Endoscopic Management of Esophageal Perforations

21

Naomi Berezin

Introduction

The past 10 years have seen a paradigm shift in the management of esophageal perforations. Whereas perforations were previously managed either conservatively or aggressively with surgical intervention depending on various criteria, endoscopic therapy and wide drainage have now become the mainstays of treatment. This has resulted in considerable improvement in patient morbidity and mortality. Yet, despite this shift in therapeutic approach, esophageal perforation remains a highly morbid and mortal diagnosis. The following chapter discusses the etiologies of esophageal perforations, presentation, workup, therapy, and outcomes.

Etiology

The incidence of esophageal perforation is largely unknown. The literature varies widely and is mostly estimated based on single-center studies or isolated populations due to the relative rarity of this condition. In Canada, for instance, the incidence is approximately 3.1 per 1,000,000 per year [1]. This number is on the rise yearly in proportion with the increased number of upper endoscopies [2].

Iatrogenic injury is the leading cause of esophageal perforation globally and most commonly occurs during endoscopy, which accounts for 60% of all perforations [3]. On the whole, upper endoscopy carries a 0.033% risk of perforation, with therapeutic endoscopy more frequently resulting in perforation than diagnostic [4]. Other iatrogenic causes such as intraoperative injuries during foregut surgery or

N. Berezin (✉)
General Surgery, Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, NY, USA

N. Zundel et al. (eds.), *Benign Esophageal Disease*,
https://doi.org/10.1007/978-3-030-51489-1_21

unrelated surgeries in the abdomen, chest, neck, and spine have been described, as well as from other instrumentation such as nasogastric tube placement.

Ingested foreign bodies such as fish or poultry bones account for 80% of cervical esophageal perforations [5].

Penetrating trauma is another well-described cause of esophageal perforation that is most frequently caused by either stabbing (15–20%) or gunshot (70–80%) [6].

Boerhaave syndrome, the most common cause of spontaneous perforation, is the second leading cause of esophageal rupture, representing between 8% and 56% of perforations [3]. Other etiologies of spontaneous perforations have been described related to various medical diagnoses and treatments including achalasia, infection, inflammatory and autoimmune diseases, radiation, and medications. Malignancy accounts for approximately 1% of perforations [5].

Finally, caustic ingestion is a leading cause of perforation among the pediatric population where this injury is almost always accidental [7]. Conversely, in the adult population, caustic ingestion is relatively rare and is more often seen as the result of an intentional ingestion during attempted suicide [8]. Household cleaning products are the most common culprit, accounting for 80% of cases, with alkali solutions more likely to cause perforation than acidic solutions [9].

Location

In terms of both therapeutic approach and outcomes, the location of an esophageal perforation is paramount. The esophagus is stratified into three regions based on its relation to anatomical compartments: the cervical esophagus, the thoracic esophagus, and the abdominal esophagus. Perforations of the thoracic esophagus account for 72.6% overall, followed by cervical at 15.2% and finally abdominal at 12.5% [10].

Perforations due to instrumentation are most likely to be thoracic (45%), whereas spontaneous and operative perforations are more commonly abdominal (60% and 75%, respectively), and trauma and foreign body perforations are predominantly cervical (80% and 85%, respectively) [5].

Signs and Symptoms

Presenting signs and symptoms are dependent on the location of esophageal perforation as well as time elapsed. Often patients with esophageal perforations will relay an inciting event. Patients with cervical perforations will present with neck pain, aerodigestive symptoms, or subcutaneous emphysema [10].

By and large, patients with thoracic esophageal perforations will present with chest pain that is pleuritic in nature and radiates to the back or shoulder [10]. Patients with Boerhaave syndrome, in particular, may present with Mackler's triad: emesis followed by chest pain and then subcutaneous emphysema, though this is seen only 14% of the time [11].

Finally, patients with abdominal esophageal perforations will present with abdominal pain, typically epigastric, or frank peritonitis [12]. Due to the rapidly progressive natural course of this disease, late presentation (>24 h) is often nonspecific with progressive findings of pneumonia, sepsis, multiorgan dysfunction, and shock [13, 14].

Diagnosis

A high index of suspicion is critical for the diagnosis of esophageal perforation. Careful history and physical exam will commonly reveal instigating events such as recent endoscopy, emesis, bone ingestion, choking, or trauma, or physical findings such as subcutaneous emphysema or peritonitis [15]. Laboratory exams may show a leukocytosis with left shift consistent with infectious process. Chest X-ray may reveal pneumomediastinum, pneumonia, or pneumothorax. In thoracic perforations, standard lung X-ray is abnormal in 90% of patients, though this is often nonspecific [3].

