17. Peroral Endoscopic Myotomy (POEM)

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Abbreviations

DES	Distal esophageal spasm
DI	Distensibility index
EGD	Esophagogastroduodenoscopy
EGJ	Esophagogastric junction
EMR	Endoscopic mucosal resection
EPT	Esophageal pressure topography
ES	Eckardt score
ESD	Endoscopic submucosal dissection
FLIP	Functional lumen imaging probe
GERD	Gastroesophageal reflux disease
HRIM	High-resolution impedance manometry
HRM	High-resolution manometry
LES	Lower esophageal sphincter
NOTES	Natural orifice transluminal endoscopic surgery
POEM	Peroral endoscopic myotomy
TBE	Timed barium esophagram

Indications

Achalasia

Achalasia is a rare disease characterized by failure of relaxation of the lower esophageal sphincter (LES) and loss of coordinated peristalsis in the esophageal body. Despite being the most common primary esophageal

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motor disorder, the annual incidence is estimated at only 1 per 100,000 individuals [1]. Initially described in 1674 by Sir Thomas Willis, our current understanding of the etiology of achalasia has developed thanks to histopathologic analysis over the last two decades. Immunohistochemical studies have suggested an autoimmune response, potentially triggered by a neurotropic virus such as herpes simplex virus 1 in genetically susceptible hosts, with selective loss or impairment of ganglions in the myenteric plexus resulting in unopposed cholinergic stimulation of the distal esophagus and LES [2]. Presenting symptoms include dysphagia to solids and liquids (>90 %), regurgitation of undigested food and saliva (76–91 %), weight loss (35–91 %), and chest pain (25–64 %). Patients may also report respiratory complications of aspiration, such as nocturnal cough and pneumonia, as well as heartburn and esophagitis secondary to stasis [3]. There is no known cure for achalasia. Current treatment options are aimed at palliation of symptoms through elimination of outflow obstruction at the EGJ.

Emerging Indications

Based on case series reporting excellent early results, POEM operators have applied the minimally invasive technique to esophageal motor disorders other than type I and type II achalasia, including type III achalasia, distal esophageal spasm (DES), Jackhammer (hypercontractile) esophagus, and hypertensive LES [4, 5]. In general, EGJ outflow obstruction caused by high LES pressure responds favorably to division of the obstructing muscle fibers, whereas symptoms such as chest pain, attributed to esophageal body contraction (DES and type III achalasia), have lower rates of symptom remission following myotomy [6]. POEM has also been utilized as a salvage operation following failed laparoscopic Heller myotomy (LHM), with dissection and myotomy occurring in the 4–6 o'clock position.

History/Background

In the 100 years since Dr. Heller first described the "transabdominal, extramucosal cardioplasty performed onto the anterior and posterior walls of the cardia," the procedure has been transformed by laparoscopy, modified in length, and augmented by anti-reflux procedures [7]. In the last 10 years, however, the complementary fields of natural orifice translumenal endoscopic surgery (NOTES) and endoscopic submucosal dissection (ESD) have expanded from simple proof-of-concept studies to a broad variety of fully incision-less operations in use today. Early animal models demonstrated the feasibility of both safe access to the submucosal space using the mucosal flap technique and endoscopic myotomy [8, 9]. Based on these techniques, Dr. Haruhiro Inoue performed the first human POEM procedure in Japan in 2008 and presented his results at the 2009 Digestive Diseases Week in Chicago with subsequent publication in Endoscopy in 2010 [10]. Following his landmark publication, the procedure as described by Inoue grew exponentially with an estimated number of POEM cases exceeding 2000 worldwide by the end of 2012, when the global experience in POEM was summarized in the international POEM survey (IPOEMS), leading up to and during the NOSCAR conference in July 2012 [6].

Patient Selection

Symptom Assessment Questionnaires

Validated, disease-specific questionnaires can help establish the diagnosis of achalasia, assess disease severity, and establish baseline values to allow postoperative evaluation of treatment effect. The most widely used and reported instrument for achalasia is the four-item Eckardt score that evaluates the frequency of occurrence of chest pain, regurgitation, dysphagia, and amount of weight loss on a 0–3 scale [11]. Higher scores represent increasingly severe disease, while post-intervention scores less than or equal to three are associated with treatment success [12]. While simple to obtain, the ES does not measure disease impact on overall quality of life. More extensive and sensitive surveys include the Mayo Dysphagia Questionnaire-30, Achalasia Disease-Specific Quality of Life measure, Visceral Sensitivity Index, and EORTC QLQ-OES18 [13].

