



Esophageal perforation in children: etiology and management, with special reference to endoscopic esophageal perforation

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Perforation of the esophagus is an uncommon problem with significant morbidity and mortality. In children undergoing endoscopy, the risk of perforation is higher when interventional endoscopy is performed. The clinical features depend upon the site of esophageal perforation. Opinions vary regarding the optimal treatment protocol, and the role of conservative management in this context is not well established. Esophageal perforation that occurs as a consequence of endoscopy in children requires careful evaluation and management, as outlined in this article.

Key words: Esophageal perforation, Foreign bodies, Child, Esophagoscopy

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Introduction

Esophageal perforation in children presents considerable challenges in terms of diagnosis and management. The esophagus is located in a relatively inaccessible location, with close proximity to vital structures such as the great vessels and trachea. This unique context places it at a greater risk of delayed recognition/presentation and poses a greater threat to effective management whenever there is a perforation injury. In addition, certain anatomical factors, namely lack of a durable serosa and precarious blood supply, multiply the clinical risk by many-fold. Endoscopic instrumentation can contribute to perforation, especially in a therapeutic intervention as opposed to a diagnostic intervention, the increase in perforation risk to the tune of 200 times.¹⁾

Given the widespread use of endoscopy in children for diagnostic and therapeutic indications, the occurrence of perforation is possible, though the risk is miniscule. Fortunately, esophageal perforation following upper gastrointestinal endoscopy in children is a rare occurrence.²⁾ This review discusses the presentation, recognition, and strategies of management, especially the role of conservative management, of esophageal perforation in children following endoscopy.

Etiology

Causative factors for esophageal perforation in children include blunt injury to the chest/neck, nasogastric tube insertion, endotracheal intubation, caustic ingestion, foreign body ingestion, and endoscopy-related procedures. Among children with complications due to instrumentation, such as esophageal perforation, endoscopic manipulation is deemed to be the usual cause in the majority of cases.³⁾ Overall, iatrogenic factors such as endoscopic instrumentation seem to be the most common cause of esophageal perforation in children.⁴⁾

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Foreign body ingestion

Foreign body ingestion is one of the problems commonly encountered in the pediatric emergency services. In general, most ingested foreign bodies transit through the gastrointestinal tract (GIT) without sequelae and are excreted in the stools. Exceptionally, impaction of foreign bodies can lead to complications. Typically, impaction occurs at potentially anatomically narrow zones at the cricopharynx, midesophagus at the level of arch of the aorta, gastroesophageal junction, gastric outlet, and terminal ileum.⁵ In addition, in the context of associated background pathology such as tracheoesophageal fistula repair, diverticular excision, caustic strictures, eosinophilic esophagitis, etc., the likelihood of impaction in the GIT increases. Depending upon the type of foreign body ingested, including sharp objects (fish bone, open safety pin, etc.), a foreign body with large irregular surface, a corrosive extravasating button battery, and others such as double magnets and water absorbent gel, there is significant cause for concern as the risk of impaction and consequent complications is multiplied. Complications increase according to the duration (late presentation, delay in diagnosis), type of foreign body (sharp, button battery), place of impaction (lower third esophagus), and underlying esophageal pathology (diseased due to stricture).^{6,7} Duration of impaction of a foreign body is a significant factor influencing adverse outcomes such as perforation.⁸⁻¹⁰ The estimated incidence of esophageal perforation in the context of foreign body ingestion is approximately 2%–15%.¹¹

Coin impaction

Coins are the most common type of the ingested foreign bodies, accounting for as many as 70% of cases.^{12,13} Although a history of ingestion is available in a vast majority of cases (84%), this is unfortunately not the case when the presentation is impacted foreign body,¹⁴ adding to the uncertainty and posing diagnostic difficulties upon presentation to the emergency department. Overall, the risk of complications is higher when the foreign body is impacted (18%). Fortunately, complications of impacted foreign bodies are less common in children when compared to adults.¹⁵ In the case of coin impaction for more than 24 hours, the focal area of the esophagus may be subjected to pressure necrosis, ultimately leading to perforation.¹⁶

