Chapter 8
Management of Esophageal Leaks and Fistulas

Min P. Kim, Karen J. Dickinson, and Shanda H. Blackmon

Esophageal Perforations

Diagnosis of esophageal perforation can be made with a water-soluble esophagram followed by thin barium if no leak is seen with the water-soluble contrast. If there is still a concern for perforation after an esophagram, a CT scan is performed to evaluate for extraluminal air and extraluminal collection. The esophagus is divided into three parts: cervical, thoracic, and abdominal (Fig. 8.1). We recommend different management options based on the location of the perforation.

M.P. Kim, MD
Division of Thoracic Surgery, Department of Surgery, Houston Methodist Hospital, Houston, TX, USA

K.J. Dickinson, MBBS, BSc, MD, FRCS (✉)
Division of General Thoracic Surgery, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA

S.H. Blackmon, MD, MPH
Associate Professor, Division of General Thoracic Surgery, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA
e-mail: blackmon.shanda@mayo.edu

S.H. Blackmon et al. (eds.), *Atlas of Esophageal Disease and Intervention: A Multidisciplinary Approach*, DOI 10.1007/978-1-4939-3088-3_8

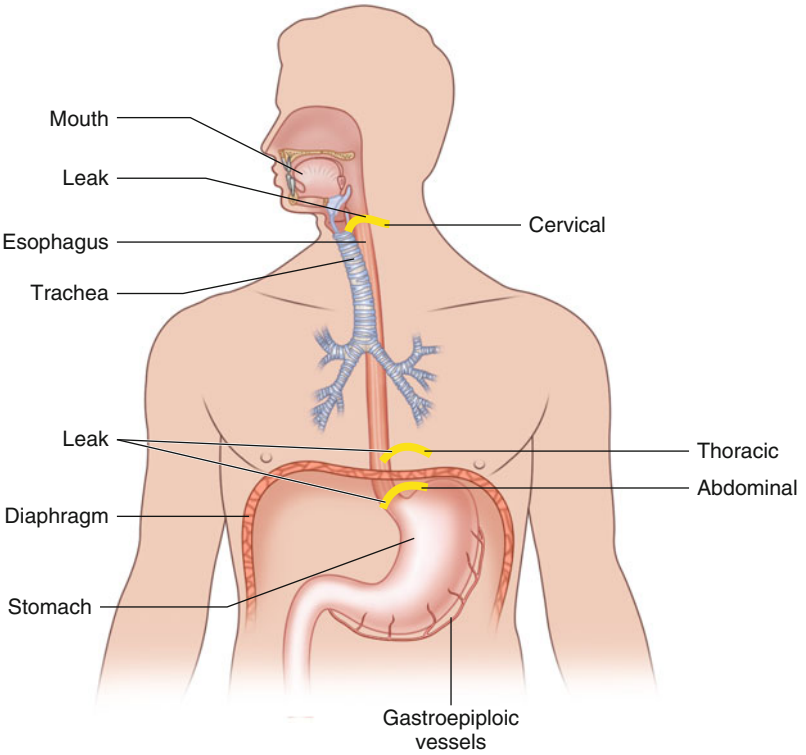

Fig. 8.1 The most common sites of cervical, thoracic, and abdominal esophageal perforations

Cervical Esophageal Perforation

Often, cervical esophageal perforation is treated by neck incision and washout of the wound. Nutrition and sepsis must be addressed. The patient is kept NPO with a Dobhoff feeding tube, a feeding tube placed surgically or by percutaneous endoscopy, or total parental nutrition (TPN). This combination provides the best opportunity to heal the leak. Esophageal stenting in this location is very difficult for the patient to tolerate. It leads to opening of the upper esophageal sphincter and higher risk of aspiration, so we typically rely on surgical drainage and antibiotics as treatment for cervical esophageal perforation.

Position

The patient is supine with a shoulder roll and the head turned towards the right side.

Operation

1. Make an incision anterior to the left sternoclavicular muscle.
2. Divide the omohyoid to expose the esophagus.
3. Irrigate the left neck and leave a Jackson-Pratt (JP) or Penrose drain.
4. Perform dressing changes.

Patient with Pneumomediastinum but Without Obvious Esophageal Leak

A patient with pneumomediastinum without any extravasation of contrast on esophagram or CT of the chest (Fig. 8.2) may be treated with NPO and IV antibiotics. Imaging should be repeated in at intervals to confirm the resolution of the pneumomediastinum and the lack of extraluminal fluid or contrast. Once the pneumomediastinum is resolved, the patient's diet should be advanced. As a follow-up, the cause of the pneumomediastinum should be investigated, most commonly with esophagogastroduodenoscopy (EGD) initially.

Fig. 8.2 CT scan demonstrating pneumomediastinum

Thoracic Esophageal Perforation

Patients without systemic sepsis and with evidence of thoracic esophageal perforation (Fig. 8.3) initially can be managed with esophageal stent placement, NPO, and IV antibiotics. Some smaller perforations or leaks without sepsis can be treated with endoluminal clips e.g. through the scope clips or over the scope clips (Fig. 8.4). Based on the degree of contamination of the mediastinum and the pleural space, the patient may require concomitant washout of the chest cavity. If the stent fails or if the leak from the perforation is large and the patient is systemically unwell, we perform surgical repair with intercostal muscle flap and wide drainage.

