Operative Techniques in Thoracic and Cardiovascular Surgery

Surgical Management of Esophageal Perforation

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Esophageal perforations remain a challenging problem with significant morbidity and mortality. Accurate diagnosis to isolate the location and etiology of the injury, as well as associated upper gastrointestinal pathologies is vital to determine appropriate, prompt treatment plan. Management options include nonoperative resuscitation and medical management, endoscopic stenting and thoracoscopic decortication, primary repair with tissue flap buttress or esophageal diversion ± resection. Posterolateral thoracotomy and primary repair of the injury with reinforcement with a pedicled tissue flap is historically considered the standard treatment by which other treatments are measured. The thoracic surgeon should be skilled in all potential treatment algorithms to provide the best outcome for the patient in these difficult clinical scenarios.
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Introduction

Esophageal perforation continues to provide thoracic surgeons' with a diagnostic and therapeutic dilemma associated with significant morbidity and mortality. Clinical outcome is determined by several factors, including the etiology of the injury, location of perforation, and delay in diagnosis and treatment. A recent meta-analysis reports a mortality rate of up to 18%.[1] However, a delay in diagnosis and treatment greater than 24 hours have been shown to double the resultant mortality.[2] Despite the high morbidity and mortality rates, the advantage of surgical repair in the appropriate clinical scenario cannot be understated.

The etiology of esophageal perforation can be divided into iatrogenic, spontaneous, and traumatic. Iatrogenic causes are the most common, accounting for up to 60% of the cases.[1] These include rigid and flexible esophagoscopy, esophageal dilation, and other interventional endoscopic techniques. Spontaneous perforations are often related to Boerhaave syndrome, in which severe wretching and vomiting leads to an esophageal tear because of significant barotrauma. Traumatic perforations are less common and usually due to penetrating injuries.

The location of the perforation is an important determinant of treatment plan, as well as resultant outcome. Although the perforation can occur at any location in the esophagus, there is a predilection to key anatomic areas that correspond to natural points of luminal narrowing. The most proximal location is in the cervical esophagus at the cricopharyngeus. Endoscopic iatrogenic injuries often occur at this location. Next, a narrowing is present in the mid-esophagus, at the area of the aortic arch, and carina. This location plays a part in the obstruction of ingested foreign bodies and resultant perforation. Finally, the gastroesophageal junction is a common area of perforation, especially those of barotrauma etiology.

Patients with cervical perforations often present with neck pain, dysphagia, and subcutaneous emphysema. In contrast, patients with intrathoracic perforations usually present with more severe findings. These include symptoms of septic shock, such as fever, leukocytosis, hypotension, and tachycardia. Additionally, the pleural contamination can induce chest pain and respiratory failure.

Several diagnostic tests are vital to the appropriate diagnosis of an esophageal perforation. Chest radiographs and computed tomography of the chest can show pleural effusions, pneumothorax, pneumomediastinum, and subcutaneous emphysema. Contrast esophagram as shown in Figure 1, preferably with gastrografin followed by thin barium for smaller defects, is the gold standard diagnostic modality.[3] Flexible endoscopy is often used by the surgeon perioperatively to steer surgical repair or detect additional esophageal pathologies or both.

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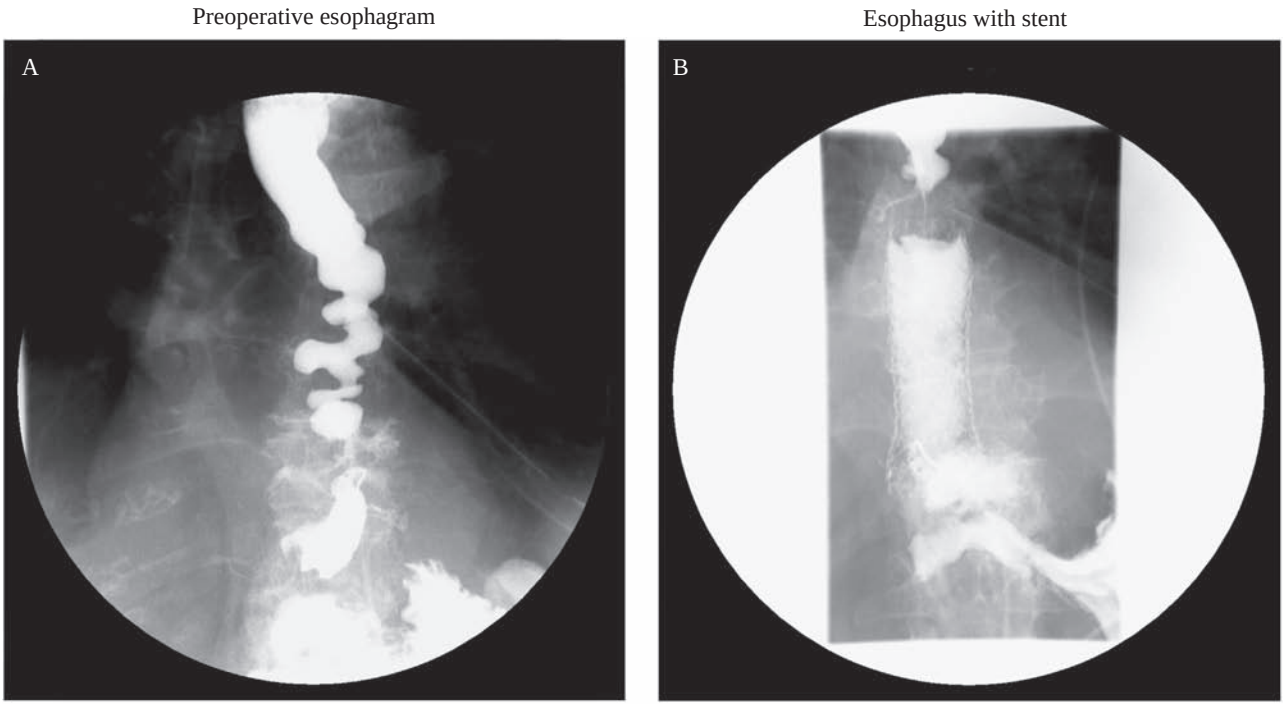

