Peroral Endoscopic Myotomy (POEM)

Eric S. Hungness and Rym El Khoury

This chapter describes preoperative work-up, operative planning, and the technique of a peroral endoscopic myotomy for achalasia, as well as troubleshooting difficult situations.

10.1 Clinical History

A 56-year-old woman presented in clinic with a 5-year history of chest pain, heartburn, and dysphagia. She was initially diagnosed with gastroesophageal reflux disease and put on a proton-pump inhibitor. Her symptoms did not resolve with anti-acid medication, and a subsequent esophagogastroduodenoscopy (EGD) was negative for esophagitis.

As her dysphagia progressed from solids to liquids, a complete work-up for esophageal motility disorder was performed:

- Repeat EGD: dilated and tortuous esophagus without mucosal-based lesions, suspicious for achalasia (Fig. 10.1)
- Timed barium esophagram: smooth tapering of the distal esophagus and a persistent contrast column of 10.2 cm at 5 min, indicative of bolus retention (Fig. 10.2)
- High-resolution impedance manometry (HRIM): elevated mean 4-s integrated relaxation pressure (IRP) of 32.4 mmHg, 10 failed swallows, and panesophageal pressurization consistent with type II achalasia according to the Chicago Classification (Fig. 10.3)
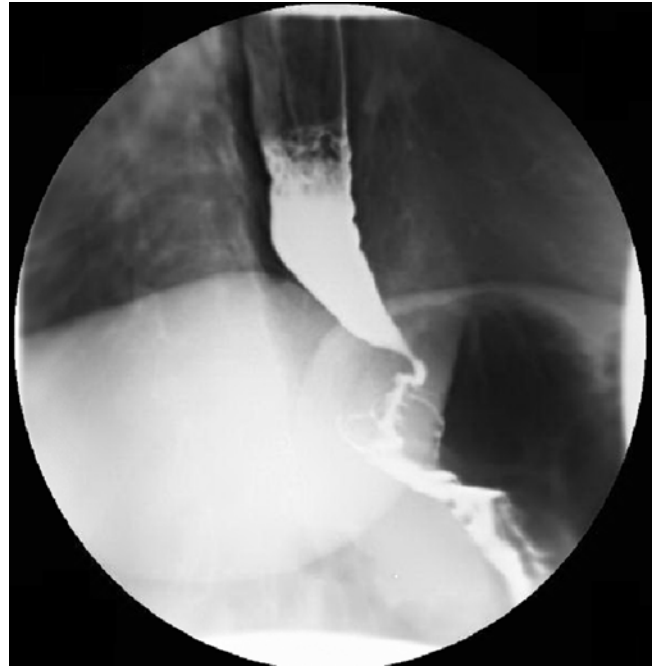
She was presented with three treatment options: pneumatic dilation, laparoscopic Heller myotomy, and peroral endoscopic myotomy (POEM). She chose to undergo POEM.
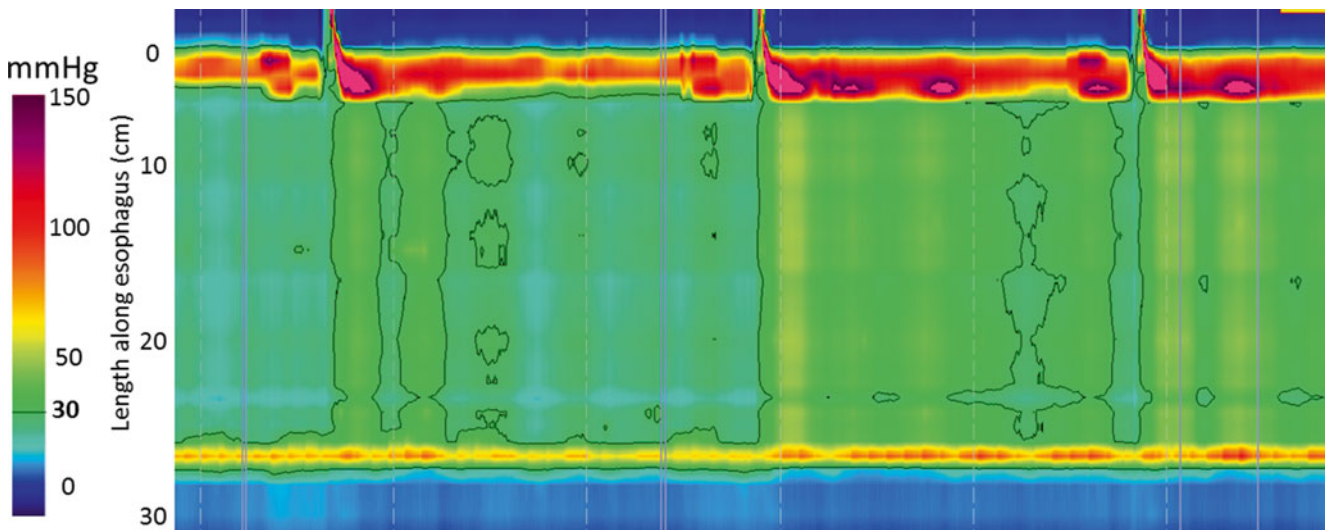
E.S. Hungness (✉) • R. El Khoury
Department of Surgery, Northwestern Memorial,
Chicago, IL, USA
e-mail: ehungnes@nmh.org
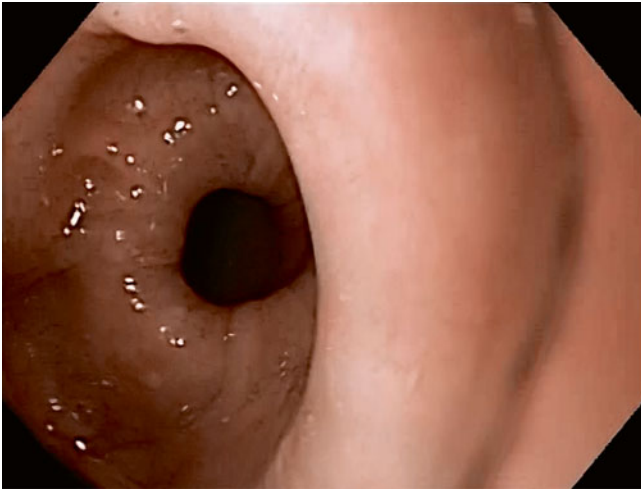
Fig. 10.1 Preoperative upper endoscopy: dilated and tortuous esophagus