Physiologic Tests

Timed Barium Esophagram

Timed barium esophagram (TBE) (Fig. 17.1), comprised of chest radiographs obtained 1, 2, and 5 min after ingestion of 200–250 ml of dilute barium contrast, is useful for evaluation of both esophageal body

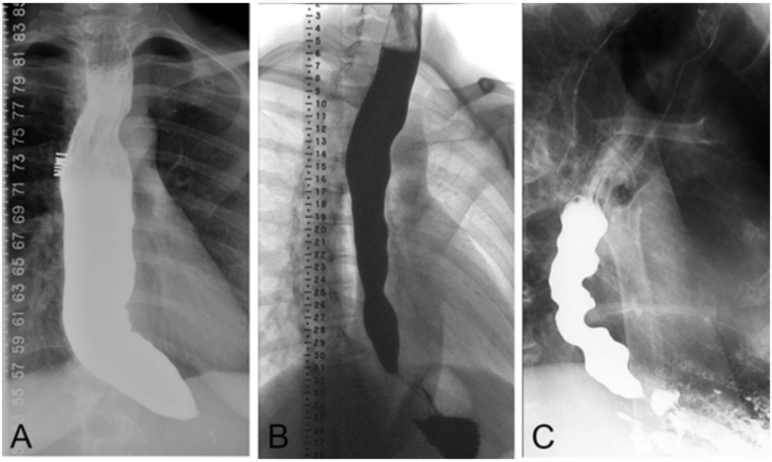

Fig. 17.1. Timed barium esophagram. Characteristic findings in achalasia include (**a**) increased esophageal width as seen in a patient with type I achalasia, (**b**) so-called bird's beak appearance of the contrast column as it tapers in the distal esophagus of a patient with type II achalasia, and (**c**) retained contrast with a "corkscrew" appearance seen in type III achalasia and other spastic disorders of the esophagus such as DES.

and EGJ anatomy (classic appearance of the "bird-beak" esophagus). TBE provides quantification of a baseline height of the barium column, degree of esophageal emptying, if any, and esophageal width. TBE also allows detection of sigmoid esophagus (representing so-called end-stage achalasia), hiatus hernia, and epiphrenic diverticula.

Esophagogastroduodenoscopy

Esophagogastroduodenoscopy (EGD) is required as part of the preoperative work-up of all patients prior to treatment for achalasia to rule out pseudo-achalasia (EGJ outflow obstruction secondary to an infiltrating malignancy). If the index of suspicion remains high for pseudo-achalasia (older patients with prominent weight loss and a short duration of symptoms), despite a negative EGD, adjunctive studies such as endoscopic ultrasound or computed tomography scan should be performed [14]. EGD also allows for assessment of retained solids or liquids, stasis, or reflux esophagitis and candidiasis.

High-Resolution Manometry

Manometry is considered the "gold standard" for the diagnosis of idiopathic achalasia. This diagnostic modality has had significant improvement in resolution and evaluation of esophageal motility over the last 10 years with the introduction of solid-state, high-resolution manometry (HRM) catheters utilizing 36 or more pressure sensors at 1 cm intervals. The increased resolution offered by HRM catheters has been accompanied by the development of esophageal pressure topography (EPT), or Clouse plots, to display pressure data in a more accessible format than traditional line tracings. Based on manometric profiles, Pandolfino et al. proposed the Chicago classification, dividing patients into three subtypes of achalasia (Fig. 17.2), with well-described prognostic implications [15, 16]. Type I, or "classic" achalasia, is defined by absent peristalsis and impaired EGJ relaxation in response to swallowing, quantified as a 4-s integrated relaxation pressure (IRP) >10 mmHg. Type II achalasia is diagnosed by the presence of panesophageal pressurization (>30 mmHg) and is associated with the best outcomes following myotomy. Type III achalasia, associated with premature, spastic contractions of the distal esophagus (two or more swallows with a distal latency of <4.5 s), and impaired EGJ relaxation, has the least reliable response to myotomy or pneumatic dilatation [16].

EndoFLIP

The functional lumen imaging probe, or EndoFLIP (Crospon, Galway, Ireland), is a novel diagnostic catheter that utilizes impedance planimetry, with sensors positioned at 0.5–1 cm intervals within a distensible balloon to generate a geometric representation of the lumen of the esophagus and LES (Fig. 17.3). When combined with a pressure sensor in the distal portion of the balloon, the FLIP allows quantification of the EGJ response to volumetric distention, calculated as the distensibility index (DI) = cross-sectional area/intra-balloon pressure. Recent publications have suggested a role for intraoperative EndoFLIP measurements to allow real-time evaluation of myotomy adequacy during LHM and POEM [17].