Fig. 8.3 Contrast swallow demonstrating a thoracic esophageal perforation

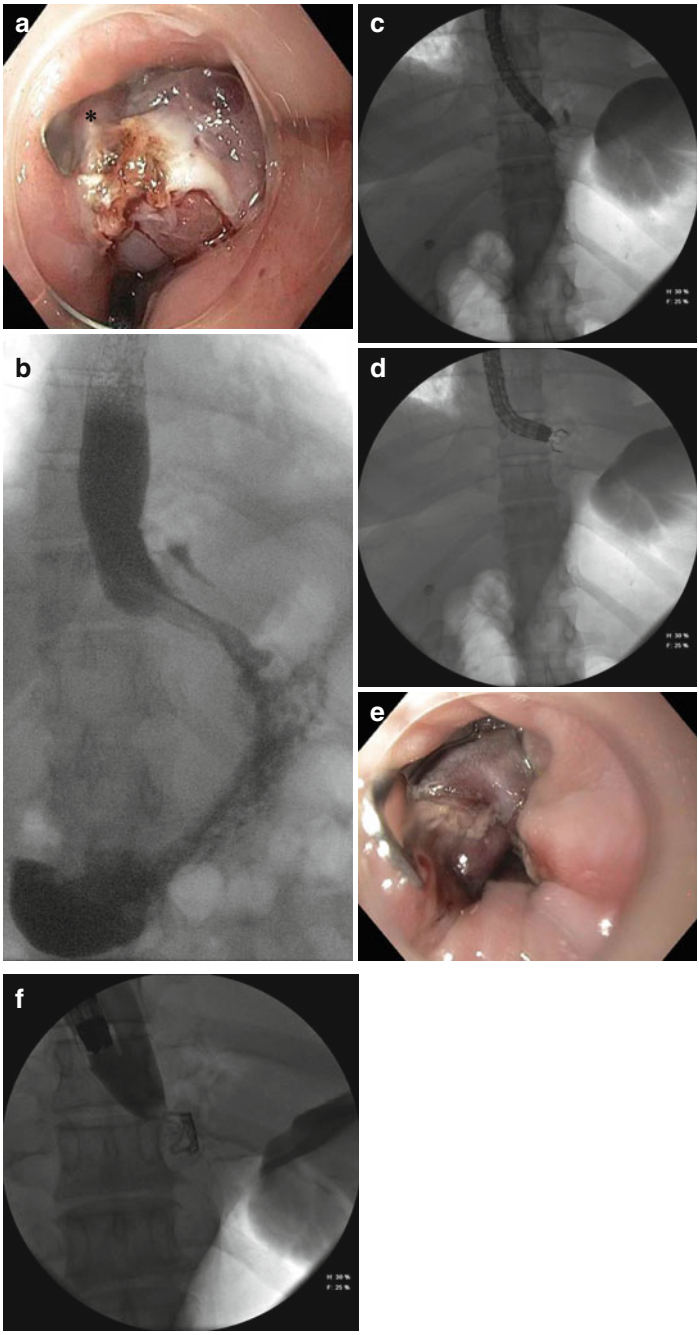

Fig. 8.4 Endoscopic treatment of an esophageal perforation using an over the scope clip. (**a**) Endoscopic appearances of esophageal perforation. * denotes the perforation. (**b**) Contrast esophagram demonstrating the esophageal perforation. (**c**) Combined endoscopic and radiological examination demonstrating the esophageal perforation and determining the correct positioning of the endoscope for clip deployment. (**d**) Deployment of the over the scope Ovesco clip to seal the esophageal perforation. (**e**) Endoscopic appearances of the esophageal perforation sealed by the Ovesco clip. (**f**) Contrast esophagram to demonstrate complete closure of the esophageal perforation by the Ovesco clip

Esophageal Stent

Position

The patient is supine.

Operation

1. Perform endoscopy to determine the location of the perforation (Fig. 8.5).
2. Irrigate the area with saline flushing from the endoscope.
3. Mark the proximal and distal point of perforation using a paper clip taped on the skin of patient, using fluoroscopy
4. Place a stiff guidewire into the stomach and remove the endoscope. Use fluoroscopy to ensure that the guidewire remains in the stomach.
5. Place the delivery system over the wire into the area of the perforation. Place two thirds of the stent above the area of the perforation.
6. Remove the delivery system.
7. Perform an on-the-table esophagram to assess for a seal; then perform an awake swallow test.
8. Place a bridle around the proximal point of the stent (Fig. 8.6), or alternatively use an Apollo OverStitch™ device (Apollo Endosurgery, Austin, TX) to suture the stent in place.

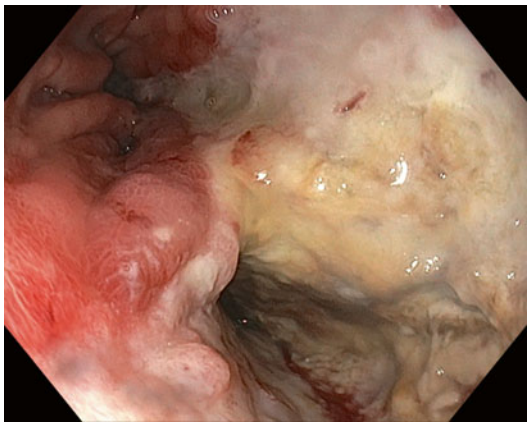

Fig. 8.5 Endoscopic appearance of a large intra-thoracic anastomotic leak post-esophagectomy. The gastric conduit can be seen to the left and cavity formed from the anastomotic leak to the right of the image

