Current Trauma Reports
https://doi.org/10.1007/s40719-019-0160-8

TRAUMA TO THE NECK (W BIFFL, SECTION EDITOR)

Penetrating Pharyngoesophageal Injuries

Andre Madsen[1] · Vimal Nair[2] · Emil Loots[3] · Victor Kong[1,2] · Damian Clarke[1,2]

© Springer Nature Switzerland AG 2019

Abstract

Purpose of Review Penetrating pharyngoesophageal injuries (PPEI) are relatively rare yet are associated with significant morbidity and even mortality. Even if diagnosed appropriately, their management is controversial. This monograph attempts to contextualize these injuries and provide evidence-based guidelines to assist with their recognition, diagnosis, and management.

Recent Findings The pharynx and esophagus may be divided into a number of regions: the pharynx, the cervical esophagus, the intrathoracic esophagus, and the intra-abdominal esophagus. Management approaches differ depending on the site of the injury. Clinical examination is important but unreliable and the clinical signs of a PPEI are nonspecific. Imaging is essential to exclude or confirm the presence of a PPEI. CT angiography can accurately assess the vasculature in the neck and can exclude a PPEI. If there is still a suspicion of a PPEI, then a contrast study or a flexible endoscopy will accurately delineate the injury. There is no need to combine these two modalities routinely. If an injury to the oro/hypopharynx is identified, then nonoperative treatment is safe and effective. Injuries to the cervical esophagus are traditionally managed operatively, but in a select subset of patients, nonoperative management may well be both safe and effective. Injuries to the intrathoracic and intra-abdominal esophagus are rare and are treated operatively.

Summary PPEI must be actively excluded by good clinical examination in conjunction with appropriate imaging. Injuries to the proximal part of the tract can be safely managed nonoperatively. More distal injuries traditionally are managed operatively but in a small subset of cases may be safely managed nonoperatively.

Keywords Penetrating injury · Penetrating pharyngoesophageal injury · PPEI · Penetrating neck injury · PNI

Introduction

Penetrating pharyngoesophageal injuries (PPEI) are relatively rare, and most high-volume trauma centers will manage only one or two cases of PPEI per year. A 24-month review of the National Trauma Data Bank (NTDB) identified 227 cases of PPEI across North America [1•]. The Scottish Trauma Audit Group calculated the annual incidence of esophageal trauma in Scotland to be in the order of 0.95 per million of population. Despite their rarity, these injuries are associated with significant morbidity and even mortality [1•, 2•, 3•, 4•]. They are also associated notoriously with delay in recognition and this increases the associated morbidity [3•, 4•]. Even if diagnosed appropriately, their management remains controversial. This monograph attempts to contextualize these injuries and provide evidence-based guidelines to assist with their recognition, diagnosis, and management. For the purposes of penetrating trauma, the pharynx and esophagus may be divided into a number of regions: the pharynx, the cervical esophagus, the intrathoracic esophagus, and the intra-abdominal esophagus. Management approaches differ depending on the site of the injury. It is

This article is part of the Topical Collection on *Trauma to the Neck*

✉ Damian Clarke
nirusha.maharaj@kznhealth.gov.za; http://www.kznhealth.gov.za

[1] Department of Surgery, University of KwaZulu Natal, Durban, South Africa

[2] Department of Surgery, University of the Witwatersrand, Johannesburg, South Africa

[3] Department of Surgery, Life Entabeni Hospital, Durban, South Africa

Published online: 27 February 2019

essential to understand the anatomical relationships of the esophagus to grasp the pathophysiology of esophageal injury, if one wishes to manage these injuries successfully.

Anatomy and Pathophysiology

The digestive tract commences behind the teeth. The oropharynx consists of the portion of the digestive tract between the soft palate and the hyoid bone, and the hypopharynx extends from the hyoid bone to the cricoid cartilage at C6, where the esophagus proper commences. The cervical esophagus lies in the deep structures of the neck and inclines to the left. It enters the thoracic cavity at the level of the sternal notch and descends in the superior mediastinum of the thorax, between the trachea and the vertebral bodies from T1 to T4 prior to returning to the midline at the level of T5 and ultimately curving to the left and anterior to the descending thoracic aorta, before piercing the muscular crus of the right diaphragm at the level of T10 and entering the abdomen. The abdominal esophagus has a short course of less than 1.5 cm and terminates in the cardia of the stomach at T11. The esophagus consists of an internal circular and external longitudinal layer of muscle. An injury to the proximal digestive tract is a serious problem as egress of saliva and food content may track down into the anterior mediastinum and precipitate mediastinitis.

