Review Article

Iatrogenic Esophageal Perforation

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Iatrogenic esophageal perforation is the most common cause of esophageal perforation associated with high mortality rate of 19%. Acute sudden onset of pain after endoscopic intervention is the most common presenting symptom. Water soluble contrast study, CT scan, and endoscopy provide a high sensitivity for diagnosis of iatrogenic perforation. Non-operative management is safe and effective treatment for early perforation (<24 hours) without clinical signs of sepsis. However, surgical management such as primary repair, esophageal exclusion and diversion, and esophagectomy is warranted in the patients who did not meet the criteria for non-operative management. Endoscopic management (clip, esophageal stent) is an alternative treatment option with 80 to 90% of esophageal healing rate. Early recognition of suspicious symptoms within 24 hours, the use of the appropriate investigation, selection of the optimal treatment options, and multidisciplinary critical care are the best way to improve outcomes.

Keywords: *Esophageal perforation, Esophageal injury, Iatrogenic perforation*

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Esophageal perforation is an emergency surgical condition related with high morbidity and mortality. Iatrogenic esophageal perforation accounts for 60% of esophageal perforation. The most common conditions associated with iatrogenic esophageal perforation include anatomical narrow portions (cricopharyngeus, aortic arch, left bronchial imprint, gastroesophageal junction) and pathological narrowing such as achalasia, benign stricture, and tumor. The appropriate treatment of iatrogenic esophageal perforation depends on time of presentation, site of injury, the extent of contamination, and the presence of underlying esophageal disorder[1,2].

Etiology

Endoscopic procedures are the most common cause of iatrogenic esophageal perforation. The perforation rate in rigid and flexible diagnosis esophagoscopy is 0.11% and 0.03% respectively. Therapeutic endoscopic procedures increase the risk of esophageal perforation. The esophageal perforation rate is 1 to 5% in dilatation for achalasia, 1 to 6% for variceal sclerotherapy, 5% of endoscopic laser therapy, and 5 to 25% in esophageal stent placement. Other causes of esophageal perforation include placement of nasogastric tube, endotracheal tube, and Sengstaken Blakemore tube[3-6].

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Clinical presentation

The patient symptoms depend on the site of esophageal peroration and time of presentation. Pain is the most common presenting symptom, which is usually sudden onset after esophageal instrumentation. Cervical perforation results in neck pain, dysphonia, hoarseness, cervical dysphagia, and subcutaneous emphysema. Thoracic esophageal perforation presents with chest or back pain, dysphagia, hematemesis, and nausea/vomiting. Abdominal pain and peritonitis are the predominant symptoms for intra-abdominal perforation. Signs of progressing infection (fever, tachycardia, mediastinitis, thoracic empyema, sepsis, or multiple organ failure) usually occur in the case with delayed presentation (more than 24 hours after perforation)[7,8].

Investigation

Conventional radiology

Chest radiography demonstrates abnormality in 90% of the esophageal perforation. The findings include pleural effusion, mediastinal air, pneumothorax, subdiaphragmatic free air, and subcutaneous emphysema. Lateral neck x-ray demonstrates air in prevertebral fascial plane in cervical esophageal perforation[9,10].

Contrast study

Water-soluble contrast agent such as Gastrograffin should be used as the first line investigation to identify esophageal perforation to avoid inflammatory reaction of barium contrast. However, the sensitivity of gastrograffin for diagnosis of esophageal perforation is only 60 to 70%. If the initial result is negative in the case with high clinical suspicion of esophageal perforation, diluted barium esophagography should be performed to demonstrate of leakage and site of perforation[11,12]. Fig. 1 illustrates a characteristic contained perforation after dilatation of esophagus.

Computed tomography scan (CT scan)

CT scan is useful when contrast esophagography cannot be performed or fail to localize the perforation site. Sensitivity of CT scan for diagnosis of esophageal perforation is 92 to 100%[13]. Abnormal findings include contrast extravasation, loculated fluid collection, esophageal thickening, air-filled esophagus with mediastinal or paramediatinal air and fluid collection. Moreover, in the patients who have deteriorated clinical status after initial management, CT scan is useful for localization of leakage, pleural fluid collection, and guidance of catheter drainage[14-16]. Fig. 2 illustrates a contrast leakage in case of esophageal dilatation after dilatation of anastomosis stricture.