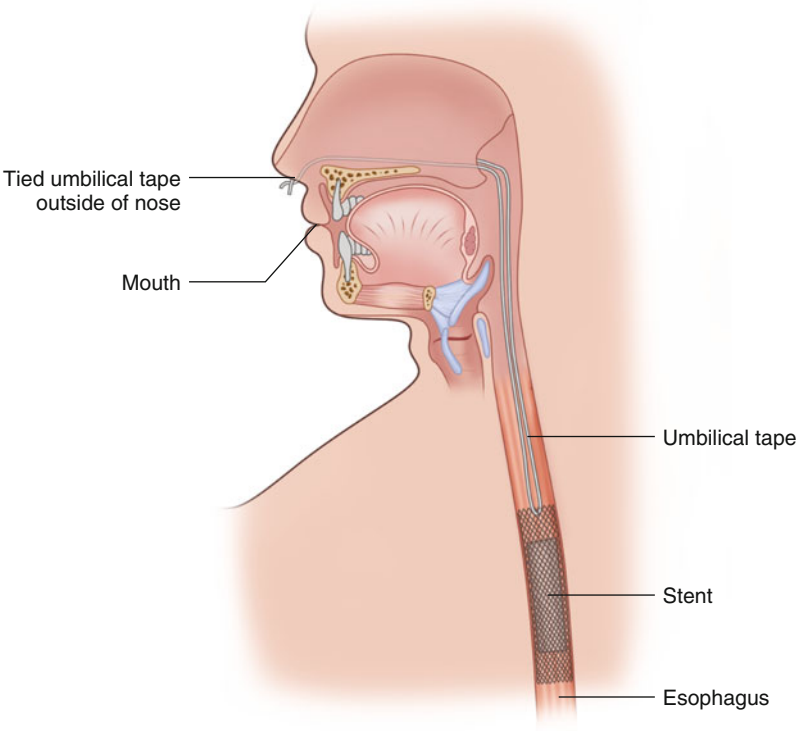

Fig. 8.6 Bridling the stent. One method for reducing the rate of stent migration is to "bridle" the stent. This involves hooking an umbilical tape through the proximal portion of the stent before placement. Once the stent is in place, the umbilical tape is carefully withdrawn through the esophagus and tied outside the nose to secure it. The stent depicted is a WallFlex™ stent (Boston Scientific, Marlborough, MA)

Thoracoscopic Washout of the Chest

Position

The patient is in a lateral decubitus position.

Operation

1. Place the ports:
   - Initial working port: 1-cm incision 1–2 cm below the scapular tip, which allows the visualization of the two anterior ports
   - Camera port: 1-cm incision above the diaphragm in the posterior axillary line
   - Working port: 1-cm incision in the sixth intercostal space, in the anterior axillary line
2. Perform washout:
   - Remove the contents of the perforation.
   - Irrigate the chest cavity with saline.
   - Decorticate the lung.
   - Place a chest tube in the area of the perforation.

Surgical Repair

If the leak is not sealed by the esophageal stent (Fig. 8.7), or if the perforation is large, primary closure with an intercostal muscle flap may be required. The lack of seal after stent placement is likely to be due to leakage from a proximal or distal point. Rarely, a hole in the middle of the stent may lead to a persistent leak. For a classification system of stent leakage and management, see Figs. 8.8 and 8.9. Exchange of the esophageal stent may seal the leak. If stent exchange or manipulation does not seal the leak, surgery is advised. For the best opportunity to seal the leak, we advise leaving the esophageal stent in place while performing the closure and muscle flap (Fig. 8.10).

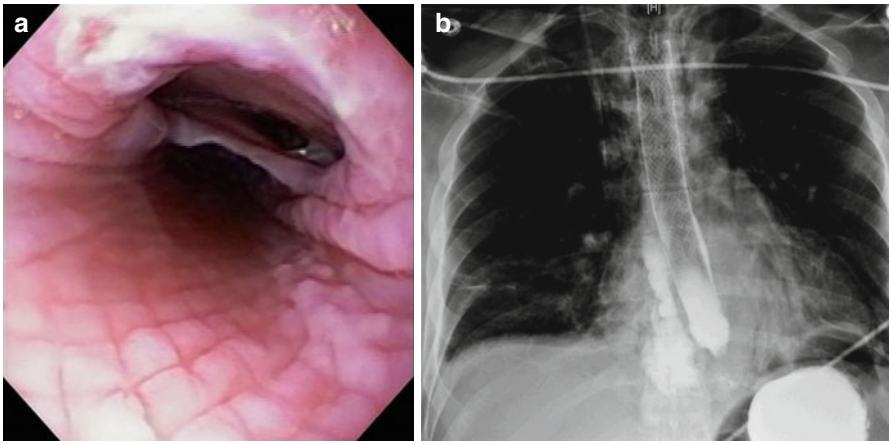

Fig. 8.7 (**a**) Endoscopic appearance of a persistent esophageal perforation despite stent placement. (The stent has been removed in this picture for the endoscopist to assess the esophageal wall.) (**b**) Fluoroscopic examination of the esophagus demonstrating a persistent thoracic esophageal leak despite stenting of the esophagus

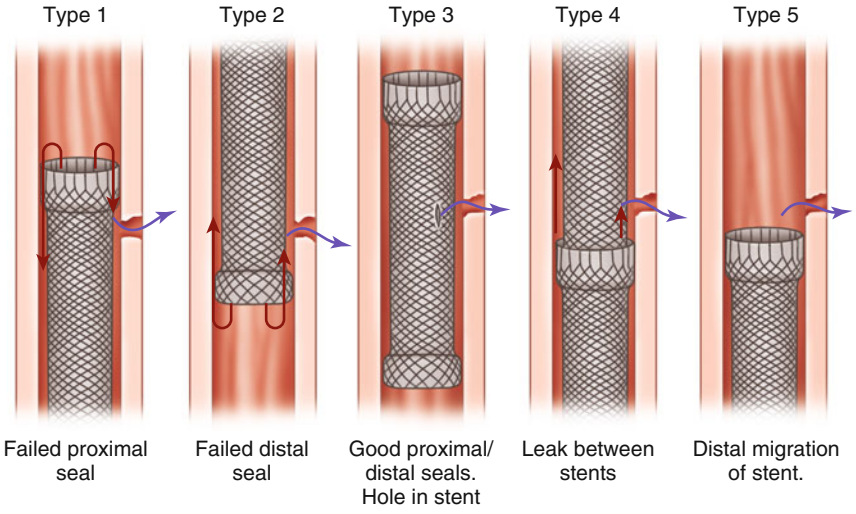

Fig. 8.8 Classification of stent leaks. *Arrow* indicates path of leak (From Stephens et al. (2014); with permission from Elsevier.)

