

## ОГЛЯДИ ЛІТЕРАТУРИ

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## Сучасні погляди на діагностику та варіанти лікування перфорації стравоходу

Д. Коко<sup>1</sup>, С. Леанза<sup>2</sup>, Р. Кампан`ячі<sup>2</sup>

<sup>1</sup>Відділення загальної хірургії Шпиталь Ріоніті Марше Норд, Пезаро (ПУ), Італія,

<sup>2</sup>Відділення загальної хірургії, Шпиталь Карло Урбані, Джесі, Італія

## Recent perspectives on insidious presentation and management options of esophageal perforation

D. Cocco<sup>1</sup>, S. Leanza<sup>2</sup>, R. Campagnacci<sup>2</sup>

<sup>1</sup>Department of General Surgery, Ospedali Riuniti Marche Nord, Pesaro (PU), Italy,

<sup>2</sup>Department of General Surgery, Carlo Urbani Hospital, Jesi, Italy

## Introduction

Perforation of the esophagus can be defined as a transmural disruption of its continuity, which results in leakage of intraluminal contents into the surrounding tissues. Most esophageal perforations are caused by diagnostic and therapeutic interventions, followed by spontaneous rupture, foreign body ingestion, trauma and malignancy [1–3]. Esophageal perforation represents a rare but potentially life-threatening condition with reported high mortality rates in published studies [3, 4]. A significant proportion of esophageal perforations are iatrogenic, while spontaneous perforations are less common [5].

Despite the fact that modern diagnostic methods have contributed significantly in many fields of modern clinical practice, diagnosis of esophageal perforations is challenging. It may present difficulties that will finally result in a significant delay of management, which in turn is associated with decreased survival rates even in high-volume centres [6].

The crucial point of esophageal perforation's management is the time from initiation of symptoms to hospital admission. It is generally reported that admission to the hospital before 24 hours of symptoms initiation is the predominant prognostic factor [7]. Besides, there is no consensus on optimal management as studies are underlying the supremacy of primary surgical repair while others indicate alternative conservative methods [8]. Furthermore, management is multidisciplinary and involves emergency physicians, trauma, general and thoracic surgeons, anesthesiologists, otorhinolaryngologists, gastroenterologists, and radiologists. Due to the rarity of these injuries, most clinicians will have limited personal experience with esophageal injuries treatment. Therapy of esophageal injuries is based on the location (neck, thorax, abdomen), the cause, and the extent of esophageal damage. A delay in providing appropriate treatment remains the dominant risk factor for mortality [9].

Moreover, diagnosis and management remain individualized as there is no consensus on the primary etiology or location of observed esophageal perforations. Finally, reported mortality rates range significantly between 4% and 80%, reflecting the significant discrepancy of studies in the diagnosis, management, and survival of such patients [7, 8, 10, 11]. Unfortunately, the rarity of this pathological condition and its nonspecific presentation can lead to delay in diagnosis in more than 50% of patients.<sup>12</sup> In these cases, the optimal therapy remains unclear. Hence, it becomes evident that esophageal perforation continues to present diagnostic and therapeutic challenges. Therefore, clinicians must be aware of its potentially insidious presentation and knowledgeable regarding the management options of this highly morbid condition.

With this scenario, this narrative review aimed to recapitulate the recent perspectives on insidious presentation, diagnosis, and deliberations on management options of esophageal perforations.

*Clinical Signs, Symptoms and Presentation:* The clinical presentation of esophageal perforation is nonspecific and can mimic that of other commoner disorders, such as pneumonia, angina, peptic ulcer disease and pancreatitis. Typical symptoms include pain in the neck, chest, back or epigastrium, as well as dysphagia, odynophagia, dysphonia and dyspnea [12–17]. Common clinical signs include subcutaneous emphysema, fever, tachypnoea, tachycardia and hypotension [12–21]. Any combination of the above signs and symptoms following instrumentation of the esophagus or surgery on neighbouring organs should raise the suspicion of esophageal perforation.