Diagnosis

All patients who sustain a penetrating neck injury (PNI) must undergo a detailed clinical examination. Active exsanguination or an immediate threat to the airway requires urgent surgical intervention [3•, 4•]. If this is the situation, care must be taken intraoperatively, to assess the digestive tract and to repair any injury which is identified. In the absence of an indication for urgent exploration, all patients with a PNI will undergo a detailed clinical examination followed by advanced imaging. The assessment and imaging of vascular injuries are not the subject of this discussion and will not be dealt with further.

Clinical Findings

A detailed examination remains essential in identifying patients who require more advanced imaging. The following clinical signs are suggestive of PPEI: hematemesis, hemoptysis, egress of saliva from the wound, subcutaneous emphysema, dysphonia, hoarseness, and stridor as well as odynophagia [5•, 6, 7•, 8, 9]. In a review of 383 patients with a PNI at our institution, a total of 38 were ultimately diagnosed with digestive tract injury (PPEI) [7•]. Of these 38 patients with a confirmed PPEI, 29 (76%) had documented clinical findings suggestive of an aerodigestive tract injury. Two patients were unconscious and this invalidated any attempt at clinical assessment. The two most common clinical findings in this series were odynophagia and/or dysphagia and subcutaneous emphysema. However, even these clinical signs are nonspecific as demonstrated in two much earlier reports from our parent institution, King Edward VIII Hospital in Durban, over two decades ago. In the first of the two reports, 44 patients were identified with clinical or radiologic evidence of a PPEI following a PNI [8]. This suspicion was based on the presence of odynophagia and/or subcutaneous emphysema. Ultimately, only 29 of these patients who had odynophagia on swallowing water were investigated further by means of a water-soluble (WS) contrast swallow. Ultimately, a PPEI was identified in only four patients. This suggests that odynophagia is a nonspecific sign. In a follow-up study from the same institution, 220 patients with odynophagia secondary to PNI were investigated with a WS contrast study [9]. An injury was identified in only 28 patients. This implies that even if clinical signs are identified, a PPEI is present in about 10% of patients. However, if any of the abovementioned clinical signs are present, then imaging to exclude a PPEI is mandatory. Using a protocol of serial neck examination combined with X-ray and selective CTA when indicated should be adequate to exclude a significant PPEI. In our report, all patients who had a PPEI either had a positive clinical examination or had surgical emphysema on radiological imaging. Thorough clinical examination remains the mainstay of the assessment of selective nonoperative management (SNOM). If further imaging is decided upon, there are a number of modalities available to assess the digestive tract. Each has advantages and drawbacks and the clinical situation will determine which modality is most appropriate [7•].

CT Angiography

The most effective single investigation for a patient who has sustained a PNI is a CT angiogram (CTA) of the neck [7•, 10]. CTA is easy to perform and can assess the soft tissues, the vasculature, and the bony structures of the neck. It is very accurate at excluding a vascular injury. The CTA cannot directly exclude or confirm a PPEI, but it will confirm or exclude the presence or absence of deep surgical emphysema (DSE). DSE is a nonspecific finding but the absence of DSE almost certainly excludes the presence of a digestive tract injury. If the CT angiography demonstrates DSE, then a digestive tract injury must be excluded. Figure 1 is a schematic diagram illustrtating where deep surgical emphysema of the neck will be located. Figure 2b shows extensive DSE following stab wound of the neck. CTA can also identify the tract of the missile and