Endoscopy

Endoscopy is a useful diagnostic procedure in the evaluation of penetrating injuries possibly involving the esophagus. However, it is not recommended in iatrogenic esophageal perforation because air insufflation during endoscopy can further dissect the perforation site, which can make conservative management likely to be unsuccessful[17,18].

Management

Early aggressive management within the first 24 hours after diagnosis of esophageal perforation is crucial for excellent outcomes. Mortality in patients with delayed diagnosis and management (>24 hours) is 40%, which is higher compared to 6.2% in patients who received optimal management within 24 hours[19]. The therapeutic strategies depend on age, general health status, interval between perforation and management, location and severity of perforation, degree of contamination, damage of surrounding tissue, and underlying esophageal pathology. The goals of management are to get rid of infection (drainage of

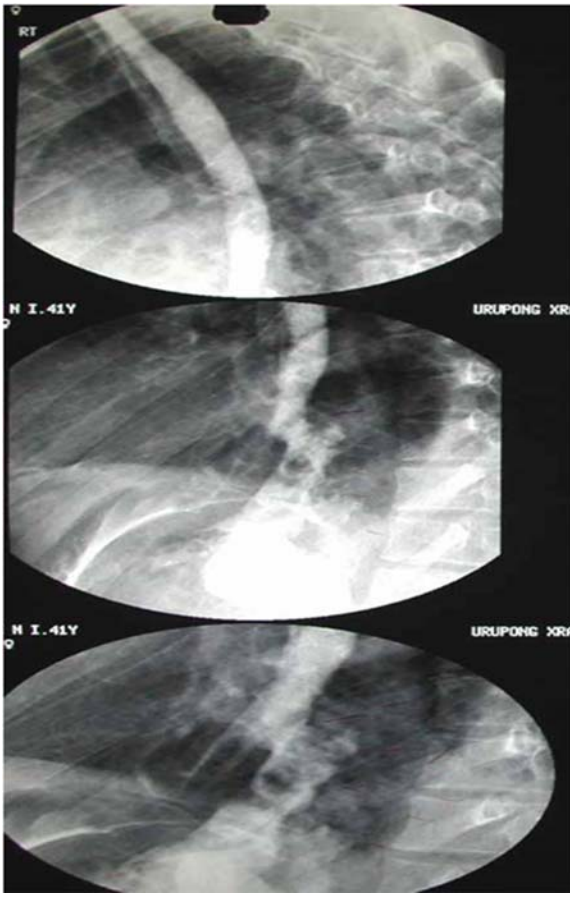

Fig. 1 Water soluble contrast study demonstrated a contained perforation after esophageal dilatation.

Fig. 2 CT scan in the patient with iatrogenic perforation after dilatation of anastomosis stricture.

collection, debridement of necrotic tissue), provide nutrition support, and restore digestive tract continuity[2,20].

Non-operative management

Majority of patients with iatrogenic esophageal perforation are suitable for non-operative management (e.g. perforation after dilatation of benign stricture). The criteria for non-operative management were described by Altorjay in 1997 as illustrated in Table 1[21]. Non-operative management includes nothing by mouth for minimum seven days, oxygen supplement, cardiopulmonary monitoring in critical care setting, total parenteral nutrition, board spectrum antibiotic for seven to 14 days, proton pump inhibitor and nasogastric tube placement to prevent reflux, and clear gastric content for prevention of further contamination. Present of pneumo-thorax and pleural effusion on chest x-ray mandates intercostal chest drainage[22]. Radiologic contrast studies or CT scan should be performed on day 7 or repeated weekly until the leakage is sealed, and then enteral nutrition can be initiated. If clinical deterioration occurs, percutaneous drainage under CT guidance or a decision for operative management should be considered[15,23-25].

Surgical management

Small and well-contained cervical esophageal perforation usually can be managed only drainage via left cervical incision[26]. Right thoracotomy incision is suitable for perforation of upper and mid-thoracic esophagus and left thoracotomy is optimal incision for lower esophageal perforation. Pleural debridement and decortication should be performed if necessary to allow lung expansion and prevent empyema.

