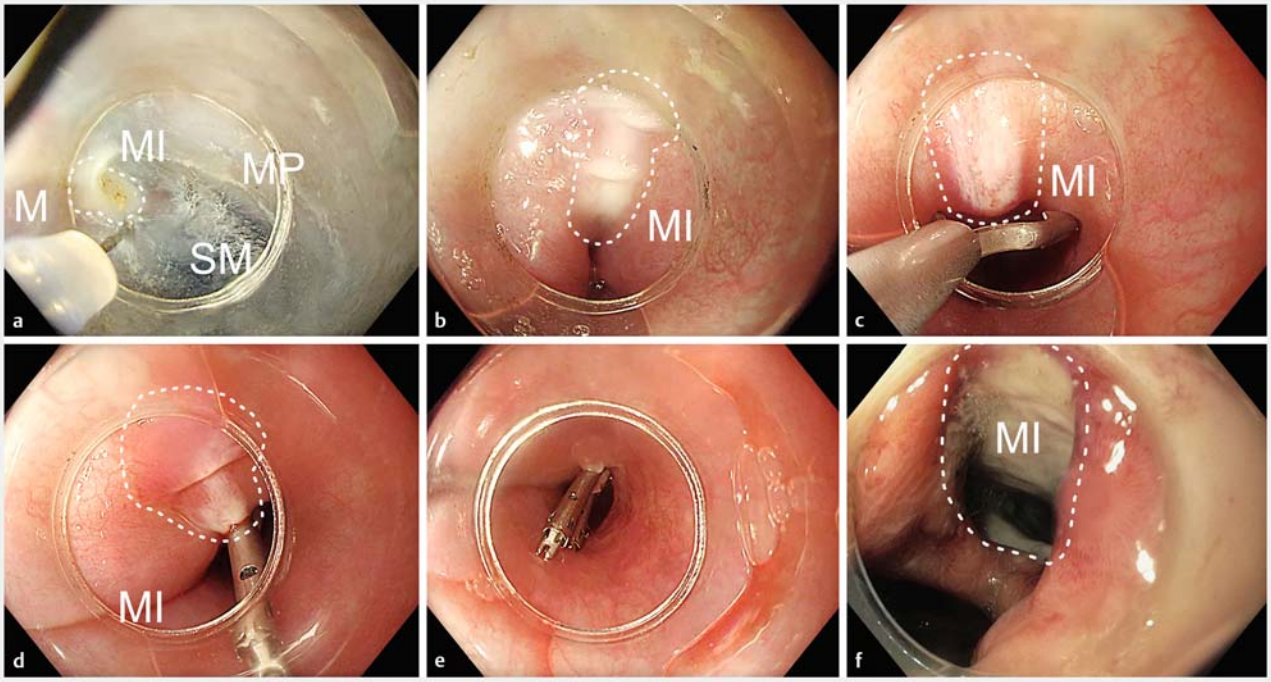
Mucosal injury can occur in up to 17 % of POEM procedures [95]. One study described two types of injury: type I injuries were small superficial mucosal injuries, presenting mostly as whitening of the mucosa or submucosal exposure lesions, whereas type II injuries were large full-thickness perforations with an irregular border [96]. Submucosal fibrosis and previous POEM were significant predictors of type II mucosal injury, as was longer procedure duration [95, 97] (▶ **Fig. 4**). The following technical points should be considered regarding the prevention and management of mucosal injury.

1. Care should be taken not to perforate the mucosa when passing instruments through the working channel, applying energy, opening instruments, and during passage of the scope within the tunnel. Where a needle is used for injection, blunt injection is favored to avoid inadvertent mucosal injury.
2. General advice to avoid mucosal injury includes liberal use of submucosal injection, performing dissection close to the muscularis propria, ensuring a tunnel wide enough to avoid spray coagulation contact with the mucosal side, and avoiding long bursts of spray coagulation.
3. The integrity of the mucosal lining should be checked during the procedure and after performing the myotomy for any injury or perforation. Mucosal injury can be identified by blanching of the mucosa or an actual hole. Any mucosal perforations should be promptly treated to avoid expansion of the perforation, and mediastinal or peritoneal contamination.
4. Mucosal injuries occur most commonly whilst crossing the GEJ [95]. Care should be taken when extending the submucosal tunnel across the GEJ as the tunnel commonly narrows at this point.
5. Mucosal injuries should be promptly identified and treated as they represent potential full-thickness perforations after myotomy. If a type I mucosal injury represents sufficient damage to the mucosa, this may lead to type II mucosal injury after the procedure. Mucosal injuries should be closed as soon as possible after tunnel passage as they can rapidly increase in size.
6. Small mucosal injuries should be closed with the use of TTS clips [98]. Strategies to treat larger mucosal injuries include the use of OTS clips or endoscopic suturing devices [99].