Although most foreign bodies are found proximal to the cricopharynx, in cases of impaction, the thoracic part of the esophagus has been noted as a common site.⁹ The impacted foreign body in the esophagus can erode into the surrounding structures, such as the pleura, mediastinum, and trachea. Depending upon the specific clinical features, there is considerable variation in the management strategies, ranging from conservative to urgent surgical intervention.¹⁷ Although endoscopy is therapeutic for coin

impaction, it can lead to adverse outcomes such as perforation. In the presence of a foreign body with esophageal perforation, the role of endoscopic removal is not clear. However, rigid rather than flexible esophagoscopy has been shown to have better success rate in the removal of the foreign body.¹⁸ As part of the initial management, esophagoscopy may be attempted, provided the duration is less than 24 hours and there is an absence of obvious complication such as a paraesophageal collection, on imaging studies.^{19,20}

Migration of a foreign body outside the esophagus into the parapharyngeal space is uncommon but has been described.²¹ Prolonged coin impaction in the esophagus has been associated with penetration and extraluminal migration, ultimately resulting in the so-called buried treasure syndrome, which is notably asymptomatic or ignored in the initial stage.¹⁰

High-risk procedures

In general, diagnostic endoscopy has a lower rate of complications compared to interventional endoscopy. Although safety records for endoscopic procedures have been well maintained, the drastic increase in the number of endoscopic examinations has led to an increase in the incidence of perforation. In cases of difficult esophageal intubation, even a simple diagnostic endoscopy is associated with a high risk of complications. In addition, the use of undue force during upper esophageal intubation and inappropriate neck extension have been identified as factors associated with iatrogenic esophageal perforation. With the advent of natural orifice transendoscopic surgery the risk of complications such as perforation remains high. Moreover, procedures such as variceal injection, dilatation of stricture/achalasia, removal of a foreign body, and advanced procedures like per-oral endoscopic myotomy, submucosal dissection, and mucosal resection are associated with varying degrees of complications.^{22,23}

Clinical presentation

Clinical presentation includes neck or chest pain, subcutaneous emphysema, and vomiting. Cervical dysphagia, dysphonia, hoarseness, and localized neck pain point to cervical esophageal perforation. Thoracic esophageal perforation is indicated by back pain, radiation of pain to the back, and/or chest pain. Features of peritonitis with abdominal pain are suggestive of abdominal esophageal perforation.²⁴ In the setting of mediastinitis and progressive sepsis, constitutional symptoms are heralded by the onset of tachycardia and fever with chills.²⁵ Fever is believed to be a late feature. It is possible for the presentation to be entirely asymptomatic, especially in the early stages.

Site of perforation

The thoracic part of the esophagus has been noted to be the common site of endoscopic perforation.²⁶⁾ In cases of cervical esophageal perforation, the clinical features may not be life-threatening in comparison to those of thoracic esophageal perforation, for which the mortality rate can be as high as 40%.²⁴⁾

Investigations

Although plain x-ray of the chest is the initial investigation in most cases, no abnormalities may be detected in up to 33% of cases. Computed tomography scan can reliably identify the site of esophageal perforation with the outlining of the extent of collection and collateral damage, provided the child is sufficiently stable to be shifted to the radiology suite.¹⁹⁾

Management

In the case of detection of perforation during endoscopic removal of a foreign body, repair is advised depending on the skill and experience of the endoscopist and the set-up. The size of the defect, edges of the defect, and the presence of bleeding are crucial factors that must be evaluated before attempting endoscopic closure. When the defect size is small, tissue sealants (fibrin glue, cyanoacrylate) and clip applicators are possible options. In particular, perforations smaller than 10 mm have been deemed suitable for endoscopic management according to the European Society of Gastrointestinal Endoscopy guidelines.²⁰⁾ Perforations smaller than 2 cm would qualify for the usage of through-the-scope or over-the-scope clips. In cases of everted edges, over-the-scope clips are preferred. When the size of the defect is between 30%–70% of the lumen, endoscopic stent placement is preferred. Fully or partially covered self-expandable metallic stents should be used in cases of perforation larger than 2 cm or perforation in the context of esophageal stenosis.²⁷⁾ Stenting has been unsuccessful for cases located in the cervical esophagus or gastroesophageal junction and when the defect size is greater than 6 cm, likely due to stent migration and ineffective tissue coverage. However, stent usage provides relief of leak, which facilitates mucosal healing, early initiation of oral feeds, and stricture prevention. Endoscopic suturing can also be employed when possible. Surgical repair should be planned when the defect size is larger.^{28–30)}