The symptomatology mostly depends on the time interval from the iatrogenic injury to the diagnosis, as well as the site of the perforation. Cervical esophageal perforation presents with neck pain and stiffness, dysphagia, dysphonia and bloody regurgitation. Due to the attachment of the esophagus

to the prevertebral fascia, the spread of oropharyngeal soilage is limited, resulting in less severe clinical manifestations compared to thoracic and abdominal perforations. Thoracic esophageal perforation causes contamination of the mediastinum, which may extend into the pleural cavities, thereby leading to pleuritic, retrosternal or interscapular pain, odynophagia, dyspnea and cough. However, this clinical presentation may be less pronounced in the presence of an intercostal chest drain that has been inserted in the pleural cavity as part of a thoracic surgical procedure. Finally, abdominal esophageal perforation contaminates the peritoneal cavity and manifests with abdominal pain, nausea and vomiting. Abdominal pain may radiate to the back if there is a collection in the lesser sac or referred to the shoulders due to diaphragmatic irritation [22]. The most common causes of esophageal perforation are listed in *Table 1*.

**Diagnosis of Esophageal Perforation: Blood parameters:** Routine blood tests, viz. CBC, serum concentrations of sodium, potassium, chlorine, magnesium, calcium, urea creatinine, liver tests (bilirubin, alanine aminotransferase, aspartate aminotransferase), pH and serum lactate should be performed in patients with suspected esophageal perforation. The initial clinical and biological presentation of esophageal perforations has no specific patterns; signs of inflammation and sep-

sis characterize late stages. To avoid delay in diagnosis (> 50% of cases) and allow timely management, a high degree of suspicion is required at presentation [1, 23, 24].

**Imaging methods:** Contrast-enhanced computed tomography (CT) and CT esophagography is the imaging examination of choice in patients with suspicion of esophageal perforation. CT is highly sensitive (92–100%) in detecting esophageal perforation and helps to assess extension to adjacent structures (collection of air or fluid in the mediastinum, pleural and intra-peritoneal effusions) and to guide initial therapy. CT can also eliminate other conditions that may mimic esophageal perforation, viz. aortic dissection, esophageal intramural hematoma, etc [25–28]. In selected cases, a contrast-enhanced esophagogram (gastrografen/barium) would provide useful information regarding the location and the contained character of esophageal perforation [28]. Indirect signs of esophageal injury can also be seen on a plain chest radiograph viz. pleural effusion, pneumomediastinum, subcutaneous emphysema, hydrothorax, pneumothorax, and the collapse of the lung [29].

Diagnostic endoscopy is useful in patients with suspected esophageal perforation and doubtful CT findings. Diagnostic endoscopy for esophageal perforation is reliable and safe in experienced hands; nevertheless, potential risks of enlarging the perforation size and aggravating the contamination of surrounding spaces warrant caution and limit its use first-line exam [30]. The most common diagnosis steps followed by physicians are summarized in *Table 2*.

**Management Options of Esophageal Perforation: Non-operative management:** Non-operative management of esophageal perforation can be considered in stable patients with an early presentation, contained esophageal disruption, and minimal contamination of surrounding spaces if highly specialized surveillance is available (Grade 1C). The criteria devel-

**Table 1. The most common causes of esophageal perforation**

*Esophageal endoscopy:	
Diagnostic flexible esophagoscopy	(0.03%)
Diagnostic rigid esophagoscopy	(0.11%)
Argon plasma coagulation of Barrett's esophagus	(2%)
Photodynamic therapy of esophageal cancer	(2%)
Stent placement for malignant dysphagia	(2%)
Dilation of simple rings or peptic strictures	(0.09–2.2%)
Endoscopic mucosal resection	(3%)
Endoscopic variceal sclerotherapy	(0.5–5%)
Endoscopic submucosal dissection	(6%)
Nd: YAG laser therapy of esophageal cancer	(7%)
Dilation of complex strictures with Maloney dilator	(2–10%)
Pneumatic dilation for achalasia	(0.4–14%)
Neck, thoracic and abdominal surgery:	
Thyroidectomy, cervical spine surgery (e.g., anterior osteosynthesis), resection of lung cancer, pneumonectomy, pulmonary transplantation, mediastinoscopy, resection of mediastinal tumours, thoracic aortic aneurysm repair, left atrial radiofrequency ablation, hiatal hernia repair, antireflux surgery, vagotomy.	
Transesophageal echocardiography	
Endotracheal intubation	
Mini tracheostomy	
Nasogastric tube insertion	
Sengstaken-Blakemore or Minnesota tube placement	
Bronchial artery embolization	
Radiotherapy	
*the risk of perforation for each esophageal endoscopic procedure is given in brackets.	