Fig. 10.2 Preoperative esophagram: retained contrast column and narrowing at the esophagogastric junction (EGJ)

Fig. 10.3 Preoperative HRIM showing elevated integrated relaxation pressure (IRP) and panesophageal pressurization consistent with type II achalasia

10.2   Operation

10.2.1 Patient Preparation and Operative Setup

Prior to surgery, the patient was kept on a clear liquid diet for 48 h and completed a 5-day course of oral nystatin for *Candida* prophylaxis.

The patient was positioned supine with the right arm abducted and the left arm tucked at the side, with the abdomen prepped in case needle decompression was required for the presence of capnoperitoneum (Fig. 10.4). The POEM was performed under general anesthesia with endotracheal intubation and skeletal muscle paralysis. Special care was taken at the time of anesthesia induction and endotracheal intubation to prevent aspiration.

Fig. 10.4 Operative setup

10.2.2 Operative Procedure

Step 1 *Initial endoscopy*

Initial endoscopy was performed using a single-channel, high-definition gastroscope with CO_2 insufflation. The air insufflation was confirmed to be turned off. The esophagus and stomach were aspirated of any retained fluid and food, the stomach was desufflated, and the esophageal body was examined for *Candida* or stasis esophagitis. The endoscope was then fitted with an oblique transparent cap (longer end of bevel posterior) and the distance from the squamo-columnar junction to the incisors was measured on the scope shaft (Fig. 10.5).