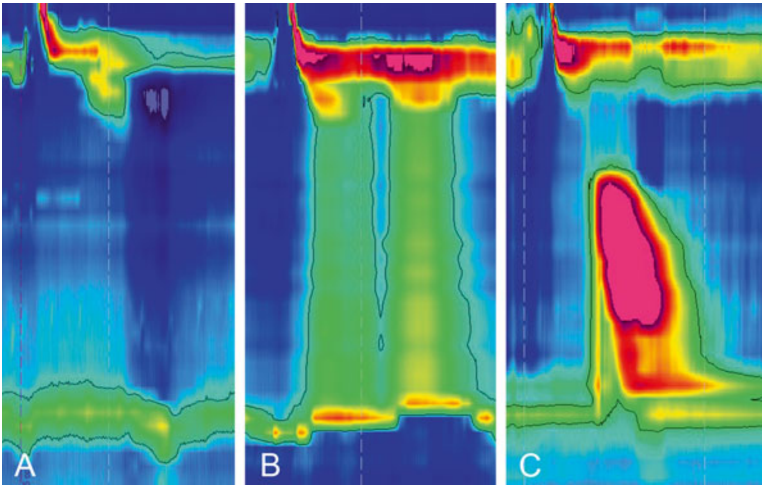

Fig. 17.2. High-resolution manometry. Distinct manometric patterns are observed in the subtypes of achalasia according to the Chicago classification. In the setting of elevated 4-s integrated relaxation pressures, (**a**) type I patients are recognizable by the absence of peristalsis, (**b**) type II patients exhibit pan-esophageal pressurization at the 30 mmHg isobaric contour, and (**c**) type III patients are defined by a spastic distal esophageal contraction with a distal latency less than 4.5 s.

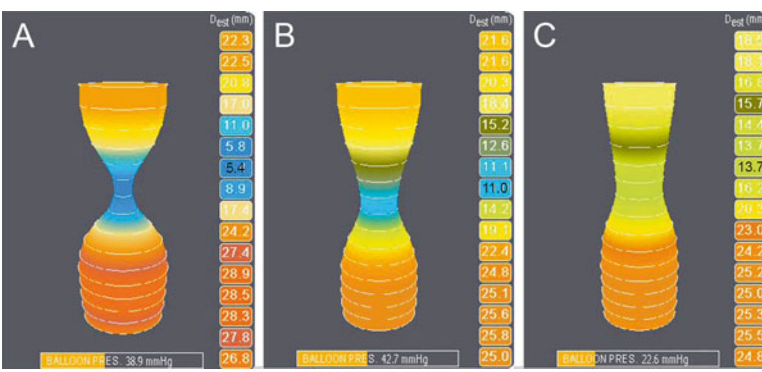

Fig. 17.3. Intraoperative EndoFLIP: The lower esophageal sphincter is identified on EndoFLIP by the characteristic "hourglass" shape (**a**) following induction of general anesthesia during a POEM procedure. Increased distensibility is noted after (**b**) creation of the submucosal tunnel, with a doubling of the minimum diameter and (**c**) completion of myotomy; final EndoFLIP measurements revealed a further increase in diameter and a nearly 50 % pressure decrease at the EGJ.

Contraindications

Patient Factors

Patients should undergo evaluation in a preoperative clinic in coordination with anesthesiology and additional work-up as indicated. The less invasive nature of the POEM procedure minimizes the list of comorbidities that preclude the procedure. Absolute contraindications to POEM include the inability to tolerate general anesthesia, secondary to prohibitive cardiopulmonary disease, uncorrectable coagulopathy/thrombocytopenia, and the presence of advanced cirrhosis, with or without evidence of esophageal varices. Additionally, the POEM procedure relies on the ability to access the submucosal space, so extensive fibrosis secondary to external-beam radiation to the mediastinum, extensive mucosal ablations, or prior EMR generally prohibit the operation. Published reports have included patients ranging in age from 3 to 97 years old [6]. Prior treatments that can cause inflammation and/or fibrosis of the submucosal space such as botulinum toxin injection, pneumatic dilation, prior LHM, or prior POEM can all contribute to the difficulty of the dissection and in some cases increase the rate of inadvertent mucosotomies or duration of the procedure. While none of the prior treatment modalities, other than esophagectomy, represent absolute contraindications to POEM, the added complexity should preclude such cases from being attempted during the initial learning curve [18].

Technical/Training

Safe conduct of the POEM procedure relies on the availability of all necessary equipment, adequately trained and well-coordinated support staff, and sufficient preclinical training. Prior experience with EMR/ESD techniques and/or NOTES procedures has been reported as helpful, as have simulations using live animal, ex vivo models, and cadavers. Most operators reported having expert proctoring during the initial human cases (median 2, range 1–7) [6].