**Table 2. Diagnosis of esophageal perforation**

<b>History:</b> recent diagnostic or therapeutic intervention on the esophagus or adjacent organs
<b>Clinical signs and symptoms:</b> pain in the neck, chest, back or epigastrium, subcutaneous emphysema, fever, tachypnoea, tachycardia, hypotension, dysphagia, odynophagia, dysphonia, dyspnea, cough, nausea, vomiting
<b>Lateral neck radiograph:</b> subcutaneous emphysema, anterior displacement of the trachea, gas in the prevertebral fascial planes
<b>Chest radiograph:</b> subcutaneous emphysema, pneumomediastinum, mediastinal air-fluid level, mediastinal widening, pleural effusion, pneumothorax, hydropneumothorax, subdiaphragmatic air
<b>Contrast esophagography:</b> extraluminal contrast
<b>Contrast-enhanced chest computed tomography:</b> extraluminal contrast, mediastinal air, periesophageal fluid collection, pleural effusion, esophageal thickening, communication of the air-filled esophagus with a mediastinal air-fluid collection
<b>Flexible esophagoscopy:</b> visualization of esophageal defect
<b>Pleural fluid analysis:</b> elevated salivary amylase, pH <6, presence of undigested food or liquids

Table 3. Criteria for non-operative management of esophageal perforations

Delay in management	Early: less than 24 h
Clinical presentation	Absence of symptoms and signs of sepsis
Radiological criteria	Cervical or thoracic location of the esophageal Perforation Contained perforation by surrounding tissues Intramural Minimal peri-esophageal extravasation of contrast material with intra-esophageal drainage Absence of massive pleural contamination
Esophageal Characteristics	No pre-existent esophageal disease
Other	Possibility of close surveillance by an expert esophageal team Availability of round the clock surgical and radiological skills

oped by Altorjay et al., more than two decades ago are still the mainstay of non-operative management (Table 3) [31]. More recently, the Pittsburgh classification has been developed to include an esophageal perforation score based on ten clinical and radiological factors to help decision-making for patients with esophageal perforation [32]. The score has been validated in a multinational study, and it has been suggested that low score ( $\leq 2$ ) patients might be eligible for non-operative management [33].

Patients eligible for non-operative management should be kept on nil per os, administered broad-spectrum antibiotics (aerobic and anaerobic bacteria), and proton pump inhibitor therapy (Grade 1C). Early introduction of nutritional support by enteral feeding or total parenteral nutrition is essential for esophageal healing (Grade 1C). Endoscopic placement of a nasogastric tube is recommended (Grade 2A). Although anti-infective treatment is considered a cornerstone in the management of esophageal perforation, there is a lack of consensus regarding the optimal antibiotic regimen and the treatment duration. Recent literature reports revealed the need for high-quality evidence related to anti-infective treatment in patients diagnosed with esophageal perforation [34]. Additional measures should target sepsis control by using percutaneous radiology techniques to drain periesophageal and pleural collections [35]. Drainage of pleural collections and pleural decortication by video thoracoscopy and use of endoscopic techniques (clips, stents, and internal vacuum drainage) are part of an aggressive minimally invasive management of esophageal perforation. Using such a combined strategy, Vogel et al. were able to perform successful non-operative management in 68% of esophageal perforation patients with a low mortality rate (6%) [36].

**Surgical management:** General principles of surgical management of esophageal perforation include i. excellent exposure, ii. debridement of non-viable tissue, iii. closure of the defect, iv. use of buttress to reinforce esophageal sutures, and v. adequate tube drainage. The surgical approach should be tailored according to the location of esophageal perforation.