Step 2 *Mucosotomy and entry into the submucosal space*

A submucosal bleb was created in the esophageal wall 12 cm proximal to the esophagogastric junction (EGJ) at the 1 o'clock position, using a sclerotherapy needle containing a solution of 0.9 % saline, 10 mL of indigo carmine (0.2 mg/mL), and dilute epinephrine (5 μg/mL) (Fig. 10.6). An endoscopic cautery knife was used to create a 2-cm longitudinal mucosotomy over the submucosal bleb (Fig. 10.7). The submucosal areolar tissue was cleared to expose the circular muscle layer. The endoscope was then bluntly maneuvered into the submucosal space, utilizing the oblique scope cap.

Step 3 *Creation of the submucosal tunnel*

Creation of the anterior submucosal tunnel required a combination of electrocautery (Fig. 10.8) and hydrodissection using a solution of saline and indigo carmine without epinephrine (Fig. 10.9). The orientation was checked periodically by evaluating the meniscus of injected fluid within the tunnel. The tunnel was extended 3 cm distal to the EGJ. Narrowing of the submucosal tunnel and the appearance of palisading vessels and aberrant muscle bundles (Fig. 10.10), as well as markings of the shaft of the endoscope, signified transition to the EGJ. The patient's systolic blood pressure was kept under 120 mmHg to avoid bleeding during progression of the submucosal tunnel. The epinephrine-containing solution was used again in the distal portion of the tunnel. After completion of the submucosal tunnel (Fig. 10.11), the scope was withdrawn from the tunnel and advanced through the esophageal body to the gastric lumen. Blanching of the gastric cardia mucosa, seen upon retroflexion, was recognized as a sign of extension of the submucosal tunnel onto the stomach (Fig. 10.12).

Step 4 *Myotomy*

A selective anterior myotomy of the inner circular muscle layer was started at 6 cm above the EGJ, using electrocautery to divide individual fibers and extended to the end of the submucosal tunnel (Fig. 10.13). Special attention was taken to protect the mucosa during myotomy progression (Fig. 10.14); splaying of longitudinal muscle fibers rarely occurred. The scope was withdrawn from the tunnel and advanced into the gastric lumen to observe patency of the EGJ.

Step 5 *Mucosotomy closure*

Finally, the scope was advanced into the tunnel, which was irrigated with a solution of bacitracin. The scope was withdrawn into the true esophageal lumen and the mucosotomy was closed with seven endoscopic clips (Figs. 10.15 and 10.16). A Veress needle was used to relieve capnoperitoneum. The stomach was intubated one last time, aspirated, and desufflated before withdrawal of the endoscope.

Fig. 10.5 Initial endoscopy showed a narrow EGJ. The endoscope was fitted with an oblique transparent cap, and the location of the squamo-columnar junction was measured on the endoscope shaft
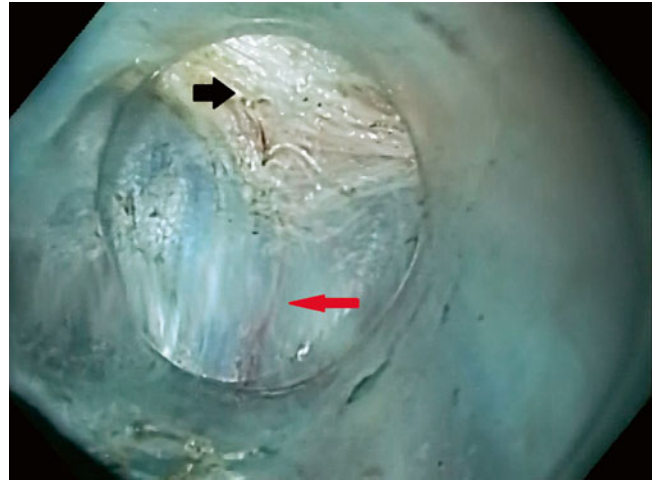