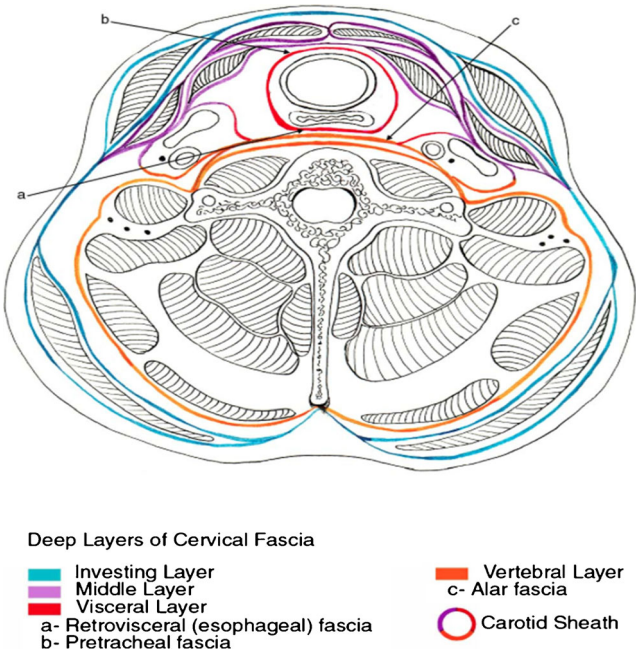


Fig. 1 Deep surgical emphysema. Surgical emphysema deep to the middle layer of the deep cervical fascia of the neck or in the mediastinum

this is also useful in determining if a PPEI is present. Figures 2 and 3 show how a CTA can delineate the tract of the missile. In our review of 383 patients with a PNI, a total of 38 were ultimately diagnosed with a PPEI, and all of these patients had DSE on CTA, except for one patient with a clinically insignificant oral cavity injury [7•]. However, a further 126 patients had deep surgical emphysema on CTA but no PPEI. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of DSE for the diagnosis of a PPEI were therefore 97.4, 63.5, 22.7, and 99.5%, respectively. The sensitivity and NPV were, however, 100% when clinically insignificant injuries were excluded. A contrast swallow can be performed during the CTA itself. This is referred to as a CT esophagram and a recent study from another South African institution has reported on this approach with good results [11•]. These authors prospectively administered oral contrast within 5 min of commencement of the CTA examination. They reported a sensitivity of 95.0% and specificity of 85.4–91.5%. As imaging technology continues to improve, CT-contrast esophagography may well become standard practice to exclude PPEI. In the absence of a formal contrast CTA esophagram, other modalities are needed to visualize the GI tract. These include contrast studies and flexible upper endoscopy.

Flexible Endoscopy

Flexible endoscopy is very accurate and will enable the pharynx and esophagus to be assessed with confidence.

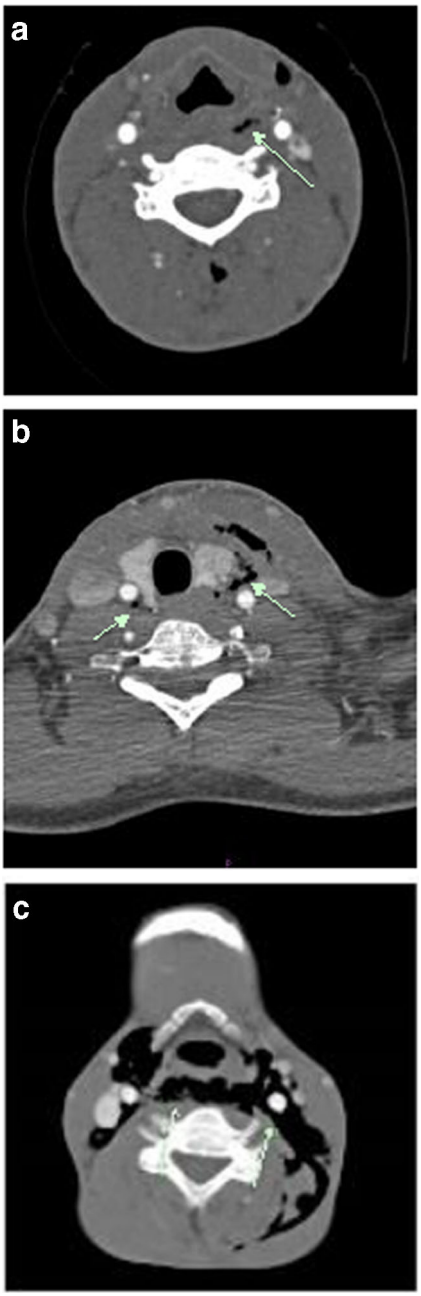


Fig. 2 **a** Zone II SW with pharyngeal injury: the green arrows point to the DSE. **b** Zone II stab wound with esophageal injury and extensive surgical emphysema. Green arrows illustrate extensive DSE

Often a contrast study has difficulty assessing the proximal part of the digestive tract [4•, 7•]. The sensitivity and specificity of flexible endoscopy is very high. The major drawback with flexible endoscopy is the availability of the modality after hours and the fact that it is an invasive procedure. If performed without due care, a flexible endoscopy may actually exacerbate the injury. We generally reserve flexible endoscopy for patients who are unable to swallow because they are obtunded or intubated.