9.3 How to prevent and manage gas-related adverse events

41 RECOMMENDATION
ESGE recommends performing POEM using low flow CO_2 insufflation.
Strong recommendation, low quality evidence.
Level of agreement 94 %.

42 RECOMMENDATION
A high index of suspicion for gas-related adverse events is required during POEM, which include (in order of frequency observed from high to low) capnoperitoneum, capnothorax, and capnomediastinum.
Good practice statement.
Level of agreement 97 %.



▶ **Fig. 4** Images of the management of a mucosal injury type 1 and evolution to a mucosal injury type 2 when left untreated (different patients) showing: **a** a mucosal injury type 1 viewed in the tunnel (delineated by a dotted line); **b** the same injury viewed from the esophageal lumen (delineated by a dotted line) a few seconds after the injury occurred; **c** the onset of surrounding erythema 20 minutes after the injury occurred; **d** a through-the-scope clip placed to treat the mucosal injury; **e** the final appearance after closure; **f** a type 2 mucosal injury that evolved over 48 hours from an unrecognized type 1 injury.
M, mucosa; MI, mucosal injury; MP, muscularis propria; SM, submucosa.

43 RECOMMENDATION

Drainage of capnoperitoneum using needle decompression is required if hemodynamic or respiratory compromise occur during the procedure. Subcutaneous emphysema invariably resolves spontaneously and does not require treatment.

Good practice statement.

Level of agreement 100 %.

CO_2 is preferred during POEM across a majority of studies, as it has been shown to reduce the incidence of AEs in comparison to room air. Our recommendation is in accordance with prior ESGE guidelines, as there is no new evidence to suggest a different approach [2]. A review found an overall rate of gas-related AEs during POEM of 36 % [100]. The most frequent was capnoperitoneum (27 %), which can lead to respiratory or hemodynamic compromise. Subcutaneous emphysema and capnomediastinum are usually clinically silent and disappear spontaneously after a few days [98]. One study developed a prediction model for gas-related AEs including four risk factors: (i) air insufflation (OR 9.1, 95 %CI 4.4–18.5); (ii) mucosal injury (OR 1.6, 95 %CI 1.0–2.5); (iii) long operation time (OR 2.2, 95 %CI 1.3–3.7); and (iv) selective myotomy (OR 2.2, 95 %CI 1.1–4.5) [101].

The following considerations pertain to the management of gas-related AEs during POEM procedures

1. The insufflation unit should be checked to ensure that CO_2 at low flow rate (~1.2 L/minute) rather than air is being used.
2. The patient should be continuously assessed for abdominal distension. If necessary, the procedure should be interrupted to perform needle decompression of a capnoperitoneum.
3. Good communication with the anesthetic team is necessary. Changes in hemodynamics, tidal volumes, ventilation, and capnography should prompt a clinical review of the patient, particularly for pleural effusion, capnothorax, or capnoperitoneum.
4. Minor levels of capnoperitoneum may be treated conservatively by temporarily pausing the procedure and waiting for absorption of the CO_2.
5. In the presence of a large tense capnoperitoneum associated with hemodynamic compromise or ventilatory compromise, needle decompression should be performed. One study suggests that the decision to intervene for capnoperitoneum could be based on end-tidal CO_2 (> 50 mmHg) [102].

The presence of a capnoperitoneum should be confirmed by abdominal examination, noting distension and a tympanic abdomen on percussion. Care should be taken to ensure that the stomach is deflated before attributing abdominal distension to capnoperitoneum. The decompression site should be identified avoiding vasculature, infected skin, or scar tissue. Multiple options have been described for the insertion point; either in the midline 2 cm below the umbilicus along the median line, or on a lateral part of the abdomen 5 cm superior and medial to the anterior superior iliac spine, or 3 cm below the left subcostal area at the midclavicular line [103, 104].

The overlying skin should be cleansed with a sterilizing solution. A test puncture might be performed using a 21-gauge needle; thereafter, an 18- or 20-gauge trocar should be used [103]. The catheter and needle should be inserted into the peritoneal cavity while applying suction on a water-filled syringe. Bubbling in the water is used to confirm the presence of gas, indicating an adequate depth of insertion. The needle may then be withdrawn while leaving the plastic catheter sheath in place. The water-filled syringe is then attached to the catheter and the plunger removed. Bubbling through the water-filled syringe is used to denote continued drainage of gas. The syringe should be secured and left in place until completion of the procedure, or longer until adequate decompression is achieved.