Fig. 10.6 Submucosal bleb created with a solution of saline, indigo carmine, and dilute epinephrine
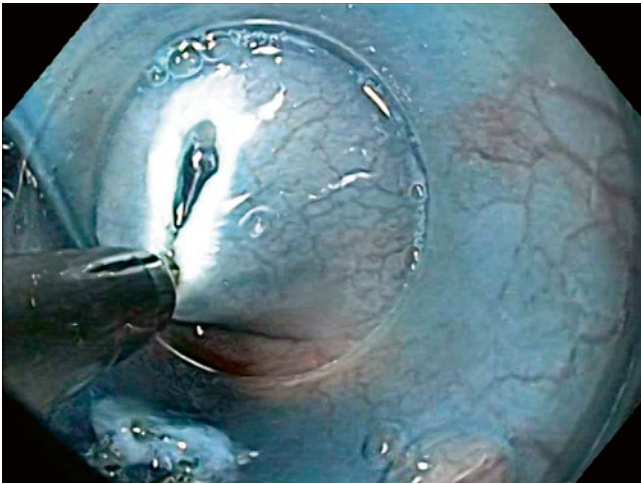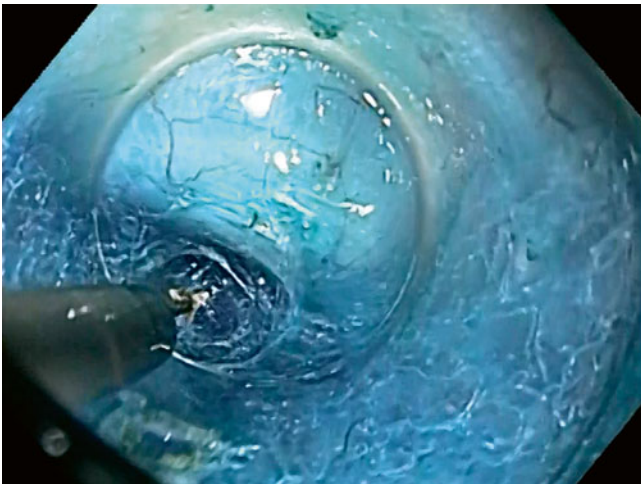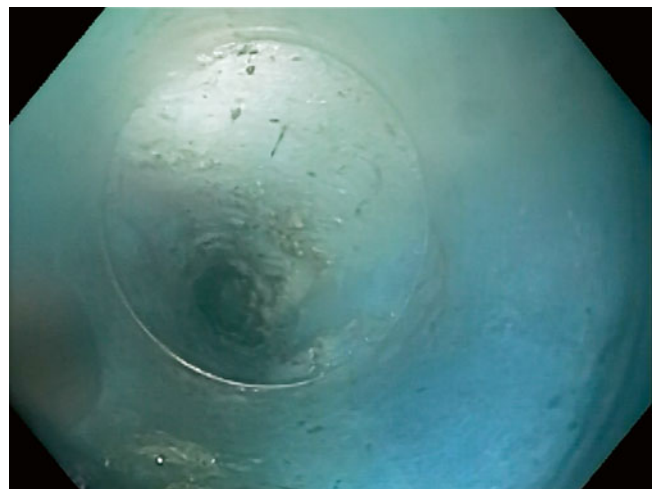
Fig. 10.7 Longitudinal mucosotomy performed by electrocautery over the submucosal bleb
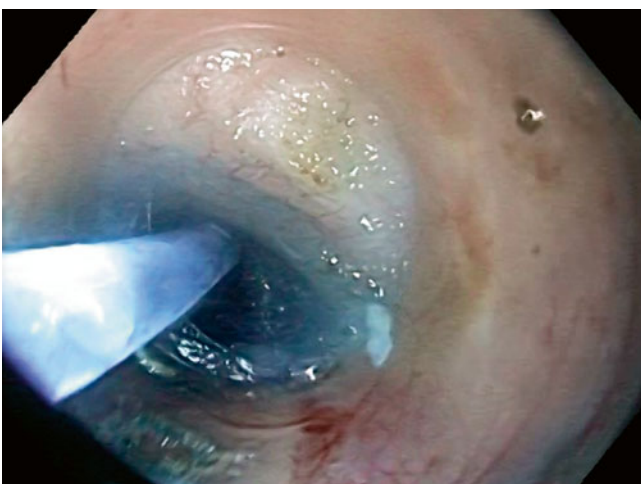