Fig. 3 **a**–**c** Suggested bullet trajectory. You see the path of the bullet highlighted by the green arrow. The green line illustrates the suggested bullet trajectory as assessed on CTA

Contrast Study

The use of WS contrast, to delineate the upper digestive tract, is the most commonly employed technique to exclude or confirm a PPEI [4•, 7•]. Barium should be avoided as the initial modality as there is a risk of a barium-induced pneumonitis if there is a significant injury. Although combining upper endoscopy and WS-swallow will result in almost 100% accuracy, a negative WS-swallow generally suffices, to exclude a PPEI. Figure 4 demonstrates a series of WS contrast studies showing significant extravasation of contrast. These patients all underwent operative exploration and repair.

Management

The management of PPEI may well depend on the site and extent of the injury. In general, there are two approaches to the problem, namely exploration with operative repair or nonoperative management. Each approach has advantages and disadvantages and it is important to understand the principles behind each approach.

Injury to the Pharynx and Hypopharynx

The pharynx and hypopharynx may be injured by SWs or GSWs. All injuries to the oropharynx or hypopharynx may be associated with injuries to other vital structures in the neck. Some of these injuries may take priority over the PPEI and hence influence the management strategy. There is a general consensus that injuries to the pharynx and hypopharynx can, with a few codicils, safely be managed nonoperatively [4•, 7•, 12•]. It is believed that the low intraluminal pressures in the pharynx in conjunction with the overlapping middle and inferior pharyngeal constrictor muscles encourage speedy spontaneous closure of the defect in the pharyngeal mucosa. Operative management of these injuries is difficult as the pharyngeal mucosa lacks a muscular layer and is prone to break down. Treating the injury without an operation does not open up the tissue planes and this tends to occlude egress of saliva. If a collection does develop, it is usually contained by the soft tissue of the neck, and if it does not resolve, it can be drained through a local incision. Large destructive pharyngeal injuries should be treated operatively as they can leak into the mediastinum along the fascial planes of the neck.

Nonoperative Options with Pharyngeal Injuries

Nonoperative management of a pharyngeal injury involves administering broad spectrum antibiotics and passing a feeding tube distal to the injury to allow for enteral feeding beyond the site of the injury [4•, 7•, 12•]. This should be continued for 10 days at which stage the injury should again be imaged to confirm healing. It must be reiterated that SNOM is not applicable to destructive pharyngeal injuries with significant extravasation of contrast and these injuries should be repaired operatively.

Injuries to the Cervical Esophagus

The standard approach to an esophageal injury in the neck is urgent exploration followed by repair of the injury and wide drainage of the repair [13•, 14•]. A feeding tube is placed past the repair and the patient is fed distally to the injury for 10 days until healing is confirmed on a WS contrast study. Antibiotic therapy is continued during this period.

Operative Management of Cervical Esophageal Injuries

Operative management of a PPEI requires a formal left-sided neck exploration and exposure of the injured structure