More specifically, there are three imaging modalities commonly used to definitively diagnose esophageal perforations. Computed tomography (CT) is the initial diagnostic test of choice as it is quick and easily obtainable in any institution. CT may reveal stigmata of perforation such as extraluminal air adjacent to the esophagus in the neck, thorax or abdomen, pneumomediastinum or pneumothorax, or pleural or mediastinal fluid. Sensitivity can be increased up to 92–100% with the addition of oral contrast [16]. This should always be water soluble in the setting of suspected perforation as barium can cause irreversible mediastinitis/fibrosis. Additionally, CT aids in ruling out other confounding diagnoses.

Fluoroscopy, or oral contrast esophagogram, similarly may reveal extravasation of oral contrast; however, it is more difficult to obtain in smaller centers. While some studies advocate fluoroscopy over CT, others show that oral contrast-enhanced CT is far superior, with fluoroscopy demonstrating only 50% sensitivity for cervical perforations and 75–80% for thoracic perforations [5, 17].

Finally, endoscopy is an excellent modality as it allows for both diagnosis and therapy. Endoscopy allows for direct visualization of the defect, and enables characterization and planning to address both the acute problem and any underlying issue [18].

Treatment and Outcomes

Early diagnosis and treatment of esophageal perforations are essential in reducing morbidity and mortality. Overall mortality for esophageal perforations is approximately 11.9%; however, for patients who necessitate operative intervention, the mortality is 20% [3, 19]. Diagnosis and treatment within 24 h, however, reduce mortality by up to 50% [20, 21].

Cervical perforations carry an overall mortality of 5.9%, thoracic perforations 10.9%, and intraabdominal perforations 13.2%. By cause, mortality after esophageal perforation secondary to foreign body was 2.1%, iatrogenic perforation 13.2%, and spontaneous perforation 14.8% [19].

First and foremost, supportive care, nil per os status, and broad-spectrum antibiotics should be initiated on presentation. Antibiotics should cover upper gastrointestinal (GI) flora including gram-positive bacteria, gram-negative bacteria, and yeast, and should be narrowed based on cultures [13]. Intervention should be performed as early as reasonably possible to shorten the length of ongoing contamination and should be focused on source control with closure or coverage of the defect where possible as well as drainage of the affected cavity when indicated [20, 21]. Perforations recognized at the time of endoscopy or surgery should be treated immediately. Intuitively, patients with small defects that are diagnosed and treated expeditiously have the best outcomes [22].

At the time of intervention, consideration for enteral feeding access should be given, as many patients will remain nil per os for extended periods of time [22].

Management of malignant perforations requires special consideration and is not discussed in this chapter.

Endoscopy Versus Surgery

There is no better opportunity to diagnose and treat simultaneously than with upper endoscopy. Surgery is far more invasive, necessitating neck dissection, thoracotomy, laparoscopy, or possibly laparotomy. Therefore, with appropriate patient selection, endoscopy should be considered the initial intervention of choice [18]. The number of patients with esophageal perforations that are managed nonoperatively has dramatically risen in the past 10 years, such that surgical intervention now is used in less than half of all cases, and this number continues to decline annually [10]. Should operative intervention be required either acutely or due to failure of nonoperative or endoscopic management, the general principles of esophageal repair apply. Regardless of location, these include: exposure, debridement of nonviable tissue, closure of defect in two layers, the use of buttress, and tube drainage [6].

Surgical approaches and technique will be discussed in the next chapter.

Endoscopic Techniques

Endoscopic management of esophageal perforations is an evolving field and techniques vary from center to center based on the availability and comfort of specialists. These injuries should only be handled in high-volume specialty centers with access to endoscopic experts as well as a thoracic or foregut surgeon who is familiar with the management and operative repair of esophageal perforations. In centers that lack these resources, patients should be stabilized and transferred expeditiously. Endoscopy, though an excellent standalone therapy when an esophageal perforation is immediately recognized, often must be combined with drainage procedures in the setting of gross contamination in order to achieve appropriate source control. Predictors of successful endoscopic therapy are smaller defect and shorter time to diagnosis and therapy [23, 24].

Clips

Endoscopic clip placement is an excellent means of managing small perforations with minimal surrounding inflammation. There are two types of clips that are used. Small clips are deployable via the working port of the endoscope, whereas the bear-trap-like over-the-scope clip (OTSC®) system (Ovesco Endoscopy AG, Tubingen, Germany) offers larger clips with fewer limitations. The latter clips are useful for lesions up to 30 mm and exert greater force on the closure [25]. When compared to through-the-scope clips, OTSCs are associated with lower rates of surgical intervention [26]. There are few unique complications of endoscopic clip use other than malfunction and failure.