10 Are there technical adaptations required for difficult POEM procedures?

44 RECOMMENDATION
ESGE suggests creating a second tunnel in an alternative orientation when poor mucosal lifting impedes the initiation of the tunnel.
Weak recommendation, very low quality evidence.
Level of agreement 89 %.

10.1 Submucosal fibrosis

Submucosal fibrosis poses one of the greatest challenges to POEM practitioners and is the leading cause of technical failure. Moreover, it is associated with an elevated risk of AEs and prolonged procedure time [105]. Numerous strategies have been proposed to address and overcome the hurdles posed by submucosal fibrosis during POEM.

- **Creation of a second tunnel** Where poor mucosal lifting impedes the initiation of the submucosal tunnel, some authors recommend creating a second tunnel in an alternative orientation. In a retrospective study involving 21 cases with severe submucosal fibrosis, this approach successfully rescued 11 patients [105].
- **Concomitant submucosal and muscular dissection** Fibrosis may be encountered at a later stage during tunneling. In such situations, concurrent submucosal and muscle dissection has demonstrated feasibility and effectiveness, as evidenced in a case report [106] and case series, albeit with limited sample sizes [107–109]. This modified POEM approach may also be considered for patients with severe spastic segments, although data specific to this scenario are currently lacking.
- **"Open POEM"** An alternative variation termed "open POEM" proposes the simultaneous cutting of the mucosa, submucosa, and muscularis propria [110]. Although initial outcomes reported in case series have been favorable, the panel does not endorse this full-thickness approach as it goes against the principles of third-space endoscopy, increases the potential for severe AEs, and has limited available data [110].

10.2 Challenges in sigmoid-type achalasia

Adequate orientation can be challenging in cases of sigmoid-type achalasia. Case reports have suggested various approaches to facilitate the completion of the procedure, including double-scope POEM, POEM with additional curved myotomy, fluoroscopy-guided POEM, and open POEM [111]. In instances of types I and II sigmoid-type achalasia, a shorter tunnel and myotomy (0–1 cm after the caudal end of the mucosal incision) may suffice; however, the existing evidence is insufficient to warrant a formal recommendation.

11 Postoperative care

11.1 When should diet be reintroduced?

45 RECOMMENDATION
In the absence of adverse events, resume fluids on day 1, soft diet on day 3, and normal diet on day 7 post-POEM.
Good practice statement.
Level of agreement 80 %.

The initial studies of POEM suggested a liquid diet on the day after the POEM procedure, followed by a soft diet on post-POEM day 3, with resumption of a normal diet on post-POEM day 4 [112]. Owing to the lack of evidence, the panel proposal is based on an internal Delphi consensus.

11.2 How should pain be managed after POEM?

46 RECOMMENDATION
ESGE recommends the use of paracetamol and/or non-steroidal anti-inflammatory drugs as first line for POEM post-procedural pain, with the consideration of opioids if the initial approach fails.
Strong recommendation, low quality evidence.
Level of agreement 83 %.

Post-procedural pain is common after POEM, with up to 10 % of patients complaining of severe pain [74, 113]. Substernal chest discomfort is usually the main complaint and reduces over time. Nearly 80 % of patients may need analgesia, particularly in the first day [44], requiring paracetamol, opioids, or nonsteroidal anti-inflammatory drugs for symptomatic control, sometimes with a combined approach. When used, opioids are usually not needed in large or prolonged doses, and chronic pain is usually related to residual achalasia symptoms rather than the procedure itself [113]. Compared with laparoscopic Heller's myotomy, post-procedure pain may be similar or lower after POEM [114], with low need for opioids within the first 4 hours, and no opioid requirement after 4 hours, particularly when using a multimodal analgesic approach [115].

Other analgesic strategies have been evaluated, such as pre-procedural paravertebral nerve block [116] or intraprocedural tunnel irrigation with 30 mL 0.2 % ropivacaine [117]; however, these have not shown a significant reduction in pain-related outcomes.

If opioids are needed, an RCT of 73 patients compared the use of two opioids for the management of post-procedural pain (0.08 mg/kg oxycodone [n = 36] or morphine [n = 37] given 15 minutes before the end of the POEM procedure), showing better efficacy with the former [118].

11.3 Should imaging be routinely performed after POEM?

47 RECOMMENDATION

ESGE recommends against the routine use of standard or CT fluoroscopic esophagrams after POEM in asymptomatic patients.

Strong recommendation, very low quality evidence.

Level of agreement 83 %.

48 RECOMMENDATION

ESGE suggests favoring the use of a CT esophagram with oral water-soluble contrast over a standard fluoroscopic esophagram in symptomatic patients with suspected post-procedural adverse events.