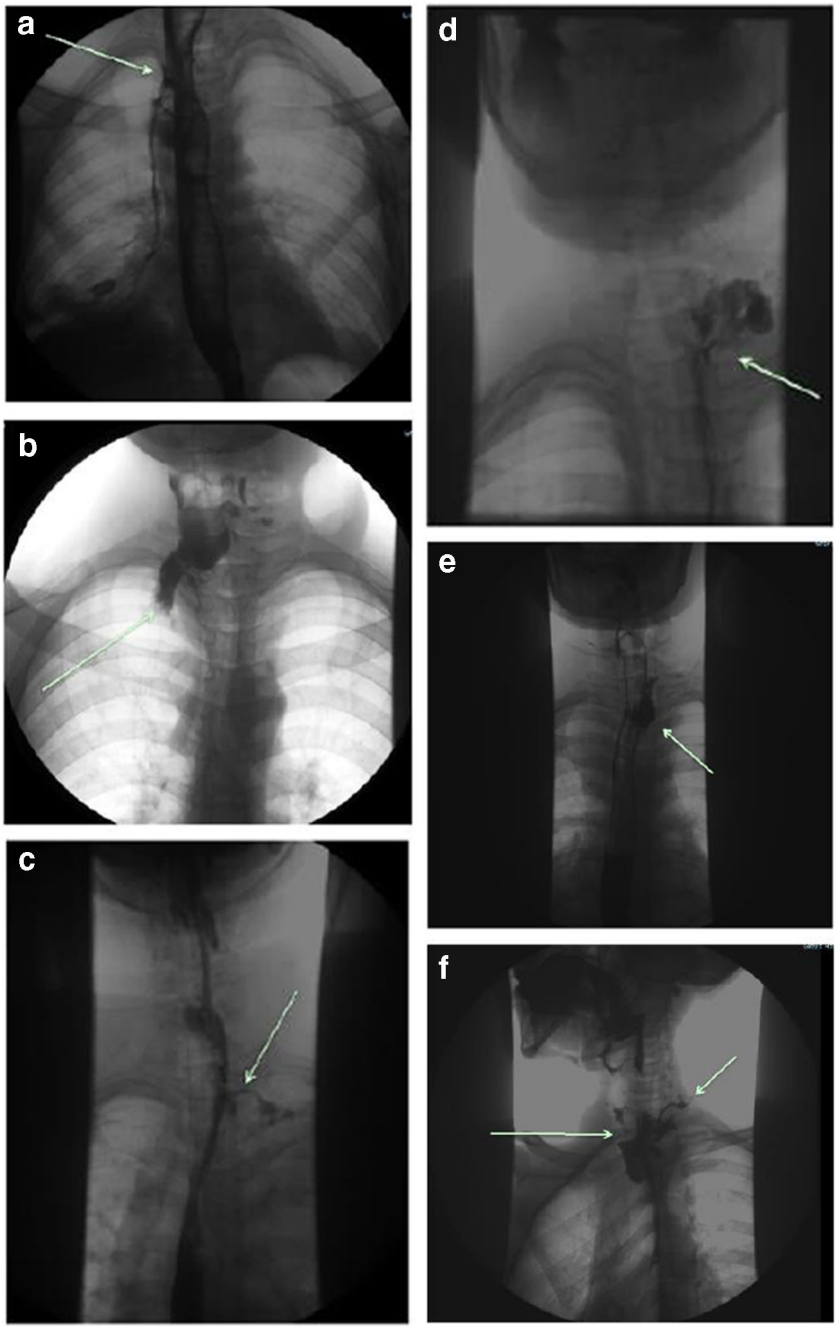


Fig. 4 **a**–**f** WS-swallow with large contrast leaks. The arrows point to the extravasation

followed by repair [4•, 13•, 14•]. A left-sided exploration along the anterior border of the sternocleidomastoid muscle provides access to the entire cervical esophagus and to the proximal thoracic esophagus. The patient is placed supine and the judicious placement of a sand bag between the scapulae allows the neck to be extended. This is safe in patients with penetrating trauma and no neurology, but caution must be exercised if there is a neurological deficit on clinical examination. The arms should be tucked down to the patient's side, to allow full access to the neck for the operating team. Rotating the neck to the right will enhance the surgical exposure. Once the sternocleidomastoid muscle is retracted laterally and the omohyoid muscle is divided, the carotid sheath and vessels can be gently retracted allowing the esophagus to be identified posteriorly on the investing fascia of the vertebrae. The use of flexible endoscopy and the administration of methylene blue during exploration are useful adjuncts to assist with identifying the injured esophagus.

Almost all cervical esophageal injuries should undergo primary repair. Often the mucosal wound may be larger than the defect in the muscle, and myotomy may help delineate the extent of the mucosal defect. The mucosal defect should be

repaired with an interrupted 4-0 absorbable monofilament suture, and the muscle layer closed with a continuous or interrupted 3-0 suture [4•]. Some authors advocate a single layer repair, but this has not been validated, and the relative rarity of these injuries means that very few centers will have large operative experience with these injuries [4•]. Repair of an esophageal injury is also difficult as the muscular layer is not as well developed as in the more distal parts of the gastrointestinal tract and there is no serosa; consequently, the strength of the repair is in the mucosa. In light of this, most authors advise that the repair be buttressed using the strap muscles of the neck.