Fig. 10.10 Submucosal tunnel appearance approaching the EGJ, including palisading vessels (*red arrow*) and oblique muscle-fiber bundles (*black arrow*)
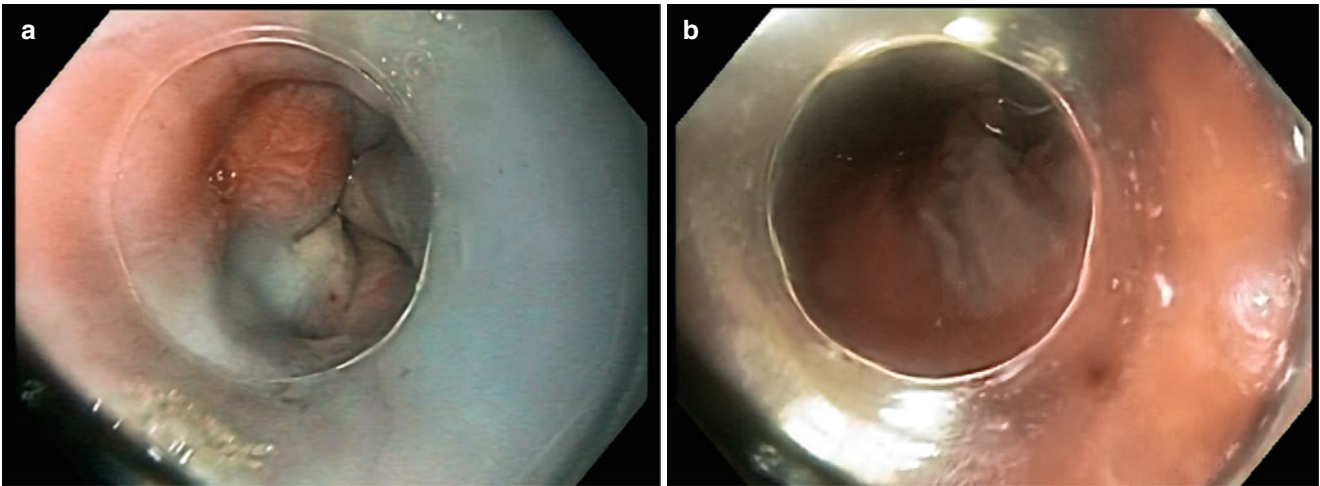

Fig. 10.8 Division of the submucosal tissue using electrocautery. The circular muscle layer can be seen in the background
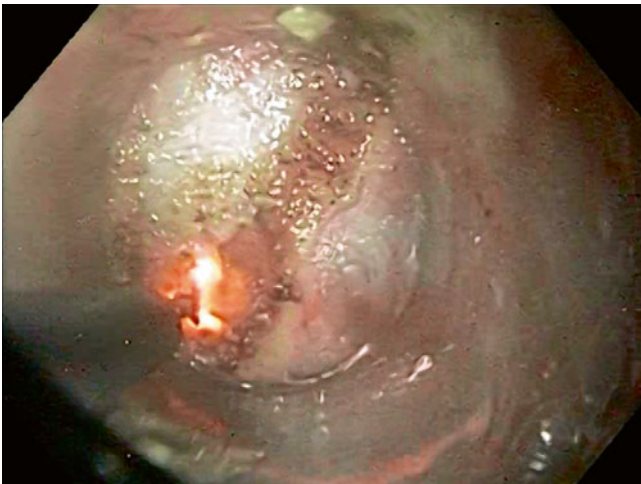

**Fig. 10.11** Inside view of completed submucosal tunnel

Fig. 10.9 Hydrodissection with saline and indigo carmine solution during the creation of the submucosal tunnel

Fig. 10.12 (**a**) Mucosal blanching after submucosal tunnel extension onto the stomach. (**b**) Blanching of the gastric cardiac mucosa seen upon retroflexion at the end of the submucosal tunnel creation