Weak recommendation, very low quality evidence.

Level of agreement 86 %.

The initial POEM series recommended a standard fluoroscopic esophagram postoperatively for the early detection of AEs. In our systematic search, we identified nine studies directly assessing the yield of conventional and/or CT esophagrams on day 1 after POEM [119–127]. Both imaging modalities demonstrated high sensitivity but low specificity for clinically relevant AEs. Abnormal findings, such as capnoperitoneum, capnomediastinum, or pleural effusions were frequently observed in asymptomatic patients and did not correlate with unfavorable patient outcomes or lead to modifications in therapeutic management [121, 122, 124, 127]. Moreover, two retrospective studies found that esophageal emptying parameters assessed in early esophagrams did not predict the clinical response to POEM [119, 120]. Among the cohorts evaluating the role of CT esophagograms, radiological findings that prompted changes in patient management were mainly observed in patients with symptoms [121, 122, 124]. In symptomatic patients, early imaging contributed to the timely identification and treatment of leaks, perforations, and infectious AEs.

We did not find any head-to-head studies comparing the use of CT versus standard fluoroscopic esophagrams (**Table 10 s**). In alignment with a consensus-based algorithm from the surgical literature to detect anastomotic leakage after minimally invasive esophagectomy and ESGE guidelines for the management of iatrogenic perforations, we favor the use of CT esophagrams over standard fluoroscopic esophagrams owing to their higher sensitivity in diagnosing small esophageal leaks and other extraluminal abnormalities [104, 128]. Furthermore, relevant abnormal findings in standard fluoroscopy are almost invariably followed by a CT esophagram.

In conclusion, the rate of imaging abnormalities requiring intervention after POEM is very low. Routine imaging is associated with radiation exposure, increased resource use, and potential AEs related to contrast ingestion. Therefore, the use of a CT esophagram after POEM should be considered primarily for symptomatic patients.

11.4 Is second-look endoscopy recommended after POEM?

Second-look endoscopy adds to both the costs and logistical challenges. Several reports indicate that POEM can be safely performed without the need for routine postoperative examinations and may even be conducted on an outpatient basis for certain individuals [129, 130].

The benefit of second-look endoscopy has been explored in a single-center retrospective study comprising 447 patients [131]. Abnormal findings were detected in 71 patients (14.3 %). Newly detected AEs that necessitated endoscopic intervention or deviation from the standard postoperative protocol were observed in 12 patients (2.4 %). These included entry site dehiscence in eight patients (1.6 %), submucosal hemorrhage or hematoma in two patients (0.4 %), and dehiscence at the site of an intraoperative perforation that had been closed with endoclips in two patients (0.4 %). Multivariate analysis indicated that an extended duration of operation and the presence of intraoperative AEs were the predictors of clinically significant findings at second-look endoscopy. Therefore, second-look endoscopy could potentially be reserved for selected patients.

11.5 Is a short-term course of PPI recommended after POEM to reduce the rate of adverse events?

PPIs have been widely studied in the literature for the management of post-POEM GERD, which is reported to occur in up to almost 30 % of the cases [132]. While PPIs are effective in this setting, no evidence was found for the use of PPIs in the peri-procedural setting to reduce AEs such as late bleeding or pain, or to induce better healing of the mucosotomy. While this practice is seen in some studies as a routine, supposedly aimed at

facilitating mucosal healing [133], no evidence-based recommendation can be made.

12 The Precision POEM Assessment Tool (PPAT)

The Precision POEM Assessment Tool (PPAT) is an ESGE competency assessment tool that is being made available alongside this position statement to facilitate a structured dialogue between POEM trainers and their trainees concerning the quality of a POEM procedure. It aligns with the recommendations in this part of the curriculum (▶ **Table 1**), with the relevant recommendation that each PPAT component was based on indicated where applicable in ▶ **Table 4**).

Development of the Precision POEM Assessment Tool

A subtaskforce of the POEM curriculum taskforce, consisting of Drs. Tate, Lala, Debels, and Montori, selected recommendations from this document that focused on the POEM technique and could be assessed during a live procedure or from a video. Once selected, PPAT statements were modified for the purpose of the online tool and grouped into domains. To aid interpretation, text was attached to each PPAT statement describing important aspects of best/poor practice. PPAT statements can be scored from 1 (poor) to 5 (very good) on a Likert scale.

▶ **Table 4** Components and scoring of the Precision POEM Assessment Tool (PPAT)[1].