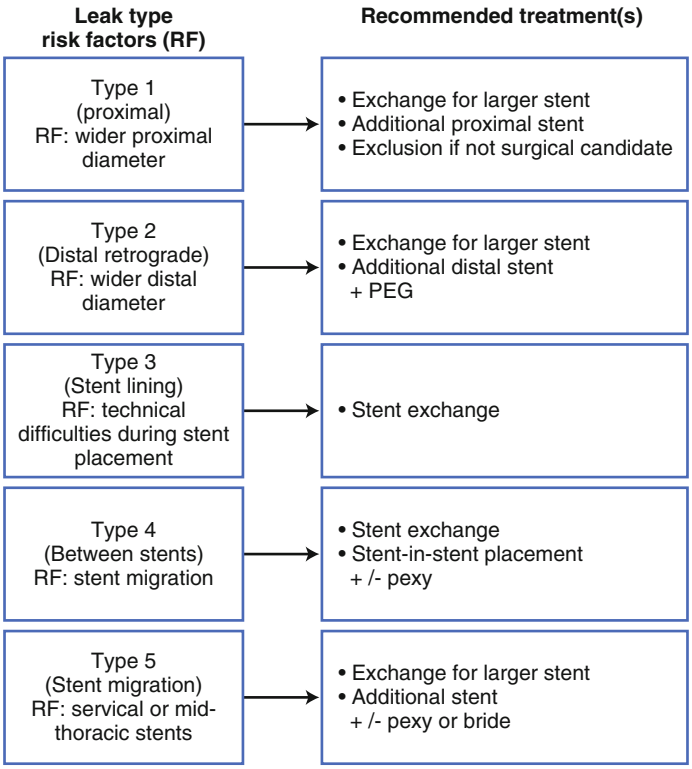

Fig. 8.9 A type-dependent treatment algorithm for stent leaks (From Stephens et al. (2014); with permission from Elsevier.)

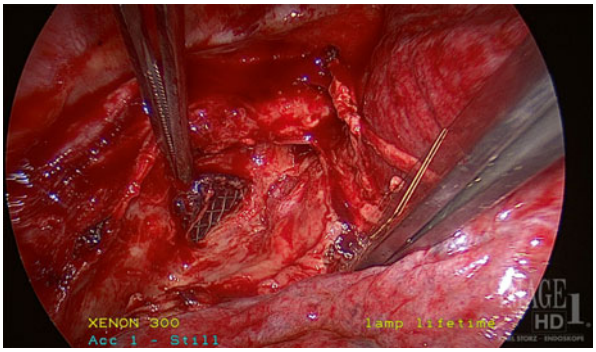

Fig. 8.10 Surgical repair of an esophageal perforation for failure of endotherapy. The stent is left in place as the surgical repair is performed and a muscle flap is buttressed in place. It is important to move the stent landing zones every two weeks to prevent erosion into the aorta or airway

Right-Sided Perforation Repair

Typically a perforation in the upper or mid esophagus is repaired through the right chest.

Position

The patient is in the left lateral decubitus position.

Operation

1. Make a right posterior-lateral muscle-sparing thoracotomy incision.
2. Harvest either the 5th or 6th intercostal muscle (Figs. 8.11 and 8.12), based on the location of the leak on the esophagram.
3. Irrigate the chest cavity.
4. Identify the area of the perforation (Fig. 8.13). If there is no perforation into the pleural space, then divide the pleura overlying the esophagus (Fig. 8.14) and irrigate the mediastinum.
5. Place 3–0 Vicryl suture to approximate the area of the perforation. If the tissue does not hold, then place interrupted suture from the intercostal muscle flap to the area of the perforation (Figs. 8.15 and 8.16).
6. Place a chest tube above the muscle flap.

Left-Sided Perforation Repair

Typically, a lower esophageal perforation is repaired through the left chest.

Position

The patient is in a right lateral decubitus position.

Operation

1. Make a left posterior-lateral thoracotomy incision over the 7th or 8th intercostal space.
2. Harvest either the 7th or 8th intercostal muscle, based on the location of the leak shown by the esophagram.
3. Irrigate the chest cavity.
4. Identify the area of the perforation and open the pleural surface.
5. Place 3–0 Vicryl or PDS suture to approximate the area of perforation. If the tissue does not hold, then place interrupted suture from the intercostal muscle flap to the area of perforation.
6. Place a chest tube above the muscle flap.

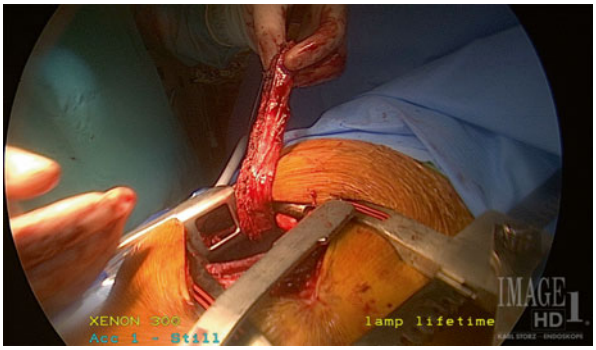

Fig. 8.11 Muscle-sparing thoracotomy is performed to repair an esophageal perforation. During the incision, care must be taken to harvest an intercostal muscle flap to provide a buttress for reinforcement of the primary esophageal repair