The sternocleidomastoid muscle has a triple blood supply from the thyrocervical trunk, superior thyroid artery, and occipital artery. This allows for it to be detached from its bony attachments and swung into position as required to reinforce the repair. A feeding tube is inserted beyond the repair to allow for enteral feeding. All repairs to the cervical esophagus must be drained as the incidence of breakdown is not insignificant, and the drain will help create an external salivary fistula if esophageal breakdown does occur [4•, 13•, 14•]. Destructive injuries to the cervical esophagus are extremely rare. Adequate mobilization of the injured esophagus usually allows for a primary repair which maintains continuity of the injured structure. Attempts to exteriorize the injury and convert it into a temporary loop cervical esophagostomy have been described [4•]. Diverting the esophagus into an end stoma is extremely morbid and usually condemns the patient to a delayed reconstruction procedure, as simple delayed end-to-end repair is rarely feasible after this.

Nonoperative Management of a Cervical PPEI

There is a small body of evidence to suggest that in a select cohort of patients with a cervical esophageal injury, conservative treatment is safe and as efficacious as operative management. Both of these studies emanate from our parent institution and follow in the tradition of SNOM which has been the main surgical philosophy underpinning the management of trauma patients at our institutions for over half a century [8, 9]. SNOM in South Africa is an example of focused pragmatic empiricism and arose as a response to a chronically underresourced service managing an excessive burden of trauma. Ongoing and repeated surgical audit allows for review and refinement of SNOM approaches to penetrating trauma. These two studies suggested that patients with a contained extravasation on WS-swallow, defined in the first study as no gross leakage, and in the latter as extravasation of contrast contained or localized to the neck and not trickling to the mediastinum, can be managed by NOM. However, apart from these two studies, this approach has not been taken further by our parent institution or adopted by any other authors. In our center, we have attempted to refine the criteria for SNOM of cervical esophageal injuries. Provided the patient is hemodynamically stable and the leak can be described as confined, in the sense that it is a localized bleb of extravasation, which does not track along fascial planes, communicate with the skin or mediastinum, or breach the pleura, then we are prepared to embark on a trial of NOM. This entails broad

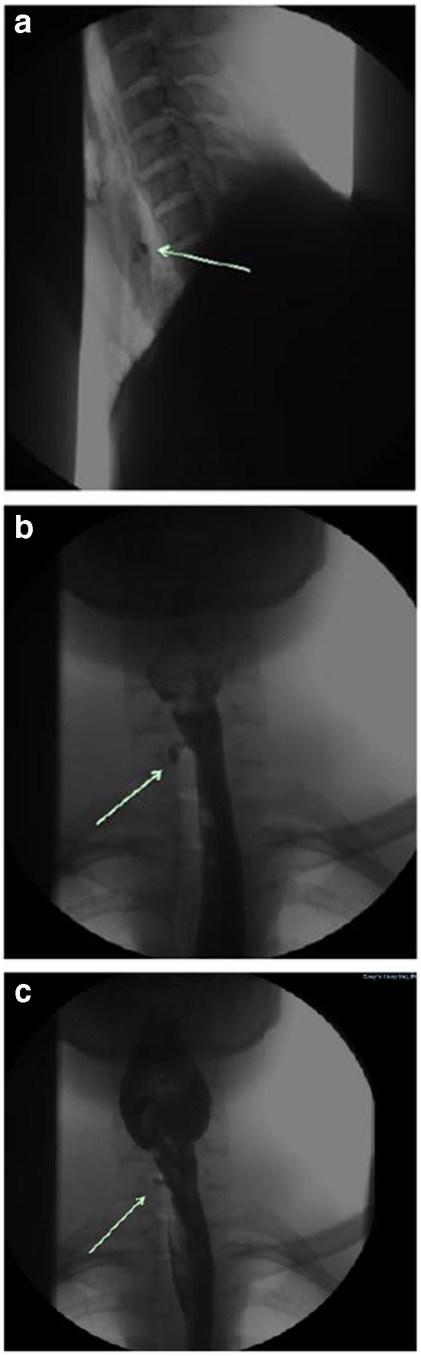


Fig. 5 Water-soluble contrast images with contained extravasation for conservative management. **a** Contained extravasation at C7. **b** Contained extravasation at C6. **c** Retained extravasation



Fig. 6 This patient sustained a transthoracic GSW of his right chest as shown in his CT scan. He had a destructive esophageal lesion and established mediastinitis. He underwent esophageal resection followed by a delayed reconstruction

spectrum intravenous antibiotics and distal enteral feeding of the patient via a nasogastrically placed feeding tube. Our results suggest that this may be a safe and feasible approach in this cohort of patients. Figure 5 shows examples of contained leaks on WS contrast study which were treated successfully nonoperatively in our center. If there is ongoing leak of gastrointestinal contents into the neck, this can usually be detected by regular clinical examination and addressed through a formal neck exploration which will allow for wide drainage of the PPEI. The patient will then continue with intravenous antibiotics and distal feeding.