Component		Possible responses and scoring		L[2]	V[3]	Recommendation number	Maximum score[4]
Global competencies							**20**
i	Tip control	**1** Very poor	Jerky, inaccurate, large, nonpurposeful movements	X	X		5
		5 Very good	Controlled, precise, fine, purposeful movements				
ii	Appreciation of planes	**1** Very poor	Repeatedly unable to identify planes and the cutting line, compromising safety	X	X		5
		5 Very good	Appreciation of planes and cutting line at all stages of the procedure. Anticipates areas of difficulty and able to optimize technique to improve the plane and safely proceed				
iii	Periodic checks	**1** Very poor	Fails to perform any periodic checks	X			5
		5 Very good	Frequently checks ESU settings before using thermal energy (after every change in settings), use of CO_2 rather than air, mucosal integrity, and abdominal distension, and maintains good communication with the anesthetic team				
iv	Achieves good orientation	**1** Very poor	Fails to achieve good orientation despite mentor input. Unaware of or ineffective use of withdrawal, advancement, and rotation of the scope	X			5
		5 Very good	Able to easily achieve orientation, tunnel easily advanced perpendicular to the circular muscle. In more difficult cases, achieves a good orientation with repeated withdrawal, advancement, and rotation of the scope				
Cleaning and inspection						9–12	**20**
v	Thorough esophageal cleansing before mucosal incision	**1** Very poor	Fails to adequately cleanse the esophagus, increasing the risk of contamination of the submucosal tunnel and compromising the ability to assess the mucosa. Does not examine the esophagus to exclude the presence of esophageal cancer or pseudoachalasia	X	X	9	5
		5 Very good	Meticulously cleanses the esophagus to minimize the risk of contamination of the submucosal tunnel, ensuring optimal mucosal visualization. Carefully examines the esophagus to exclude the presence of esophageal cancer or pseudoachalasia				

▶ **Table 4** (Continuation)

Component		Possible responses and scoring		L[2]	V[3]	Recommendation number	Maximum score[4]
vi	Documentation of obstructive esophageal spastic segments	**1** Very poor	Does not document observed obstructive esophageal spastic segments, fails to evaluate correlation with HRM and imaging test findings, even with prompting	X		10	5
		5 Very good	Consistently and independently documents all observed obstructive esophageal spastic segments, accurately evaluates and correlates them with HRM and imaging test findings				
vii	Identification of anatomical landmarks	**1** Very poor	Fails to identify and document the position of the upper esophageal sphincter and the GEJ, even with prompting	X		11	5
		5 Very good	Effectively and independently identifies all key anatomical landmarks including the upper esophageal sphincter, and the GEJ				
viii	Identification of anterior vs. posterior approaches	**1** Very poor	Cannot identify anterior (1–2 o'clock in supine position) or posterior (5–6 o'clock) position, even with prompting	X		12	5
		5 Very good	Independently and accurately identifies anterior (1–2 o'clock in supine position) or posterior (5–6 o'clock) orientation based on gastroesophageal landmarks and gravity				
Mucosotomy						10, 12, 17, 18	**20**
ix	Identification of the mucosotomy site	**1** Very poor	Unable to locate and justify the mucosotomy site, despite mentor input. Does not consider spastic segments, length of myotomy or orientation	X		10, 12, 17	5
		5 Very good	Independent, justifiable, identification of the mucosotomy site. Considers length of myotomy, length of spastic segment, appropriately allows enough space for the myotomy				
x	Submucosal injection[5]	1 Very poor	Unable to find the submucosal plane. Static injection with an inadequate volume of injectate, resulting in a poor lift despite prompting, compromising the safety of the mucosotomy by risking muscle injury	X	X	None	5
		5 Very good	Efficiently finds the submucosal plane. Caution is taken to avoid mucosal and intrathoracic injection. Dynamic injection of an adequate volume to obtain a lift large enough to facilitate a safe mucosotomy incision				
xi	First incision of the mucosotomy	**1** Very poor	Fails to make the first incision at the site of previous injection. Uses an improper knife angle. Makes multiple taps on the electrosurgical unit	X	X	17	5
		5 Very good	Meticulously performs the mucosotomy by making the first incision at the site of previous injection. Uses the fewest possible taps on the electrosurgical unit with a cutting current. Maintains the knife tip at a 45–80° angle to the mucosal surface				
xii	Extending the mucosotomy incision	**1** Very poor	Lacks control over the longitudinal extension of the incision, deviating from the tunnel direction. Fails to lift the mucosa at the caudal end and tolerates insufficiently injected submucosa, risking damage to the muscle. Inappropriate incision length, either too short or too long, preventing proper entry	X	X	18	5
		5 Very good	Controlled, safe, and precise longitudinal extension of the incision, maintaining the direction of the tunnel. Gently lifts the mucosa at the caudal end and repeatedly injects the submucosa, if required, to avoid damage to the muscle. Appropriate length (1.5–2 cm) to facilitate entry				