Preoperative Care

Prior to surgery, a multidisciplinary team including gastroenterologists and minimally invasive surgeons should evaluate the patient.

Patient Instructions

Preoperatively, the patient is prescribed Nystatin swish-and-swallow for an empiric 3-day course, instructed to maintain a clear liquid diet starting 24 h, and to remain NPO for 12 h, prior to surgery. Some centers report conducting routine EGD 1–3 days preoperatively to screen for candidiasis. Management of perioperative medications should be performed in consultation with the preoperative clinic, cardiology, and the patient's primary care provider. In general, we continue beta blockers perioperatively, as well as Aspirin when indicated for a history of stent placement, coronary artery disease, or coronary artery bypass graft. Prophylactic Aspirin and Plavix are typically held for 7 and 5 days preoperatively, respectively, and decisions regarding management of therapeutic anticoagulation are made on an individual basis.

Anesthetic Considerations

Preoperative and intraoperative coordination with the anesthetic team is crucial to safe conduct of the POEM procedure. Issues of particular importance include positioning and securing the endotracheal tube as far laterally as possible and potentially utilizing a pre-formed, right-angled Oral RAE™ tracheal tube (Moore Medical, Farmington, CT). The anesthesia team should be aware of the potential for unplanned extubation given the frequent passage of the endoscope through the oropharynx, with the equipment necessary for re-intubation readily available. It is also helpful to discuss blood pressure management, specifically maintaining the systolic blood pressure below 100–110 mmHg, if feasible, as this is anecdotally associated with fewer bleeding complications.

Room Setup and Equipment

For a list of equipment recommended for POEM, see Table 17.1. Sequential compression devices are utilized for thromboprophylaxis and a second-generation cephalosporin or comparable preoperative antibiotic (Ancef/Flagyl at our institution) is given. After successful induction of general anesthesia and secured positioning of an endotracheal tube, the patient is positioned supine, flush with the head of the OR table, the right arm is supported on an arm board, and the left arm is appropriately padded and tucked next to the torso. The bed should be lowered and step

Table 17.1. Equipment checklist.

Room setup	Forward viewing, high-definition gastroscope with 2.8 mm working port (GIF-H180, Olympus)
	Clear cap with ¼″ tape to secure at the end of the gastroscope
	Carbon dioxide (CO_2) insufflation system (Olympus)
	High-frequency electrosurgical generator (ERBE)
Intraoperative tools	Bite-block
	60–90 ml syringes with saline for irrigation ± simethicone
	Indigo carmine injection solution with epinephrine
	Indigo carmine injection solution without epinephrine
	Dilute bacitracin irrigation
	¼″ Red tape to mark insertion depth for endoscopic instruments
	Sterile toothbrush for cleaning knife
Endoscopic instruments	Endoscopic injection/sclerotherapy needle (Olympus)
	Triangular-tip endoscopic submucosal dissection knife (Olympus)
	Coagrasper hemostatic forceps (Olympus)
	QuickClip2 (Olympus) hemostatic clips
	Instinct Hemoclips (Cook) for closure of wider mucosal defects
	OverStitch (Apollo Endosurgery) endoscopic suturing system

stools positioned at the head of the bed as needed to minimize strain and fatigue on the part of the operator. An endoscopy tower, equipped with a forward-viewing, 2.8 mm single-channel, high-definition flexible gastroscope (GIF-H180; Olympus America, Inc., Center Valley, PA), with carbon dioxide (CO_2) insufflation, is positioned near the midpoint of the OR table and the cautery foot pedal is placed within reach of the operator. A minimum of one assistant is required to coordinate the operation of the injector and triangular-tip ESD knife and should be positioned to the left of the operator. A second assistant, to the right of the operator, can stabilize the endoscope at the mouth allowing simultaneous manipulation of the deflection wheels and the injector or cautery knife. The second assistant can also assist with passage of intraoperative measurement devices such as the EndoFLIP catheter. A time-out should be performed prior to the procedure to confirm patient identity, procedure, and availability of endoscopic equipment (clips, coagulation forceps, etc.) and ensure that the endoscopy tower is utilizing CO_2 insufflation and that correct electrocautery levels are set.