Figure 1 (A) Esophagram showing extravasation of contrast indicating esophageal perforation. Water-soluble contrast agents should be used initially, followed by thin barium, if necessary. Specific features to note on the imaging include anatomical features or abnormalities of the esophagus, location of perforation, and direction and extent of contrast extravasation. (B) Esophageal stent in place excluding perforation.

Surgical approach and technique for esophageal perforation is varied and based on location of the perforation, timing of diagnosis, and the patient's clinical state. Cervical perforations are often treated with surgical drainage alone or primary repair, and drainage. In general, they have a lower morbidity and mortality than intrathoracic perforations.[1] If diagnosed within 24 hours and the patient is not floridly septic, than intrathoracic perforations require surgical exploration, debridement, buttressed repair, and wide drainage. Surgical repair is the historical standard and author's preference for treatment of an esophageal perforation, especially in patients who have presented early or are appropriate candidates for surgical intervention. If diagnosed after 24 hours, primary repair may not be feasible due devitalized, necrotic tissue. In this situation, or in the case of an unstable patient, esophageal diversion may be the best approach. Additionally, in those patients who have small, usually iatrogenic, clinically insignificant perforations or in the elderly or medically comorbid, a minimally-invasive endoscopic approach may provide the most benefit. The following sections would describe a buttressed primary repair of a distal esophageal perforation via a left posterolateral thoracotomy, as well as minimally-invasive endoscopic therapeutic options and a brief description of esophageal diversion.

Operative Technique

Thoracic Exploration and Repair

Before surgical exploration and repair, a flexible esophagogastroduodenoscopy should be performed to visualize the injury location and extent, as well as possible associated upper gastrointestinal pathologies. The esophagogastroduodenoscopy also helps identify potential distal obstructions, such as achalasia or malignancy that could lead one to avoid primary repair, but rather resection vs esophageal diversion. The authors frequently also place a percutaneous endoscopic gastrostomy (PEG) for postoperative drainage as well eventual enteral access (Fig. 2A). We have not noticed further damage to the perforation site with this procedure. Additionally, the PEG tube placement has not been a hindrance to a possible subsequent esophagectomy and gastric pull-up, only requiring a simple repair in that scenario. Alternatively, a small upper midline laparotomy can be performed before or after the perforation repair for enteral access (Figs. 2B and 3).

Esophageal perforations are most commonly located in the distal third of the esophagus. Injuries at this location are best approached via a left seventh or eighth intercostal space posterolateral thoracotomy (Figs. 4 and 5). In rare circumstances, a lower esophageal perforation can extend across the gastroesophageal junction. Unfortunately, this is usually not discovered until during the thoracotomy and exploration. If the full extent of the perforation cannot be visualized and extends across the gastroesophageal junction, the left diaphragm may need to be partially opened to access the abdominal cavity and repair the perforation accordingly. The diaphragm can subsequently be closed with interrupted 0 or 2-0 interrupted, horizontal mattress, Ethibond suture. Perforations of the middle third of the esophagus are managed via a fourth or fifth intercostal space posterolateral thoracotomy. The technique of repair is the same for both approaches: longitudinal myotomy, mucosal repair, closure of myotomy, and buttress reinforcement with intercostal muscle, pericardial fat, pleural patch, or diaphragm flap. Importantly, the decision