Overall, clips are successful in closing 56–100% of perforations for which they are attempted, without the need for any surgical intervention or repeat endoscopy [18]. Furthermore, when clips are used as first line therapy, there is a higher rate of success than when applied after another therapy has failed [27]. Limitations include the size of the perforation, and the quality of the surrounding tissue. Along these lines, risk of failure is greater with chronic perforations and fistulae [28]. The average size lesion that results in successful closure with endoscopic clips is 8 mm, with a significantly increased rate of failure for defects greater than 13 mm [29, 30].

Stents

Endoscopic stents have become the mainstay of therapy for esophageal perforations that are too large or long standing to be amenable to endoscopic clipping. Stents are indicated in almost any type of esophageal injury but have varying rates of success depending on the size and location of injury. Overall, technical success rate is ~91% and clinical success rate ~81% with endoscopic stenting. The rate of stent migration is significantly higher with plastic stents than metal stents, 27% versus 11%, respectively, whereas metal stents are more prone to causing postprocedural strictures. Due to the differences in stent migration, patients with plastic stents need far more reintervention [31]. Bare metal stents are prone to mucosal ingrowth, and therefore are excellent for permanent placement such as for patients with malignancy. Covered stents are retrievable, and because of this, self-expanding covered metal stents should be used preferentially.

There are four factors that are most predictive of stent failure: injury to the proximal cervical esophagus, injury that traverses the gastroesophageal junction, length of injury greater than 6 cm, and anastomotic leak associated with more distal conduit leak [32].

Despite initial technical success, some patients will still require surgery upon stent removal due to persistent leak. Several studies have shown various outcomes with self-expanding metal stents with ranges from 77% to 100% success. Stent failure either mandates repeat stenting for long-term course or operation [33, 34].

Not surprisingly, stent migration is the most common complication, 8.8–40%, with other complications including tissue overgrowth, erosions/ulcerations, bleeding, aspiration, perforation, fistula, and reflux being relatively rare [35, 36]. When compared to open repair, stent placement is associated with a 4% morbidity as opposed to 43%. Length of stay, time to oral intake, and cost are also significantly decreased [32].

Endoluminal Vacuum Therapy

In light of the improved outcomes with nonoperative treatment of esophageal perforations, new techniques are on the horizon that could potentially obviate the need for surgery even in patients who would otherwise not meet the criteria for endoscopic management. One such therapy is endoluminal vacuum therapy, which utilizes a vacuum sponge that is endoscopically placed into the perforation cavity. The Endo-SPONGE® is not yet FDA approved for esophageal perforations, and studies are still underway regarding its efficacy. Currently, it is approved only for the treatment of rectal anastomotic leaks.

References

1. Bhatia P, et al. Current concepts in the management of esophageal perforations: a twenty-seven year Canadian experience. Ann Thorac Surg. 2011;92(1):209–15.
2. Peery AF, et al. Burden of gastrointestinal disease in the United States: 2012 update. Gastroenterology. 2012;143(5):1179–1187. e3.
3. Chirica M, et al. Esophageal perforations. J Visc Surg. 2010;147(3):e117–28.
4. Merchea A, et al. Esophagogastroduodenoscopy-associated gastrointestinal perforations: a single-center experience. Surgery. 2010;148(4):876–82.
5. Brinster CJ, et al. Evolving options in the management of esophageal perforation. Ann Thorac Surg. 2004;77(4):1475–83.
6. Sudarshan M, Cassivi SD. Management of traumatic esophageal injuries. J Thorac Dis. 2019;11(Suppl 2):S172.
7. Betalli P, et al. Update on management of caustic and foreign body ingestion in children. Diagn Ther Endosc. 2009;2009:969868.
8. Cheng H-T, et al. Caustic ingestion in adults: the role of endoscopic classification in predicting outcome. BMC Gastroenterol. 2008;8(1):31.
9. Chirica M, et al. Caustic ingestion. Lancet. 2017;389(10083):2041–52.
10. Sdralis EIK, et al. Epidemiology, diagnosis, and management of esophageal perforations: systematic review. Dis Esophagus. 2017;30(8):1–6.
11. Mackler SA. Spontaneous rupture of the esophagus; an experimental and clinical study. Surg Gynecol Obstet. 1952;95(3):345–56.
12. Aronberg RM, et al. Esophageal perforation caused by edible foreign bodies: a systematic review of the literature. Laryngoscope. 2015;125(2):371–8.