Operative Technique (Fig. 17.4)

Diagnostic Endoscopy

Once the anesthesiologist is satisfied with the positioning and security of the endotracheal tube, the abdomen is prepped and draped to provide access in the event that Veress needle decompression of a capnoperitoneum is required. A bite-block is placed to facilitate passage of the endoscope (Fig. 17.4a). Thorough clearance of impacted food is required for complete assessment of the esophageal mucosa (Fig. 17.4b) and to minimize soilage of the submucosal tunnel. Placement of a 16 or 18 French orogastric tube can facilitate clearance, as can availability of 60–90 ml flushes or a power-flush system for the working port. It is not uncommon to encounter copious frothy sputum in the esophagus (Fig. 17.4c), a condition that resolves quickly with irrigation using dilute simethicone. Initial EGD is performed to assess for the presence of active candidiasis (Fig. 17.4d), an indication to abort the procedure and reschedule the myotomy pending resolution of the infection. Following a visual inspection of the esophagus and stomach, note should be made of the location of the esophagogastric junction as determined by the distance from the incisors to the squamocolumnar junction (Fig.17.4e) using the external markings on the endoscope for reference. In the absence of a hiatal hernia, the SCJ is typically located between 38 and 42 cm from the incisors.

Mucosal Lift and Mucosotomy

In the case of a standard length myotomy (extending 6–7 cm proximal to the EGJ), the mucosotomy should be made 12–14 cm above the EGJ. The majority of operators participating in the IPOEMS reported creating an anterior submucosal tunnel in the 1–2 o'clock position [6]. An endoscopic needle is inserted just below the mucosa and a 3–4 cm wheal is raised using 10 ml of solution containing indigo carmine (0.2 mg/ml), epinephrine (5 mcg/ml), and 0.9 % saline (Fig. 17.4f). A longitudinal mucosotomy is created (using a few drops of liquid to create a meniscus to assess positioning relative to the most anterior aspect, designated 12 o'clock). Mucosotomy length should be just large enough to accommodate the clear cap on the endoscope (Fig. 17.4g), as excessive length will add time and cost to the procedure during clip closure of the mucosotomy.

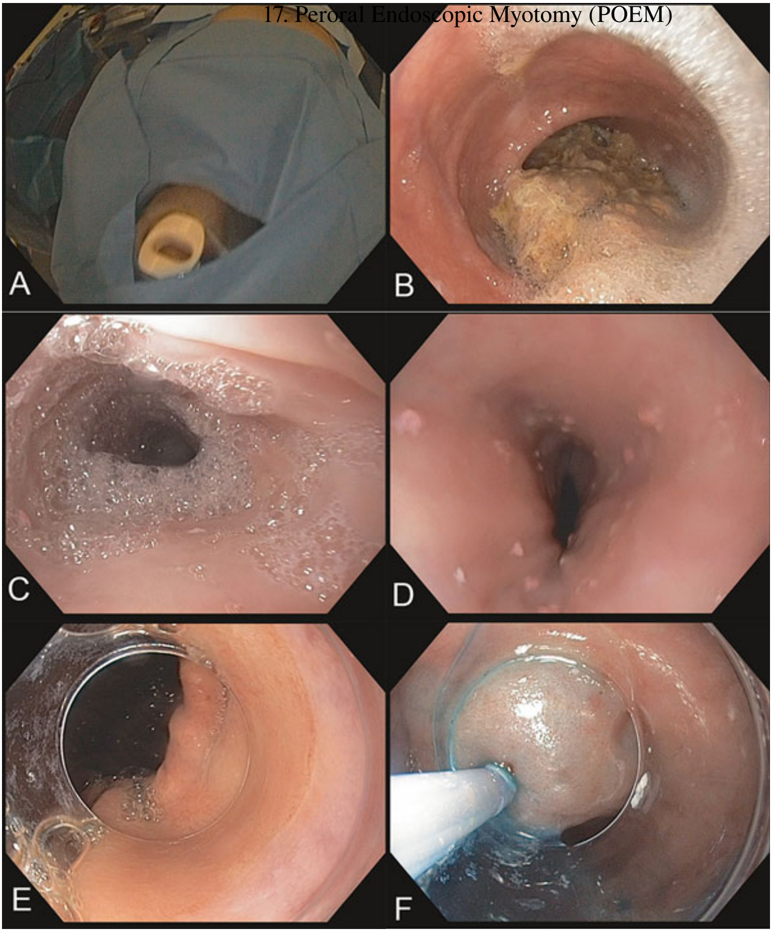

Fig. 17.4. (**a**–**i**) Operative steps for POEM: Patients are (**a**) prepped and draped with the abdomen exposed and a bite-block is placed to facilitate passage of the endoscope. Findings during initial EGD can include (**b**) impacted food and (**c**) copious frothy sputum that should both be cleared to allow for detection of (**d**) active candidiasis. Identification of the (**e**) squamocolumnar junction provides an approximation distance to the EGJ. A combination of dilute epinephrine and indigo carmine is injected to (**f**) elevate the mucosa. The submucosal space is accessed through (**g**) creation of a longitudinal mucosotomy. The submucosal tunnel is extended distally with a combination of (**h**) dilute indigo carmine injection for marking and hydrodissection and (**i**) cautery to divide the tissue of the submucosa. Withdrawal from the tunnel and retroflexion in the stomach allow (**j**) endoluminal verification of adequate extension onto the gastric cardia. Starting 6–7 cm proximal to the EGJ, (**k**) a selective myotomy of the inner, circular muscle layer is performed to 2–3 cm distal to the EGJ. After ensuring hemostasis and irrigation of the submucosal tunnel with dilute bacitracin, (**l**) endoscopic clips are used for mucosotomy closure.