▶ **Table 4** (Continuation)

Component		Possible responses and scoring		L[2]	V[3]	Recommendation number	Maximum score[4]
Submucosal tunneling						19–25	**25**
xiii	Accessing the submucosal tunnel	**1** Very poor	Uncontrolled, nonpurposeful movements of the knife. Trims incorrect area, inadequate lift, risks thermal injury to the mucosa and/or muscle. Trimming does not allow tunnel access	X	X	19, 20	5
		5 Very good	Careful, precise, controlled trimming of the submucosa at the caudal incision end. Uses the cap to protect the mucosa from thermal injury and submucosal injection to avoid muscle injury. Trimming easily allows access to the tunnel				
xiv	Submucosal tunneling	**1** Very poor	Fails to perform submucosal tunneling properly, neglecting the use of CO_2 insufflation, injection of saline and chromic dye, and cap use, hindering proper exposure of the submucosa–muscularis propria interface. Creates multiple dissection planes, leading to an inefficient and potentially unsafe procedure	X	X	21	5
		5 Very good	Meticulously performs submucosal tunneling using a combination of CO_2 insufflation, frequent injection of saline and chromic dye, and a gentle forward pressure of the cap to expand the submucosa–muscularis propria interface. Avoids creating multiple dissection planes				
xv	Maintaining direction	**1** Very poor	Does not periodically check direction, continues to dissect unaware of deviations in direction, unable to determine the direction of the GEJ	X	X	21	5
		5 Very good	Periodically checks the direction of the tunnel by withdrawing the scope. Able to identify any deviation in direction and correct it in timely fashion				
xvi	Recognizing the GEJ	**1** Very poor	Does not measure distance between the incisors and the GEJ before starting procedure. Fails to identify the GEJ during tunneling. Does not recognize key anatomical features such as palisade veins, increased vascularity, spindle-shaped veins, large perforating vessels, and/or the narrowing of the lumen	X	X	22, 23	5
		5 Very good	Meticulously measures the distance between the incisors and the GEJ before starting the procedure. Accurately identifies the GEJ using key anatomical observations such as palisade veins, increased vascularity, spindle-shaped veins, large perforating vessels, and/or the narrowing of the lumen				
xvii	Extending the submucosal tunnel into the stomach	**1** Very poor	Fails to extend the submucosal tunnel adequately, with less than 3 cm distal extension to the GEJ. Does not use anatomical landmarks or the double-scope method, leading to uncertainty about the correct extension length for gastric myotomy	X	X	24, 25	5
		5 Very good	Meticulously extends the submucosal tunnel at least 3 cm distal to the GEJ and confirms the correct extension using a combination of anatomical landmarks and, if necessary, the double-scope method to ensure an acceptable length for gastric myotomy				
Myotomy						26–34	**30**
xviii	Starts at appropriate site	**1** Very poor	Fails to start the myotomy 2 cm or more below the caudal extent of the mucosotomy site. Uses uncontrolled, repeated taps with the knife, leading to a less precise and unsafe procedure	X	X	26	5
		5 Very good	Meticulously performs the myotomy in a cranial to caudal manner, starting 2 cm or more below the caudal extent of the mucosotomy site, using controlled sequential single taps with the knife				

▶ **Table 4** (Continuation)