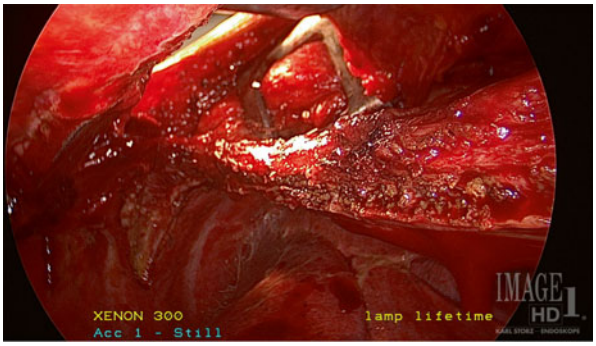

Fig. 8.12 Using thoracoscopy in conjunction with a limited muscle-sparing thoracotomy allows harvest of an intercostal muscle flap and repair of the esophageal perforation

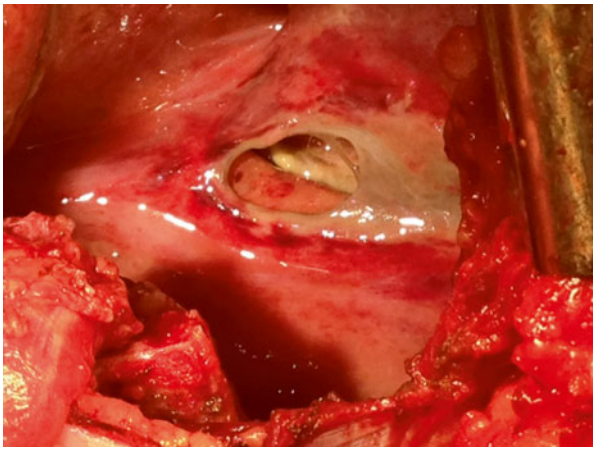

Fig. 8.13 Boerhaave esophageal perforation seen at thoracotomy

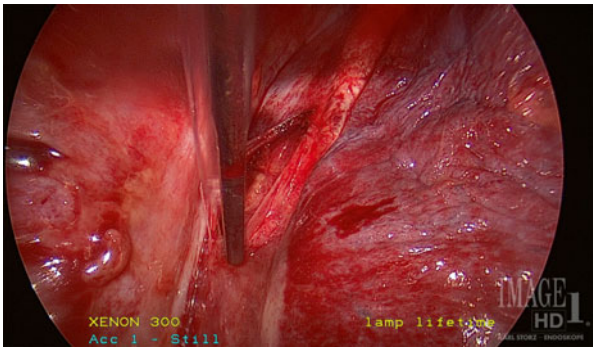

Fig. 8.14 Division of the pleura overlying the esophageal perforation. Division allows assessment of the size of the perforation and washout of the mediastinum and any associated cavity

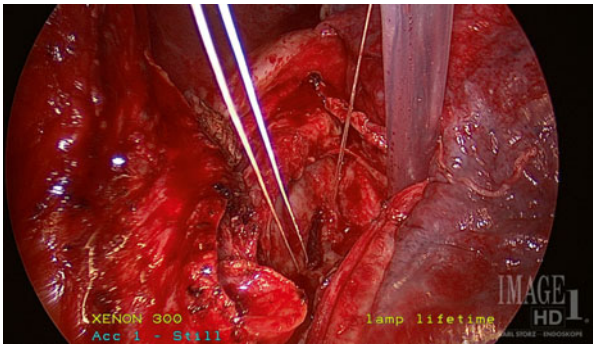

Fig. 8.15 The esophageal perforation can be repaired primarily, but if the tissue is too friable, then interrupted sutures can be placed to secure an intercostal muscle to buttress the esophageal defect

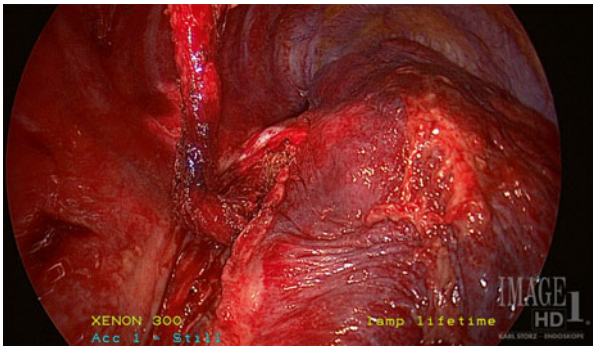

Fig. 8.16 Intercostal muscle used to buttress the esophageal perforation

Abdominal Esophageal Perforation

Patients with abdominal esophageal perforation, typically located at the GEJ (Fig. 8.17), usually have perforations from excessive vomiting or retching. We place an esophageal stent and perform washout of the abdomen; laparoscopic placement of a gastrostomy tube (G-tube) and jejunostomy tube (J-tube) is also performed. The G-tube is placed to gravity and the patient is fed through the J-tube. The G-tube decompresses the stomach to avoid a retrograde leak. This may occur as the stent crosses the GEJ and allows free reflux of gastric contents. To reduce aspiration, the patient is kept NPO and with a venting gastrostomy.