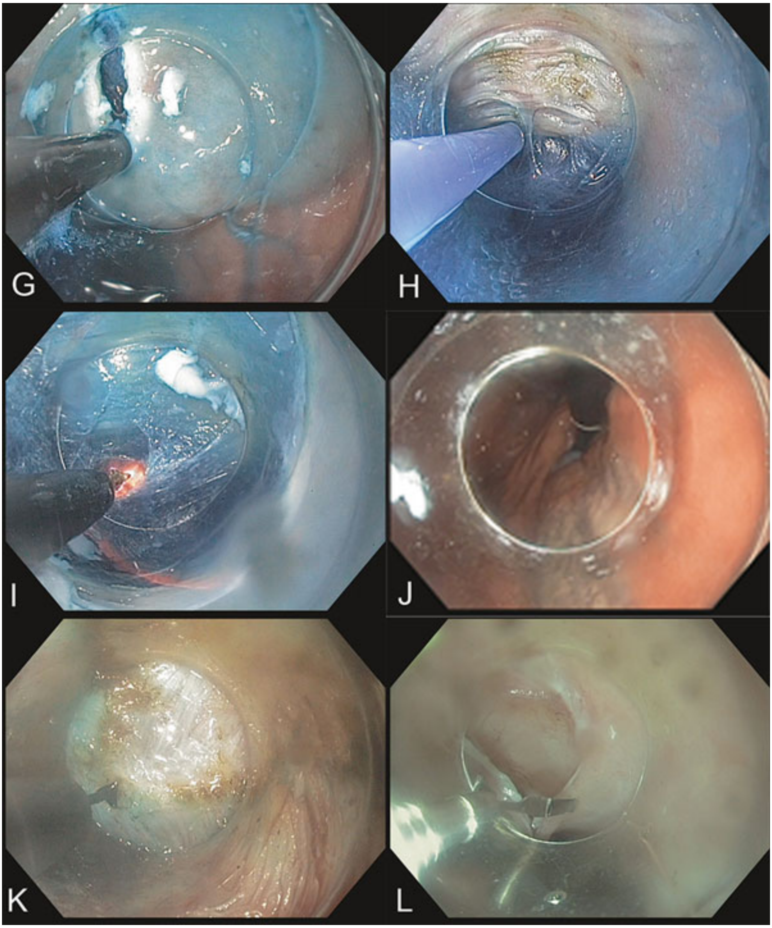

Fig. 17.4. (continued)

Creation of the Submucosal Tunnel

After the initial mucosal lift, subsequent injections during the creation of the submucosal tunnel should be diluted dye without epinephrine to limit total exposure to the adrenergic agent. Distal progression of the submucosal tunnel is facilitated by alternating hydro-dissection to enlarge the submucosal space (Fig. 17.4h) and cautery to divide the thin fibers connecting the mucosa to the inner, circular muscle layer

(Fig. 17.4i). Careful advancement of the endoscope and slight posterior deflection of the cap can be used to put the submucosal fibers on stretch and guide dissection. Frequent reference to fluid meniscus can help prevent spiraling as the tunnel is carried distally on the esophagus. Extra care should be taken near the EGJ as this area is prone to inadvertent mucosotomy given the increased muscular tone and anecdotally described “stickiness,” attributed to prior episodes of inflammation or previous treatment modalities. Beyond the EGJ, switching back to an injection solution containing both dye and dilute epinephrine can aid in demarcating the distal extent of the submucosal tunnel. To confirm adequate extension onto the gastric cardia, the endoscope can be withdrawn from the submucosal tunnel and passed into the stomach lumen to obtain a retroflex view of the EGJ (Fig. 17.4j).