Component		Possible responses and scoring		L[2]	V[3]	Recommendation number	Maximum score[4]
xix	Choice of anterior or posterior myotomy	**1** Very poor	Fails to select the appropriate orientation for myotomy, chooses the same orientation as a previous surgical or endoscopic myotomy	X		28, 29	5
		5 Very good	Meticulously chooses the appropriate orientation for myotomy, performing it on either the anterior (1–2 o'clock) or posterior (5–6 o'clock) side, and avoids the same orientation as any previous surgical or endoscopic myotomy				
xx	Approach to myotomy: mucosal to adventitial or adventitial to mucosal	**1** Very poor	Chooses an incorrect approach, disregarding the available space in the tunnel. Applies excessive traction on the muscle with the knife. Makes uncontrolled incisions. Struggles to switch between approaches. Fails to maintain a perpendicular direction to the circular muscle layer, leading to improper dissection	X	X	27	5
		5 Very good	Meticulous choice of approach based on the amount of space in the tunnel. Avoids excessive traction/pressure on the muscle with the knife. Controlled, stepwise incisions made. Able to seamlessly switch between approaches. Maintains the direction perpendicular to the circular muscle				
xxi	Use of adventitial injection to improve safety[5]	**1** Very poor	Does not use adventitial injection to improve safety when using the mucosal to adventitial approach	X	X	27	5
		5 Very good	Repeatedly uses injection into the adventitial space to prevent thermal injury to mediastinal structures when using the mucosal to adventitial approach				
xxii	Length of the myotomy	**1** Very poor	Does not extend the myotomy adequately, fails to tailor the length based on the disease being treated	X		31–34	5
		5 Very good	Independently extends the myotomy 2–3 cm distal to the GEJ and decides the esophageal myotomy length based on the disease being treated, such as 4–7 cm for type I and II achalasia and tailored for type III achalasia and spastic esophageal motility disorders				
xxiii	Ensures completeness of myotomy	**1** Very poor	Fails to complete the myotomy. Does not recognize remaining circular muscle	X	X	30	5
		5 Very good	Meticulously inspects the myotomy to ensure complete disruption of the circular layer				
Mucosal closure						35, 36	**5**
xxiv	Closing the mucosal incision	**1** Very poor	Unable to close the mucosotomy. Inaccurate, uneven, incorrect positioning of clips. Deploys clips without confirming position. Risks injury to the mucosa. Persistent tissue inversion. Unsafe closure	X	X	35, 36	5
		5 Very good	Even and accurate placement of clips. Ensures adequate positioning and tissue eversion prior to clip deployment to provide a secure zipper-type closure				

▶ **Table 4** (Continuation)

Component		Possible responses and scoring		L[2]	V[3]	Recommendation number	Maximum score[4]
Adverse events						37–43	**20**
xxv	Preventing and managing bleeding during submucosal tunneling and myotomy	**1** Very poor	Fails to identify or pretreat vessels during the procedure and ignores bleeding vessels prior to tunnel closure, potentially leading to significant bleeding and procedural complications	X	X	37, 38	5
		5 Very good	Proactively identifies nonbleeding vessels based on size, avoids very large vessels which do not hamper tunnel progression. Pretreats vessels up to 1–1.5 mm with the knife, and considers coagulation forceps for larger vessels. Uses water irrigation and endoscope cap pressure to manage active bleeding effectively. Identifies and treats any bleeding vessels prior to tunnel closure. Appreciates the higher risk of bleeding in the cardia				
xxvi	Preventing mucosal injuries	**1** Very poor	Neglects necessary precautions to prevent mucosal injuries when applying energy, using open instruments, or passing the scope within the tunnel. Does not use injection adequately. Performs dissection too far from the muscularis propria. Creates a narrow tunnel that increases the risk of spray coagulation coming into contact with the mucosa. Neglects to be particularly careful while crossing the GEJ	X	X	39	5
		5 Very good	Carefully avoids mucosal injuries when applying energy, using instruments, and during scope passage within the tunnel. Repeatedly uses injection. Performs dissection close to the muscularis propria and maintains a wide enough tunnel to avoid spray coagulation contact with the mucosa. Is particularly careful while crossing the GEJ. Promptly identifies and treats any mucosal injuries or perforations to prevent expansion and contamination				
xxvii	Managing mucosal injuries[5]	**1** Very poor	Fails to identify or manage mucosal injuries during the procedure, leading to potential full-thickness perforations and complications	X	X	39, 40	5
		5 Very good	Promptly identifies mucosal injuries during and after the procedure. Treats current or potential perforations with appropriate techniques such as TTS or OTS clips, or endoscopic suturing				
xxviii	Preventing and managing gas-related adverse events	**1** Very poor	Fails to check the insufflation unit for CO_2 usage at a low flow rate, does not continuously assess the patient for abdominal distension, and neglects to communicate with the anesthetic team regarding changes in hemodynamics, tidal volumes, ventilation, and capnography. Does not perform needle decompression when necessary, even with prompting. Demonstrates imprudent behavior in managing minor or large capnoperitoneum, leading to potential respiratory or hemodynamic compromise	X		41–43	5
		5 Very good	Independently ensures the insufflation unit is set to use CO_2 at a low flow rate (~1.2 L/minute). Continuously assesses the patient for abdominal distension and interrupts the procedure to perform needle decompression of a capnoperitoneum when necessary. Maintains excellent communication with the anesthetic team, promptly responding to changes in hemodynamics, tidal volumes, ventilation, and capnography to review the patient for pleural effusion, capnothorax, or capnoperitoneum. Manages minor levels of capnoperitoneum conservatively and performs needle decompression for large, tense capnoperitoneum associated with hemodynamic or ventilatory compromise				

▶ **Table 4** (Continuation)