Injuries to the Intrathoracic Esophagus

Penetrating injuries to the intrathoracic esophagus are rare, and very few centers will have significant experience with the management of these injuries. They are most commonly caused by a transthoracic GSW. Patients who present with hemodynamic instability following a transthoracic GSW should be expedited to the OR. Their management will need to be individualized according to the priorities of the injuries. A patient who reaches hospital alive and hemodynamically stable must be subjected to a thoracic CT scan. If there is evidence of an intrathoracic esophageal injury, then this can be confirmed by either a contrast study or a flexible upper endoscopy. If confirmed, the management of these injuries is operative. Provided other injuries have been excluded, the intrathoracic esophagus is approached through a right posterolateral thoracotomy. As in the neck, the use of intraoperative flexible endoscopy and/or ethylene blue may help identify the injury. Once the defect has been identified, the management is similar to that described above and consists of debridement of contaminated and necrotic tissue, followed by primary repair. As in the neck, most authorities advocate reinforcing the repair with autologous tissue such as the pleura, pericardium, intercostal muscle, diaphragm, or the stomach. Wide drainage is advocated by almost all authors. Postoperatively, these patients are not fed orally until healing can be confirmed, by a contrast study after 10 days. A distal feeding tube allows for ongoing enteral support during this period. If primary repair is not feasible but tissue loss is minimal, then attempts to create a controlled fistula by repairing the defect over a makeshift T tube placed into the lumen have been described. Once the T tube has been removed, spontaneous closure of the fistula can be expected. If there is extensive tissue loss, esophageal diversion may be appropriate. This will necessitate a cervical esophagostomy, as well as a decompressive

gastrostomy and a feeding jejunostomy. This is a morbid option and the patient will require complex postoperative care and a delayed reconstruction procedure. Figure 6 shows a series of images demonstrating a patient with an intrathoracic esophageal injury following a GSW to his chest. This was a destructive lesion with an already established mediastinitis. Attempting a delayed primary repair in this situation is generally futile and we proceeded to esophageal resection and an eventual esophageal replacement procedure.

Endoscopic Management of Penetrating Injuries of the Thoracic Esophagus

The widespread use of self-expanding luminal stents (SELS) in the upper gastrointestinal tract has resulted in a number of reports of the use of these devices in the management of a variety of intrathoracic esophageal perforations. These studies reflect a plethora of pathologies and by their very nature are anecdotal. The situation following iatrogenic esophageal perforation is not analogous to that of a PPEI. A PPEI disrupts the fascial planes around the esophagus and this creates a potential communication with the mediastinum. In addition, the use of SELS can cause a number of complications such as tears, perforations, bleeding, and stricturing. The placement of the stent does not obviate the need to debride the injury and to continue enteral support. There is currently no evidence to support their use for PPEI in the literature. We have had experience with one such case. The patient sustained a destructive intrathoracic esophageal injury secondary to a thoracic GSW. A covered self-expanding intraluminal stent was deployed in an attempt to exclude the injury. The stent migrated and exacerbated the injury. The patient ultimately required a formal exploration and esophagetcomy.

Conclusion

PPEI is relatively rare but is associated with significant morbidity. Clinical examination is important but unreliable and the clinical signs of a PPEI are nonspecific. This means that imaging is essential to exclude or confirm the presence of a PPEI. There are a number of modalities available. CTA is the most common initial investigation. It can accurately assess the vasculature in the neck and can exclude a PPEI if there is no DSE or if the tract is away from the digestive tract. If there is still a suspicion of a PPEI, then a contrast study or a flexible endoscopy will accurately delineate the injury. There is no need to combine these two modalities routinely. If an injury to the oro/hypopharynx is identified, then nonoperative treatment is safe and effective and probably has a lower morbidity than operative treatment. Injuries to the cervical esophagus are traditionally managed operatively, but in a select subset of patients, nonoperative management may well be both safe and effective. PPEI to the intrathoracic esophagus is very rare and is usually seen following a transthoracic GSW. All patients with a transthoracic GSW must undergo a CT scan of the chest in conjunction with a contrast study. If an intrathoracic esophageal injury is identified, then formal surgical exploration is mandatory. This may ultimately be very morbid. The use of SELS is experimental and may actually exacerbate the pathology.