Anterior Myotomy of the Circular Muscle Layer

Using the endoscopic markings, the selective myotomy of the circular muscle layer should be initiated 6 cm proximal to the EGJ for a standard length myotomy. Variations in myotomy length have been suggested when treating conditions that predominantly affect the esophageal body, such as type III achalasia or jackhammer esophagus; in these cases, the myotomy can be started just proximal to the spastic segment, ensuring at least 2–3 cm of mucosal flap coverage in the submucosal tunnel [19]. Once the plane between the inner circular muscle layer and thin, outer, longitudinal muscle layer is accessed, the triangular-tip ESD knife can be used to hook the circular muscle fibers and extend the myotomy distally (Fig. 17.4k). Full-thickness myotomy or splaying of the thin, outer longitudinal muscle fibers is common, especially around the EGJ. The myotomy should be extended 2–3 cm distal to the EGJ onto the gastric cardia. At the conclusion of the myotomy, after assuring hemostasis in the tunnel, irrigation is performed with dilute bacitracin solution.

A variety of intraoperative techniques have been described to evaluate for adequacy of myotomy in relieving esophageal outflow obstruction at the level of the EGJ. These range from purely subjective, based on laparoscopic inspection or ease of passage of the endoscope during EGD post-myotomy, to quantitative, but time consuming, in the case of intraoperative manometry. At least three centers in the USA currently employ the EndoFLIP device described earlier, in the diagnostic testing section, for intraoperative assessment of myotomy adequacy as measured by an increase in EGJ distensibility index [17].

Closure of Mucosotomy

Mucosotomy width will help guide initial clip selection, with the Instinct™ Endoscopic Hemoclip (Cook Medical, Winston-Salem, NC, USA) or Resolution Clip (Boston Scientific, Marlborough, MA, USA) being helpful in cases of wider mucosal defects and the QuickClip2 (Olympus, Tokyo, Japan) offering a smaller overall size following deployment (Fig. 17.4l). Alternative methods of closure have been described utilizing proprietary endoscopic suturing devices such as the OverStitch (Apollo Endosurgery, Austin, TX, USA), to allow a running closure of longer mucosotomy defects.

Avoiding Complications

Aspiration

Preoperative dietary restriction to clear liquids in preparation for the procedure as well as utilization of a "rapid-sequence" intubation technique by anesthesia (limited pre-oxygenation/bag-masking) can help minimize the risk of aspiration during induction. If needed, awake fiberoptic intubation in the upright position can be utilized in high-risk patients.

Capnothorax

Given the frequency of full-thickness myotomy or splaying of the outer, longitudinal muscle fibers, development of unilateral or bilateral capnothorax is common [6]. There is no data supporting routine postoperative chest X-rays, assuming CO_2 is utilized for insufflation in place of air. Capnothorax progressing to tension physiology or hemodynamic compromise is exceedingly rare but the instruments should be available as well as staff capable of performing an emergent needle or tube thoracostomy, if needed. Self-limited subcutaneous emphysema is also common with expected resolution within 24 h postoperatively. In addition, roughly 50 % of POEM cases are accompanied by the development of some degree of capnoperitoneum secondary to CO_2 tracking from the mediastinum or full-thickness gastric myotomy [6]. Capnoperitoneum can be differentiated from an insufflated stomach by the presence of isolated epigastric fullness in the latter; the diffuse abdominal distension of the former, when accompanied by hemodynamic instability or impaired ventilation, is an indication for decompression with a Veress needle (typically in the right upper quadrant, just inferior to the costal margin) or laparoscopic port. While not necessarily complications, the relative frequency with which insufflation-related events are encountered highlights the necessity of utilizing CO_2 insufflation during POEM.

Bleeding

Based on the global POEM experience to date, bleeding, if it occurs, is most commonly encountered during dissection across and distal to the EGJ. As previously discussed, even mild hypertension will compound the bleeding risk inherent to the increased vascularity in the submucosal space of the EGJ and gastric cardia. Mild bleeding can typically be controlled with application of monopolar electrocautery. Brisker bleeding, or unavoidable division of larger bridging vessels, should be approached with coagulation forceps. Submucosal tunnel bleeding that obscures endoscopic visualization can occasionally be temporized by removal of the endoscope from the tunnel and application of direct pressure with the scope or cap from the esophageal lumen for 10–20 min. Alternative techniques include hemostatic clip application and judicious injection of dilute epinephrine. Case reports have suggested the option of utilizing tamponade devices such as Sengstaken-Blakemore, Minnesota, or Linton Tubes (All Bard Medical) to staunch brisk bleeding. Given the disastrous consequences of this in the setting of a partial or full-thickness myotomy, these high-pressure balloons should not be considered as part of the endoscopic armamentarium when approaching bleeding during the POEM procedure.