Fig. 10.13 Circular muscle division using electrocautery
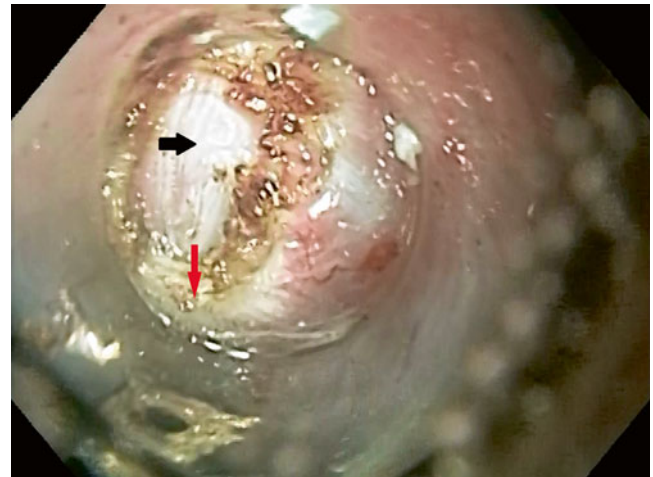
Fig. 10.14 Myotomy progression. Longitudinal muscle fibers (*black arrow*) are seen in the background during progression of the selective circular muscle division distally (*red arrow*)
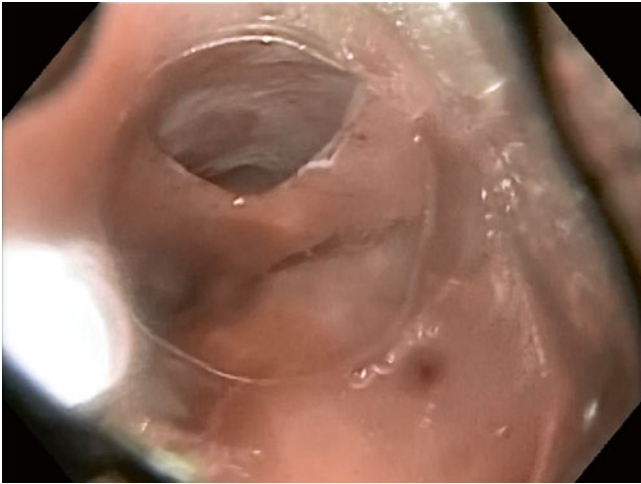
Fig. 10.15 Mucosotomy before clip closure

Fig. 10.16 (**a**) First clip applied to close the mucosotomy. (**b**) Mucosotomy clip closure in progress

10.3 Troubleshooting

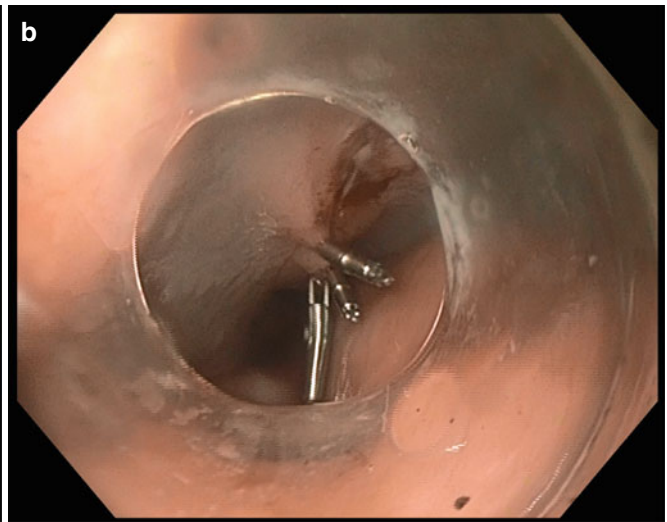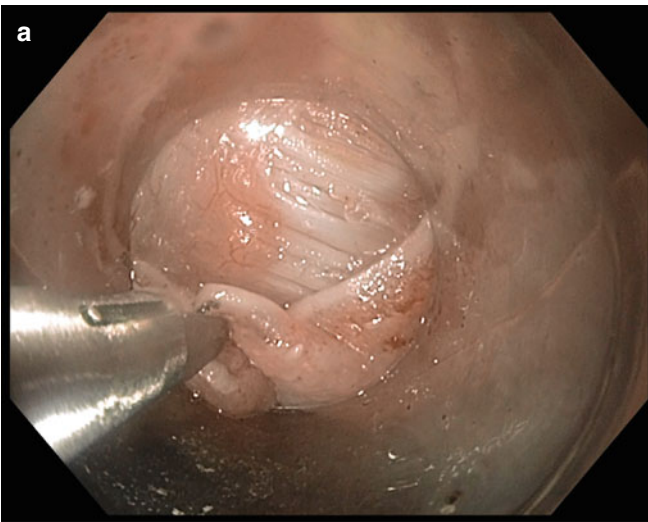POEM is a safe surgical option for the treatment of achalasia, but it requires advanced endoscopic and surgical skills. Initial endoscopy can be difficult in the context of food impaction or retention. This situation can be prevented by giving a clear liquid diet 48 h prior to surgery. In cases of severe esophageal stasis, extensive lavage and aspiration are often required before mucosotomy.