Compliance with Ethical Standards

Conflict of Interest The authors declare no conflicts of interest relevant to this manuscript.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance

1.• Patel MS, Malinoski DJ, Zhou L, Neal ML, Hoyt DB. Penetrating oesophageal injury: a contemporary analysis of the National Trauma Data Bank. Injury. 2013;44:48–55.
2.• Skipworth RJ, McBride OM, Kerssens JJ, Paterson-Brown S. Esophagogastric trauma in Scotland. World J Surg. 2012;36:1779–84.
3.• Vassiliu P, Baker J, Henderson S, Alo K, Velmahos G, Demetriades D. Aerodigestive injuries of the neck. Am Surg. 2001;67(1):75–9 **Papers 1–3 are important demographic papers which contextualize the problem. Essentially these are rare injuries and very few centers will acquire significant experience with the management of PPEI**.
4.• Biffl WL, Moore EE, Feliciano DV, Albrecht RA, Croce M, Karmy-Jones R, et al. Western Trauma Association critical decisions in trauma: diagnosis and management of esophageal injuries. J Trauma Acute Care Surg. 2015;79(6):1089–95. https://doi.org/10.1097/TA.0000000000000772 **This is an important and well written consensus document on PPEI and must be considered the gold standard in our contemporary approach to the problem**.
5.• Roon A, Christensen N. Evaluation and treatment of penetrating cervical injuries. J Trauma. 1979;19:391e397 **This is a seminal historical paper on PPEI**.
6. Gouda SL, Miller FB, Bumpous JM. Neck crepitance: evaluation and management of suspected upper aerodigestive tract injury. Laryngoscope. 2002;112:791e795.
7.• Madsen AS, Oosthuizen G, Laing GL, Bruce JL, Clarke DL. The role of computed tomography angiography in the detection of aerodigestive tract injury following penetrating neck injury. J Surg Res. 2016;205(2):490–8 **This is a large study showing clearly that CT angiography is the single most**

useful and important investigation in patients who have sustained a penetrating neck injury.

8. Ngakane H, Muckart D, Luvuno F. Penetrating visceral injuries of the neck: results of a conservative management policy. Br J Surg. 1990;77(8):908–10.
9. Madiba TE, Muckart DJ. Penetrating injuries to the cervical esophagus: is routine exploration mandatory? Ann R Coll Surg Engl. 2003;85(3):162–6.
10. Inaba K, Munera F, McKenney M, et al. Prospective evaluation of screening multislice helical computed tomographic angiography in the initial evaluation of penetrating neck injuries. J Trauma Acute Care Surg. 2006;61:144e149.
11.• Conradie WJ, Gebremariam FA. Can computed tomography esophagography reliable reliably diagnose traumatic traumatic penetrating upper digestive tract injuries? Clin Imaging. 2015;39:1039e1045 **Another large series from South Africa which proposes the use of CT esophagography as an investigation for PPEI**.
12.• Madsen AS, Oosthuizen GV, Bruce JL, Bekker W, Laing GL, Clarke DL. Selective non-operative management of pharyngo-esophageal injuries secondary to penetrating neck trauma: a single-center review of 86 cases. J Trauma Acute Care Surg. 2018;85:541–8. https://doi.org/10.1097/TA.0000000000001973. **This paper is part of a tradition of applying SNOM to PPEI form our institution and follows on references 8 and 9 in trying to define which subset of patients may well be suitable for SNOM**.
13.• Asensio J, Chahwan S, Forno W, et al. Penetrating esophageal injuries: multicenter study of the American Association for the Surgery of Trauma. J Trauma. 2001;50:289e910, 6.
14.• Asensio J, Berne J, Demetriades D, et al. Penetrating esophageal injuries: time interval of safety for preoperative evaluation how long is safe? J Trauma. 1997;43(2):319e324 **(13, 14) These two studies are seminal and show how delay in diagnosis and treatment of a PPEI result in increased morbidity and even mortality. They represent the traditional approach to a PPEI which is early operation**.