Component		Possible responses and scoring		L[2]	V[3]	Recommendation number	Maximum score[4]
Technical adaptations required for difficult POEM procedures						44	**5**
xxix	Managing submucosal fibrosis during POEM[5]	**1** Very poor	Fails to recognize or address submucosal fibrosis when poor mucosal lifting impedes tunnel initiation. Neglects to create a second tunnel in an alternative orientation. Does not consider concomitant submucosal and muscular dissection when the second tunneling attempt proves unsuccessful	X	X	44	5
		5 Very good	Promptly recognizes and addresses submucosal fibrosis when poor mucosal lifting impedes tunnel initiation. Creates a second tunnel in an alternative orientation when necessary. Considers concomitant submucosal and muscular dissection in cases of severe fibrosis or obstructing spastic segments				
Overall PPAT							**145**

ESU, electrosurgical unit; GEJ, gastroesophageal junction; HRM, high resolution manometry; OTS, over the scope; TTS, through the scope.
[1] Best practice videos for the components of this PPAT are available from: https://academy.esge.com/en/pages/poem-curriculum-part-2-statement-video-links.
[2] L, applicable to live assessment
[3] V, applicable to video assessment.
[4] Possible total scores (denominators) per domain will vary according to whether the procedure is assessed live or using video and the number of unfilled non-mandatory components.
[5] Non-mandatory component.

Once all required fields are completed, an overall score can be obtained, providing an indication of the quality of the POEM. The denominator of this fraction reflects the number of relevant components (5 points for each component). Possible total scores (denominators) per domain will vary according to whether the procedure is assessed live (L) or using video (V), and the number of unfilled non-mandatory components (i.e. PPAT statements x, xxi, xxvii, and xxix).

With all optional fields filled in, the PPAT is distributed across its domains with a maximum denominator of 145 points. The distribution is as follows: "global competencies," 20 points (13.8%); "cleaning and inspection," 20 points (13.8%); "mucosotomy," 20 points (13.8%); "submucosal tunneling," 25 points (17.2%); "myotomy," 30 points (20.7%); "mucosal closure," 5 points (3.4%); adverse events, 20 points (13.8%); and "technical adaptations required for difficult POEM procedures," 5 points (3.4%).

A fillable version of the PPAT form for completion by trainers/trainees is available at: https://academy.esge.com/en/pages/poem-curriculum-part-2.

In order to provide trainees with a straightforward and visually clear reference to best practice, presented in a deconstructed manner, videos that exemplify best practice technique during POEM for the various PPAT domains have been made available at: https://academy.esge.com/en/pages/poem-curriculum-part-2-statement-video-links. These anonymized videos were carefully selected and have been edited to ensure they correspond precisely to the relevant domain of the PPAT. This approach allows trainees to directly observe and focus on specific aspects of the procedure where they may need improvement, thereby enhancing their learning experience by targeting areas that require further attention.

The PPAT tool, although still requiring prospective validation, is offered by the ESGE as a potentially effective measure of POEM competency based upon this curriculum, which is very likely superior to traditional markers such as number of cases performed.

Published scores such as FOODS [134], which assess the difficulty of the specific POEM procedure, might be used in the future to adjust the PPAT, accounting for procedural complexity and allowing for competency comparisons across procedures of varying difficulty.

Conflict of interest

P. Fockens has provided consultancy to Cook Endoscopy and Olympus (both 2022 to present). I.M. Gralnek is a consultant for Olympus (2024 to present). E. Rodríguez de Santiago has received speaker's and consultancy fees from Olympus (2017–2024), fees for advice from Adacyte Therapeutics (2023) and support for educational activities from Apollo Endoscopy (2023), Norgine (2023–2024), and ERBE (2024), plus speaker's fees from Izasa (2024). A. Sethi has provided consultancy and received research support from Boston Scientific (2009 ongoing) and consultancy to Olympus (2022 to present), Pentax (2024 to present), Medtronic (2021–2023), and Cook Medical (2023–2024), and research support from ERBE (2022). D.J. Tate has provided consultancy to Olympus EMEA (2019 to present) and Fujifilm (2021 to present); his department has received educational grants from Pentax, Olympus, Fujifilm, Boston Scientific, Prion Medical, Ovesco, Medtronic, CREO Medical, and Cook Medical. E. Albéniz, I.K. Araujo, L. Debels, A. Ebigbo, P. Familiari, H. Heinrich, E.G. Hourneaux de Moura, O. Kiosov, V. Lala, J. Martinek, H. Messmann, M.

Montori, S. Nagl, J. Santos-Antunes, R. Soetikno, M. Tantau, T.C. Tham, and Z. Vacková declare that they have no conflict of interest.

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