Full-Thickness Perforation

Entry into the mediastinum at the level of the mucosotomy, either during initial access of the submucosal space or subsequently, should prompt close attention to mucosal closure technique, including consideration of alternative methods of closure such as endoscopic suturing [20] or utilization of larger clips. Blunt dissection of the submucosal space has been described in both animal models and human case series as a means to expedite tunnel creation and decrease procedure duration. This technique is associated with increased rates of inadvertent mucosotomy, particularly in the area just proximal to the EGJ, where relative tethering of the mucosa can occur and predispose the proximal tissue to perforation when approached blindly. Significant mucosal defects that occur prior to myotomy creation should prompt consideration of aborting the procedure and/or attempting submucosal tunnel and myotomy in an alternate position on the esophagus (i.e., posterolateral). Small mucosal defects and those that occur during or after myotomy should be closed from the lumenal side with endoscopic clips or suture. Note that mucosal injuries, especially in the region of the EGJ, can lead to the development of strictures and recurrent dysphagia.

Postoperative Care

At the conclusion of the case, patients are extubated in the operating room and transferred to the post-anesthesia care unit (PACU). During the initial recovery phase in the PACU, patients are given standing intravenous antiemetics and analgesia as needed and kept nil per os (NPO) pending further evaluation. If the patient is sufficiently recovered from the effects of anesthesia and not experiencing chest pain, fever, or tachycardia, sips of clear liquids are initiated in the evening of surgery. In the absence of concerning symptoms or signs that suggest leak, patients are given a tray of clear liquids in the morning and advanced to a full liquid diet for lunch. Discharge typically occurs in the afternoon of the first postoperative day (POD#1) after response to lunch is evaluated. Among the IPOEMS centers, the weighted mean length of stay was 3.1 days (range 1–7), with the six US centers generally reporting earlier discharges postoperatively [6]. Patients are discharged on twice-daily proton pump inhibitors that are continued until physiologic testing is performed at 6 months to assess for the presence or degree of gastroesophageal reflux. Many centers advocate routine imaging (water-soluble or thin barium esophagram) on POD#1 with some centers performing second-look EGD prior to diet initiation or hospital discharge [6]. During our initial experience, the postoperative care pathway included obtaining a POD#1 esophagram, but the lack of impact on patient management and low leak rate have led to abandonment of asymptomatic screening of all patients postoperatively. There are descriptions of postoperative computed tomography scans of the chest being routinely obtained; however, following the same logic that led to abandonment of routine esophagram use, there is no clear evidence to support the cost or radiation exposure associated with routine screening CT scans.

Follow-Up

Patients should be seen 2–6 weeks postoperatively to evaluate treatment response and detect potential early failures. In the absence of recurrent symptoms, full physiologic testing with TBE, HRIM, EndoFLIP, and pH-impedance is postponed until the 6-month follow-up appointment. TBE in particular has been shown to have significant prognostic value following pneumatic dilation in detecting patients with symptomatic relief that are at increased risk for early treatment failure [21]. Patients are seen again at 1 year and then annually for life, with completion of validated questionnaires and intermittent physiologic testing to track long-term outcomes. Long-term follow-up protocols can also incorporate routine or symptom-triggered screening for esophageal malignancy.

Review of Existing Literature

Efficacy

To date, no prospective, randomized trials comparing POEM to LHM or pneumatic dilatation have been published. The IPOEMS reported overall treatment success of 98 % at a mean follow-up of 9.3 months, with 40 % of patients having failed prior treatments [6]. The multicenter, prospective trial by Von Renteln et al. showed a decline in success rate over time, from 97.1 % at 3 months to 82.4 % at 1 year [22], although this may reflect a learning curve issue as many of the cases in this report were performed during the early portion of POEM series at participating centers.

Rates of GERD

Richards et al. demonstrated in 2004 that in the absence of a concurrent fundoplication, complete division of the lower esophageal sphincter and gastric sling fibers during Heller's cardiomyotomy results in debilitating reflux [23]. Neither partial nor complete fundoplication is performed following POEM and concern has been raised regarding the potential for higher long-term rates of GERD. While long-term data is forthcoming, based on visualization of erosive esophagitis on EGD or abnormal pH studies during short-term follow-up (<1 year), the estimated prevalence of GERD following POEM may be in the range of 20–46 % [6]. Comparable rates have been reported in patients undergoing LHM with anterior (Dor) fundoplication in multicenter, prospective, randomized trials [24, 25]. Similar to the argument put forth by proponents of anterior (Dor) fundoplication, the lack of posterior mediastinal dissection and preservation of the phreno-esophageal ligament during POEM may mitigate the absence of a surgical anti-reflux barrier. Preservation of the angle of His may also contribute to the anatomic anti-reflux barrier when the 1–2 o'clock position is used for myotomy during POEM, as the natural course of the esophagus (clockwise rotation and right-to-left sweep) favors dissection onto the lesser curve and division of the clasp fibers with maintenance of the sling fibers.

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