Surgical repair is advocated in the presence of tracheo-esophageal fistula, with excision and repair of the involved segment of the esophagus. In the event of esophageal perforation into the thoracic cavity with manifested signs of sepsis, thoracotomy and repair are advocated.³⁾ Ideally, intervention is not advised in the early stages

owing to tissue friability and the risk of anastomotic disruption. Given an adequate time interval of about 4–6 weeks after the acute episode, the onset of fibrosis and clearance of the infective process can occur, making it potentially safer to proceed with surgery.

A paradigm shift toward conservative management in children in cases of esophageal perforation is currently the norm as the perforation closure is considered to occur automatically, provided that there is no downstream obstruction, that contamination due to perforation is well addressed, and that nutritional status is preserved. However, the necessity of judicious shifts to surgical intervention in the face of a worsening clinical status should not be minimized.^{15,24,25)}

Use of nasogastric tube drainage has been advocated in the management of perforation, but this has led to increased mediastinal soiling in the presence of gastroesophageal reflux. In addition, it has been reported that no adverse outcomes were observed and there was satisfactory healing of the perforation with nondeployment of nasogastric tube drainage.^{16,19)}

Nutritional support during conservative management plays an important role in hastening the closure of perforation. Although parenteral nutrition may be required in some children, the majority may be well maintained with enteral feeds, either by nasojejunal tube or feeding jejunostomy. When possible, the use of a nasojejunal tube, introduced via endoscopy, is a viable feeding option that precludes additional surgical procedures. This also confers a beneficial effect in the form of a decrease in retrograde mediastinal contamination by the stomach contents.^{20,23)}

Prognostic factors

Several favorable prognostic factors have been identified in the management of esophageal perforation, irrespective of the type of management, whether operative or otherwise.^{1,8)}

- Early diagnosis and management within 24 hours of onset
- Iatrogenic cause
- Absence of comorbidities
- Absence of esophageal disease
- Hemodynamic stability
- Preserved nutritional status
- Cervical location is more favorable than thoracic
- Sharp injury is more favorable than blunt injury

However, of these, there are certain specific factors that favor nonoperative management, depending on the time of presentation, as follows.

(1) When the presentation/diagnosis is early (preferably within 24 hours of onset):

- Localized perforation
- Absence of mediastinitis
- No contamination by solid food
- Demonstration of free contrast flow into the distal GIT

(2) When the presentation is late:

- Well-contained contamination
- Minimal sepsis
- No other risk factors/morbidities
- Established enteral/parenteral feed

Nonoperative management is the recommendation after correctly identifying the clinical status of the case, and successful outcomes can be expected with the combination of antibiotics, nutritional support, and drainage of contamination or secretions.³¹⁾ Whenever there is evidence of uncontrolled sepsis or failure of conservative management, escalation to appropriate surgical intervention is mandatory.^{1,4)}

Limitations in pediatric endoscopy

The performance of pediatric endoscopy requires extra vigilance in view of the need for sedation/anesthesia. Generally, the practice is to use short-acting agents such as propofol, midazolam, etc. Some centers routinely conduct the procedures with a trained pediatric anesthetist. The availability of the appropriate scope size for the child and additional devices such as retrieval devices, hemostatic devices, etc., are other factors that must be considered in a center dedicated to pediatric endoscopy. Adherence to the established guidelines is essential for the prevention of adverse events such as perforation.³²⁾

Conclusion

In light of advancements in antimicrobial therapy and nutrition, the careful assessment of children with endoscopic esophageal perforation makes conservative management an effective and successful modality. Prompt recognition of esophageal perforation is essential to limit complications and expedite the most appropriate and earliest possible clinical management.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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