Preoperative treatment with antifungals (nystatin or fluconazole) is recommended to prevent *Candida* esophagitis, which has a high prevalence in patients with achalasia.

Esophageal muscle circular thickening, sigmoid esophagus, and severe esophageal dilatation can add technical difficulty to POEM. A decision to proceed with POEM in a patient with these findings should be at the discretion of the operating surgeon.

After longitudinal mucosotomy, the endoscope is bluntly maneuvered into the submucosal space. In patients with type III achalasia, Jackhammer esophagus, or esophageal spasms, this step can be technically challenging.

Additionally, bleeding can occur in the submucosal tunnel, particularly when approaching the EGJ, because of the robust blood supply in this area. Bleeding can be controlled by directly coagulating injured vessels (away from mucosa) or applying indirect pressure onto the tunnel with the endoscope positioned in the esophageal true lumen. A systolic blood pressure goal under 120 mmHg is also recommended during this step of the procedure.

Mucosal injury can occur during initial endoscopy or submucosal tunnel creation, but it usually can be repaired by clips. Depending on the extent and location of the mucosal defect, the procedure can be aborted, continued, or performed at an orientation other than the anterior position.

The current recommendation for spastic achalasia is an extended proximal myotomy ablating the entire spastic segment. In these patients, the submucosal tunnel and myotomy are started more proximally in the esophageal body.

Sparing of longitudinal muscle fibers is not always possible. Limited areas of full-thickness myotomy are acceptable in POEM.

Capnoperitoneum may require decompression with a Veress needle. Capnoperitoneum should not be considered as a complication, but rather as a normal consequence of the procedure, given that CO_2 can easily dissect through tissue planes.

Finally, mucosal redundancy and infoldings can add to the difficulty of mucosotomy clip closure. Various types of clips can be used to facilitate this last step.

10.4   Postoperative Course

Postoperatively, the patient was extubated and transferred to the postanesthesia care unit for observation. She stayed overnight and was kept nil per os. She received standing intravenous (IV) antiemetics, pain medication, and IV narcotics as needed.

A routine esophagram was performed on the morning of postoperative day 1 to rule out esophageal leak. (This systematic esophagram has since then been eliminated from our practice.) She was started on clear liquids, advanced to full liquids, and discharged on the afternoon of postoperative day 1 on anti-acid medication. The full liquid diet was maintained for 2 weeks and then gradually increased to include soft foods.

She was seen at 2 weeks postoperatively and showed great improvement in her symptoms. Subsequently, she was advanced to a regular diet and scheduled for long-term physiologic follow-up studies.

At 9 months, she was complaining of minimal heartburn on anti-acid medication. The EGD showed Los Angeles grade A reflux esophagitis. The HRIM showed absent peristalsis with eight failed swallows without panesophageal pressurization, and an IRP of 11 mmHg. At 18 months after the POEM procedure, her Eckardt score had decreased to 0 from a preoperative score of 5.

Suggested Reading

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