**Cervical esophageal perforation:** For esophageal perforation located in the neck, direct repair of the esophageal de-

fect should be attempted whenever feasible (Grade 1C). The esophagus is approached through a left neck incision along the anterior border of the sternocleidomastoid muscle or by a collar incision if bilateral cervical exploration is required [28, 37]. Surgical treatment includes circumferential esophageal mobilization to facilitate repair, debridement of the perforation site, single or double-layer tension-free closure of the perforation, buttressing of the repair with vascularized tissue (sternocleidomastoid muscle, digastric muscle), and adequate drainage [37]. Placement of a feeding tube (nasogastric, jejunostomy) at the time of repair allows early nutritional support and favours healing [1].

If direct repair is not feasible (disruption exceeds 50% of the esophageal circumference, delayed surgical exploration), external drainage is recommended (Grade 2A). Construction of a lateral or end esophageal stoma should be considered to decrease contamination of surrounding spaces.

**Thoracic esophageal perforation:** Primary repair is the treatment of choice for esophageal perforation with free perforation of the thoracic esophagus (Grade 1C). Management of perforation of the thoracic esophagus relies on the immediate interruption of mediastinal and pleural contamination, debridement of the perforation to healthy tissue, tension-free primary repair, and adequate external drainage [38].

These cases demand an individualized approach, and it is challenging to be prescriptive about the actual operative steps. Thoracotomy will usually be required, and the degree of pleural effusion or visible wall defect on CT may guide the incision side. A laparotomy or laparoscopy will usually be required in addition to enabling the construction of a feeding jejunostomy and possibly a decompressive tube gastrostomy. The alternative is a nasogastric tube or combination of tubes to allow decompression and feeding. In general, a diversionary cervical esophagostomy (for saliva) is not recommended. In some patients with suitable body habitus, a transhiatal approach via a midline laparotomy may be used. Excision of the xiphoid coupled with the use of a sternal hook retractor can allow repair of thoracic esophageal perforations without thoracotomy. The fundus will need to be mobilized and the esophagus encircled with tape to allow full mobilization and dissection high up into the mediastinum.

The mucosal defect is often longer than the muscular tear; longitudinal myotomy at both ends of the esophageal perforation is useful for exposing mucosal edges for appropriate repair [1]. Two-layer repair separate suturing of mucosa and muscle has traditionally been recommended. The risk of suture breakdown is generally quoted to be between 25 and 50%. Buttressing the esophageal repair with surrounding viable tissue (intercostal muscle flap, pleural or pericardic patch) has been recommended to decrease the risk of leakage. In cases approached transhiatally, a Nissen fundoplication can be an effective buttress of the repair. Drainage of the mediastinum and pleural cavity is required, and enteral nutrition remains an essential component of the treatment plan.

If direct repair of thoracic esophageal perforation is not feasible (hemodynamic instability, delayed surgical exploration, extensive esophageal damage), esophageal exclusion, diversion, or resection should be performed (Grade 1C). Repair over a large size T-tube can be used to create a controlled esophago-cutaneous fistula and minimize mediastinal and pleural contamination [39]. Complete esophageal diversion or thoracic esophageal resection is required in the presence of large esophageal disruption; the creation of a cervical esophagostomy and feeding jejunostomy is mandatory in these patients [39]. Moreover, resection is the best option in the presence of pre-existing esophageal pathology [1, 40]. If the patient survives, colon interposition or gastric pull-up reconstruction are required 6–12 months after complete diversion or resection of the thoracic esophagus.

*Abdominal esophageal perforation:* Operative repair is the treatment of choice for patients with free perforation of the abdominal esophagus (Grade 1C). Abdominal esophageal perforation should be approached by a midline laparotomy. Following debridement of necrotic tissues, single- or double-layer tension-free closure of the perforation should be performed. It is recommended to buttress the esophageal suture with a gastropasty using the gastric fundus (i.e., complete or partial fundoplication), position a nasogastric tube, construct a feeding jejunostomy, and perform external drainage of the subphrenic space [28].

## Conclusions

Esophageal perforation is a serious complication of various diagnostic and therapeutic interventions that can be challenging to diagnose and difficult to treat. The surgical approach of management should be tailored according to the location of esophageal perforation, while it was not possible to treat non-operatively. Complete esophageal diversion is required in the presence of large esophageal disruption. Moreover, resection is the best option in the presence of pre-existing esophageal pathology. Abdominal esophageal perforation should be approached by a midline laparotomy.

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