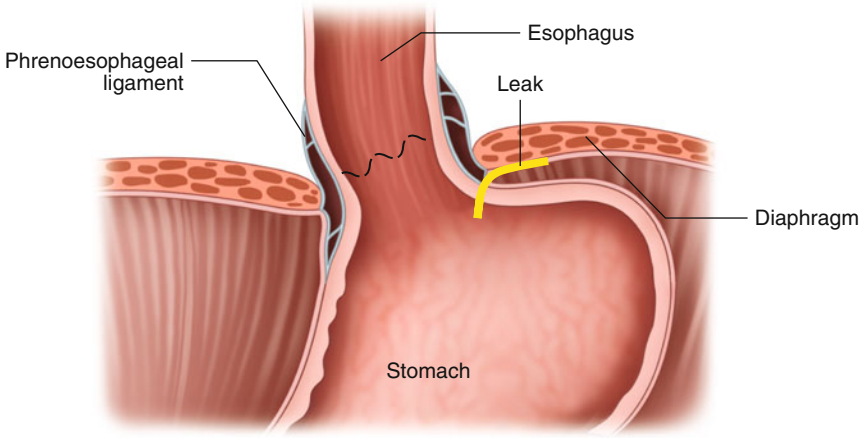

Fig. 8.17 The common site of an intra-abdominal esophageal perforation

Esophageal Stent

An esophageal stent is placed in the manner described above for management of thoracic esophageal perforation.

Laparoscopic G-Tube and J-Tube

Position

The patient is placed in a supine position.

Operation

1. Place a 5-mm instrument port in the right upper quadrant under direct vision (e.g., Ethicon XCEL® trocar) or using an optical trocar.
2. Place a 5-mm camera port below the umbilicus.
3. Place the distal anterior wall of the stomach to the medial left upper quadrant of the abdomen.
4. Place four T fasteners.
5. Place the needle in the middle of the T fastener into the stomach. Place a wire through the needle into the stomach and remove the needle. Inject saline to distend the stomach.
6. Over the wire, serially dilate the tract. Place the introducer with the dilator over the wire into the stomach. Remove the dilator and the wire. Place the G-tube over the introducer into the stomach. Remove the introducer.
7. Identify the jejunum at the ligament of Treitz (Fig. 8.18a) by lifting the omentum to expose the transverse colon. Follow the base of the mesentery to identify the proximal jejunum. Identify a portion of jejunum (approximately 15 cm from the ligament of Treitz) that will come up to the anterior abdominal wall without tension (Fig. 8.18b).
8. Place four T fasteners. Each fastener is passed through a needle (Fig. 8.18c) into the bowel wall (Fig. 8.18d). All four fasteners should form a square (Fig. 8.18e).
9. Place the needle in the middle of the T fasteners into the jejunum (Fig. 8.18f). Place a wire through the needle into the antimesenteric side of the jejunum and remove the needle.
10. Over the wire, serially dilate the tract. Place the introducer with the dilator over the wire into the jejunum. Remove the dilator and the wire. Place the J-tube over the introducer into the jejunum (Fig. 8.18g). Remove the introducer. Tie the T fasteners to the skin with the securing mechanism to secure the tube to the anterior abdominal wall (Fig. 8.18h).
11. After the J-tube is fastened with the four T fasteners, secure the tube approximately 2 cm proximal and distal with two other T fasteners (six used in total). Doing so will reduce the risk of volvulus of the small bowl around the J-tube.