13. Shaker H, et al. The influence of the "golden 24-h rule" on the prognosis of oesophageal perforation in the modern era. Eur J Cardiothorac Surg. 2010;38(2):216–22.
14. Søreide JA, Viste A. Esophageal perforation: diagnostic work-up and clinical decision-making in the first 24 hours. Scand J Trauma Resusc Emerg Med. 2011;19(1):66.
15. Herrera A, Freeman RK. The evolution and current utility of esophageal stent placement for the treatment of acute esophageal perforation. Thorac Surg Clin. 2016;26(3):305–14.
16. di Castelguidone EdL, et al. Esophageal injuries: spectrum of multidetector row CT findings. Eur J Radiol. 2006;59(3):344–8.
17. Makhani M, et al. Pathogenesis and outcomes of traumatic injuries of the esophagus. Dis Esophagus. 2014;27(7):630–6.
18. Watkins JR, Farivar AS. Endoluminal therapies for esophageal perforations and leaks. Thorac Surg Clin. 2018;28(4):541–54.
19. Biancari F, et al. Current treatment and outcome of esophageal perforations in adults: systematic review and meta-analysis of 75 studies. World J Surg. 2013;37(5):1051–9.
20. Onat S, et al. Factors affecting the outcome of surgically treated non-iatrogenic traumatic cervical esophageal perforation: 28 years experience at a single center. J Cardiothorac Surg. 2010;5(1):46.
21. Vallbohmer D, et al. Options in the management of esophageal perforation: analysis over a 12-year period. Dis Esophagus. 2010;23(3):185–90.
22. Madanick RD. Medical management of iatrogenic esophageal perforations. Curr Treat Options Gastroenterol. 2008;11(1):54–63.
23. van Halsema EE, et al. Stent placement for benign esophageal leaks, perforations, and fistulae: a clinical prediction rule for successful leakage control. Endoscopy. 2018;50(2):98–108.
24. El H II, et al. Treatment of esophageal leaks, fistulae, and perforations with temporary stents: evaluation of efficacy, adverse events, and factors associated with successful outcomes. Gastrointest Endosc. 2014;79(4):589–98.
25. Gubler C, Bauerfeind P. Endoscopic closure of iatrogenic gastrointestinal tract perforations with the over-the-scope clip. Digestion. 2012;85(4):302–7.
26. Khater S, et al. Over-the-scope clip (OTSC) reduces surgery rate in the management of iatrogenic gastrointestinal perforations. Endosc Int Open. 2017;5(5):E389–94.
27. Haito-Chavez Y, et al. International multicenter experience with an over-the-scope clipping device for endoscopic management of GI defects (with video). Gastrointest Endosc. 2014;80(4):610–22.
28. Disibeyaz S, et al. Endoscopic closure of gastrointestinal defects with an over-the-scope clip device. A case series and review of the literature. Clin Res Hepatol Gastroenterol. 2012;36(6):614–21.
29. Sulz MC, et al. Multipurpose use of the over-the-scope-clip system ("Bear claw") in the gastrointestinal tract: Swiss experience in a tertiary center. World J Gastroenterol. 2014;20(43):16287–92.
30. Hagel AF, et al. Over-the-scope clip application yields a high rate of closure in gastrointestinal perforations and may reduce emergency surgery. J Gastrointest Surg. 2012;16(11):2132–8.
31. Dasari BV, et al. The role of esophageal stents in the management of esophageal anastomotic leaks and benign esophageal perforations. Ann Surg. 2014;259(5):852–60.
32. Freeman RK, et al. Analysis of unsuccessful esophageal stent placements for esophageal perforation, fistula, or anastomotic leak. Ann Thorac Surg. 2012;94(3):959–64; discussion 964–5.
33. Johnsson E, Lundell L, Liedman B. Sealing of esophageal perforation or ruptures with expandable metallic stents: a prospective controlled study on treatment efficacy and limitations. Dis Esophagus. 2005;18(4):262–6.
34. Fischer A, et al. Nonoperative treatment of 15 benign esophageal perforations with self-expandable covered metal stents. Ann Thorac Surg. 2006;81(2):467–72.
35. Speer E, et al. Covered stents in cervical anastomoses following esophagectomy. Surg Endosc. 2016;30(8):3297–303.
36. Turkyilmaz A, et al. Complications of metallic stent placement in malignant esophageal stricture and their management. Surg Laparosc Endosc Percutan Tech. 2010;20(1):10–5.