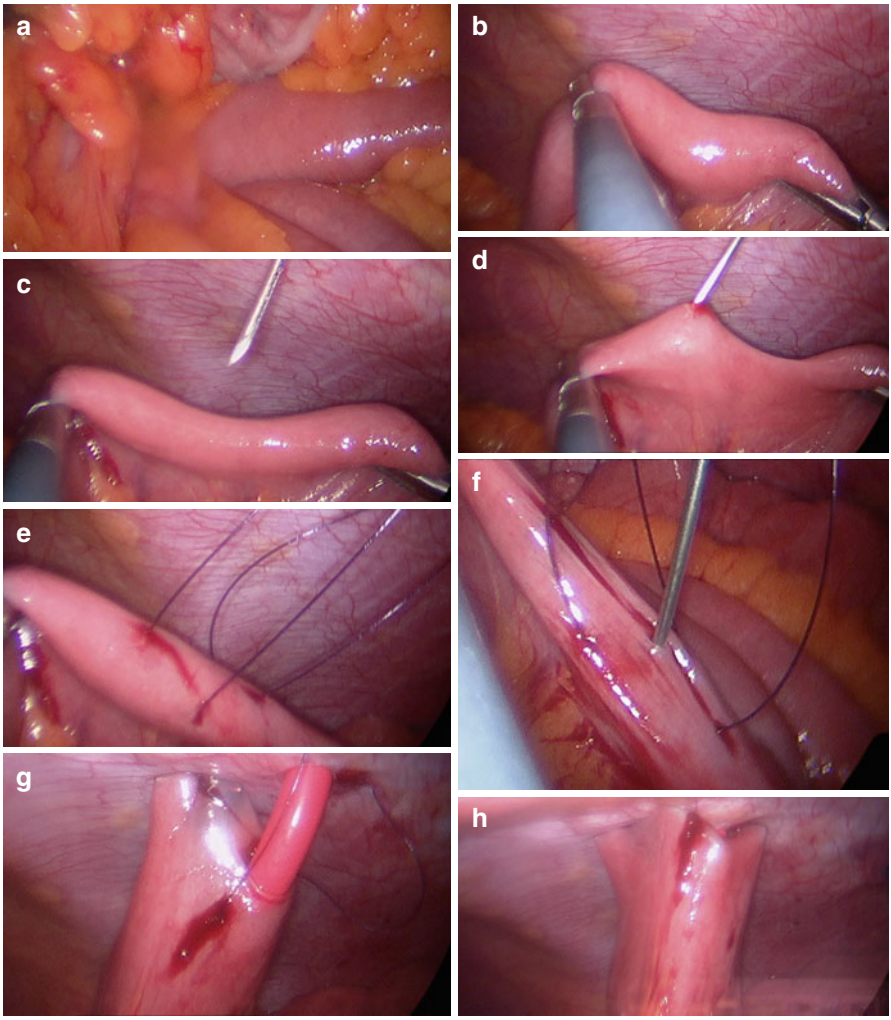

Fig. 8.18 (**a**) Laparoscopic identification of the ligament of Treitz. (**b**) Identification of a segment of jejunum that will reach the abdominal wall without tension. (**c**) A T fastener is placed through the abdominal wall. (**d**) The T fastener is placed into the jejunum and the "T" is deployed. (**e**) Four T fasteners in total are placed in this manner, forming a square. The jejunostomy tube (J-tube) will ultimately be positioned in the center of this square. (**f**) A needle is passed through the abdominal wall and into the center of the T fasteners; a guidewire is passed through this needle. Subsequently a dilator and then an introducer are passed over the guidewire to establish a tract for the J-tube. (**g**) The J-tube is placed into the jejunum through the introducer, and the introducer is withdrawn. (**h**) The T fasteners are snugged to the skin and deployed to fasten them, holding the J-tube securely to the abdominal wall. An endoscopic whitzel or pursestring over the tube entry site into the small bowel is recommended to limit leakage around the tube. It is very important to pass a further two T fasteners, one approximately 3–4 cm proximal and the other distal to the feeding jejunostomy and through the jejunum. These fasteners secure the jejunum longitudinally and reduce the risk of torsion around the J-tube and subsequent bowel obstruction

Esophageal Diversion and Exclusion

If a persistent leak remains uncontrolled despite an esophageal stent and muscle flap and the patient is septic, then esophageal exclusion or diversion may provide a way to salvage the patient.

Esophageal Exclusion with Salivary Tube

Position

The patient is in a supine position.

Procedure

1. Perform a left neck incision in front of the sternocleidomastoid muscle, extending to sternal notch.
2. Divide the omohyoid.
3. Identify the esophagus and dissect and preserve the recurrent laryngeal nerve.
4. Dissect around the esophagus and mobilize the esophagus proximally and distally to bring a section of the esophagus to the left neck.
5. Place a 2–0 Vicryl around the esophagus. Make a small incision in the esophagus with purse-string suture around it. Place an NGT through the opening. A Montgomery salivary tube is sutured to the NGT and is pulled out through the esophagus to the left neck (Fig. 8.19). Alternatively, the esophagus can be sewn on the side circumferentially to the skin, opening as a side ostomy without the salivary bypass tube (Fig. 8.20). To completely divert the saliva, a 0 Vicryl suture can be used to tie off the distal end of the esophagus just caudal to the area of diversion. The Vicryl should dissolve in 2–3 months, allowing time for the leak to heal without saliva passing through the area of the leak. Once the esophageal lumen reconstitutes, the side diversion can be repaired.

Fig. 8.19 A Montgomery salivary tube is useful for allowing esophageal drainage if the esophagus is too tethered or short to be delivered to the skin of the neck

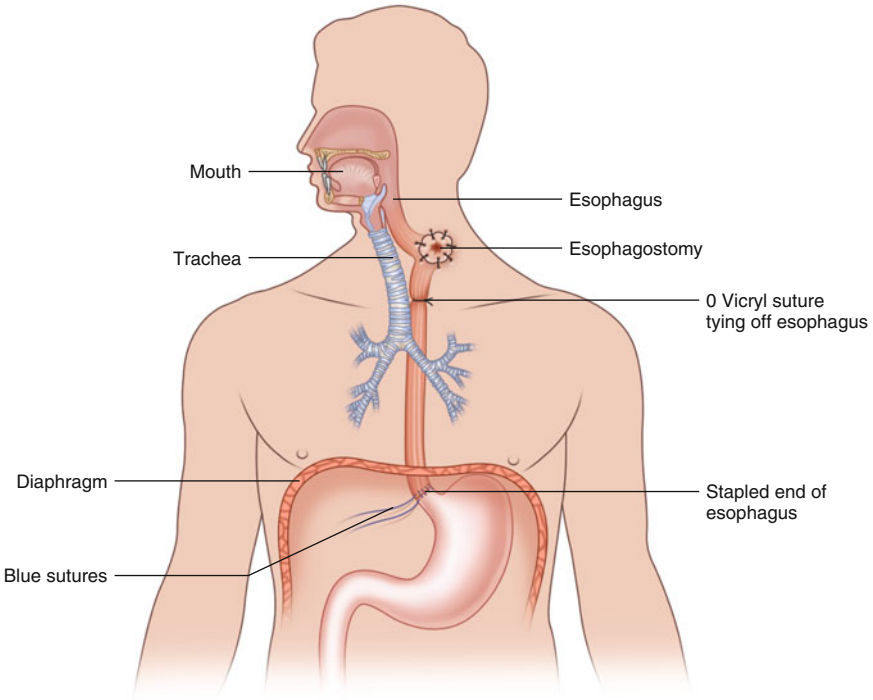

Fig. 8.20 Side esophagostomy. A side esophagostomy allows diversion of esophageal contents to the skin. To completely divert saliva, the esophagus can be ligated distally with an absorbable suture if temporary diversion is required

Esophageal Diversion

If the patient has persistent, uncontrolled leak despite esophageal exclusion, or if the patient is not a candidate for exclusion (such as a patient with esophageal tumor perforation), then we recommend esophageal diversion. If a gastric conduit anastomotic leak is caused by a nonviable conduit or necrosis, then diversion is advised.

The diversion procedure occurs in two parts: First, a right thoracotomy is performed, with resection of the esophagus. Second, a left neck incision is performed and the esophagus is brought out to the left chest. A chest diversion (Fig. 8.21) is always better than a neck diversion (Fig. 8.22), as it will result in a better-fitting ostomy.

Position: Resection of the Esophagus

The patient is placed in a left lateral decubitus position.

Operation

1. Perform a right posterolateral muscle-sparing thoracotomy.
2. Divide the esophageal pleura.
3. Divide the azygous vein with a stapler.
4. Mobilize the entire esophagus. Place a Penrose drain around the esophagus. Dissect the esophagus away from the pericardium, airway, and aorta. Divide the vagus nerve at the level of the azygous vein and separate it away from the esophagus. Place the Penrose drain in the thoracic inlet. Staple the end of the esophagus at the level of the diaphragm and use the entire length of the esophagus to be mobilized out of the neck. Do not transect the esophagus above the azygous vein if you want to have plenty of length to mobilize for chest diversion.

Position: Creation of Ostomy

The patient is in a supine position.

Operation

1. Perform left neck incision anterior to the sternocleidomastoid muscle (4–5 cm).
2. Divide the omohyoid muscle.
3. Dissect and preserve the recurrent laryngeal nerve.

4. Dissect down to the Penrose that was left at the top of the thoracic esophagus and bring the Penrose and the esophagus out of the left neck. If the Penrose cannot be reached with a finger, a video mediastinoscope may be used to safely identify the Penrose and grasp it for retraction.
5. Tunnel the end of the esophagus to the left chest. Stretching the esophagus towards the chest will allow a test to ensure that adequate length is available to reach the ostomy site.
6. Identify the area for the ostomy. The ideal site (with unlimited esophageal length) is inferior to the border of the clavicle and medial, traveling over the sternocleidomastoid and making a gentle curve. A Kocher clamp is used to elevate the skin, and the Bovie or a knife is used to cut away a circle of skin 2 cm in diameter. Dissection of the esophagus away from the trachea to ensure the creation of a gentle curve will prevent dysphagia. Some surgeons advocate going through the sternocleidomastoid muscle, but our service typically passes the esophagus over this muscle. Finally, the esophagus is passed out of the ostomy hole and is sutured circumferentially around the edge of the wall to the dermis with absorbable suture. Leaving the terminal end of the esophagus hanging out of the skin edge is important, as the esophagus will retract (as when a pie crust is baked). Leaving additional length allows the patient to have extra length, better emptying into the bag, and demarcation without wasting precious esophagus (Fig. 8.23). By using this technique, the patient will have fewer events requiring manual dilation.
7. Place a vented ostomy bag over the ostomy.

Other novel ways to treat a perforation are discussed in Chap. 6.

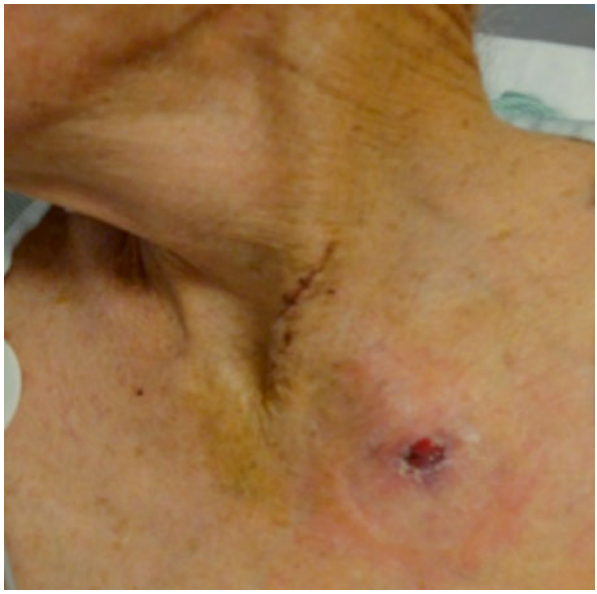

Fig. 8.21 Chest wall esophagostomy. This is the preferred site for placement of an esophagostomy, as esophageal length is maximally preserved. Additionally, the patient's quality of life is improved, as this site is easier to care for and it is easier to manage the stoma bag under clothes

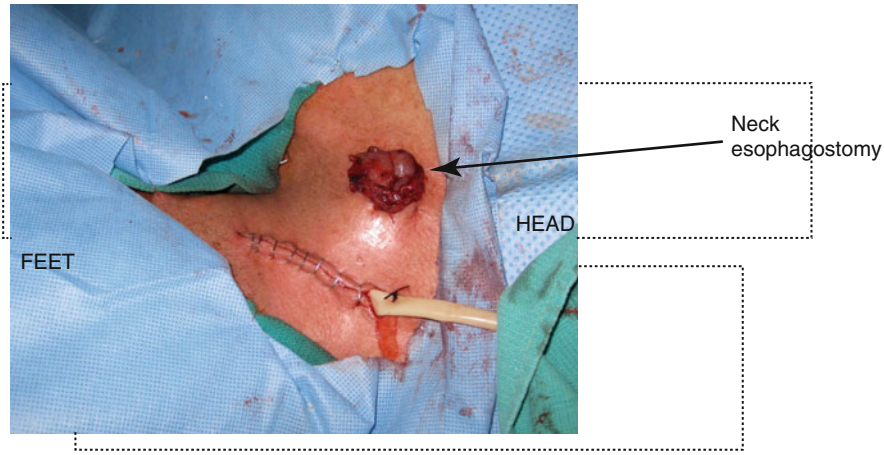

Fig. 8.22 Neck esophagostomy. We prefer the chest wall esophagostomy, but in some situations (e.g., inadequate esophageal length), a cervical esophagostomy is the only option

Fig. 8.23 Diverting the esophagus onto the left chest. Significant esophageal length can be preserved for future esophageal reconstruction

Suggested Reading

Schaheen L, Blackmon SH, Nason KS. Optimal approach to the management of intrathoracic esophageal leak following esophagectomy: a systematic review. Am J Surg. 2014;208(4): 536–43.

Stephens EH, Correa AM, Kim MP, Gaur P, Blackmon SH. Classification of esophageal stent leaks: leak presentation, complications, and management. Ann Thorac Surg. 2014;98(1): 297–303; discussion 303–4.