Primary repair is an appropriate option for patients who present within 24 hours after perforation. Primary repair include esophagomyotomy proximal and distal to the perforation site, debridement of necrotic tissue and separately repair of mucosa and muscular layer with fine absorbable 4-0 sutures. Reinforcement of the repair should be considered if the repair is performed in a contaminated filed to reduce the risk of post-operative leakage. Intercostal muscle and pedicle pleural flap are preferable in mid-thoracic esophagus perforation while the omental flap and stomach are preferable in lower third thoracic esophageal perforation. The successful rate of reinforced primary repair is 89% with low mortality rate (14%)[27,28]. However, primary repair is not suitable option in the presence of distal obstruction or cancer. Post-operative leakage is increased in delayed repair of thoracic esophageal perforation (40% vs. 86% for repair within 24 hours and greater than 24 hours after perforation, respectively). In addition, concomitant myotomy at opposite site should be applied after esophageal repair in the case of achalasia and the anti-reflux procedure should be performed in the cases of severe reflux esophagitis. Drainage gastrostomy should be performed routinely for prevention of gastric reflux and feeding jejunostomy should be performed to promote early enteral feeding[29,30].

In the severe cases of esophageal perforation with significant devitalized tissue, esophageal exclusion and diversion is recommended. The operative approach includes: 1) exclusion of esophagus by ligation or stapling of the cardia to prevention of gastroesophageal reflux, 2) proximal diversion of oral secretion via cervical esophagostyomy, and 3) thoracotomy for debridement and drainage of mediastinal and pleural contamination. Tube gastrostomy and feeding jejunostomy are important to allow distal drainage and nutrition support. Reconstruction of esophageal continuity should be performed several months later after recovery from mediastinal sepsis by gastric tube or colonic interposition[31]. T-tube drainage with repair of esophageal perforation is not recommended because of suboptimal control of pleural contamination and increase in morbidity (47%) and length of hospital stay[2,32].

Urgent transhiatal esophagectomy should be considered in iatrogenic esophageal perforation because of less contamination and tissue necrosis. Factors associated with the need for esophagectomy include distal esophageal stricture, malignancy, perforation size greater than 5 cm and lesions that are difficult to repair (i.e. corrosive ingestion or achalasia with mega-esophagus). Immediate reconstruction should be considered if the patients are not critically ill[33,34].

Endoscopic management

The goal of endoscopic management is to occlude of the leakage by endoscopic clipping or esophageal stent. Endoscopic treatment could be combined with a multi-modalities minimally invasive treatment (such as CT-guide percutaneous drainage) for control of the sepsis.

Endoscopic clipping for closing of esophageal perforation should be performed by experts in endoscopy. This procedure is suitable for iatrogenic

esophageal perforation after endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD), early perforation (less than 24 hours), small size of the defect (less than 1 cm), none or minimal passage of esophageal content into mediastinum, lack of co-morbidity, and absence of clinical instability[35].

Esophageal stent is used to cover the perforation to prevent contamination and promote sealing of esophageal perforation. The fully covered self-expandable stent (such as Wallflex®, Polyflex®) should be used for this situation. The indications for stent placement in esophageal perforation include 1) thoracic esophageal perforation, 2) perforation in benign disease, 3) perforation size smaller than 3 cm, and 4) palliation in malignant perforation. The contra-indications for stent placement include perforation within 2 cm of cricopharyngeus muscle or in achalasia with dilated esophagus (greater than 3 cm). Abdominal esophageal perforation is a relative contraindication because of the risk of stent migration. Water-soluble contrast study should be obtained at 72 hours after stent placement and clear liquid diet can be started if leakage of the contrast is not demonstrated[36,37]. The successful leak occlusion rates by stent placement are between 83 and 94% and the migration rates are 10 to 18%. Stent removal should be performed four weeks after insertion to avoid stent impaction and hemorrhage[38,39].

Ben-David et al. report a management of esophageal perforation using esophageal stent combined with minimally invasive surgery such as thoracoscopic/laparoscopic drainage, laparoscopic repair with gastric wrap and feeding jejunostomy in 76 consecutive patients. The mean and median length of esophageal perforation healing was 28 and 36 days, respectively. Stent migration rate was 34.2% and the results demonstrated 100% of esophageal salvage rate[40]. The algorithm for therapeutic strategies in patients with iatrogenic esophageal perforation was illustrated in Fig. 3.

Table 1. The criteria for non-operative management in iatrogenic esophageal perforation

Criteria for non-operative management in iatrogenic esophageal perforation
- Early diagnosis within 24 hours
- Absence of clinical sepsis
- Cervical or thoracic esophageal perforation
- Contained perforation (Limited extravasations of the contrast into esophageal lumen)
- Absence of extravasations into pleura
- Non-tumoral perforation
- Absence of distal esophageal obstruction

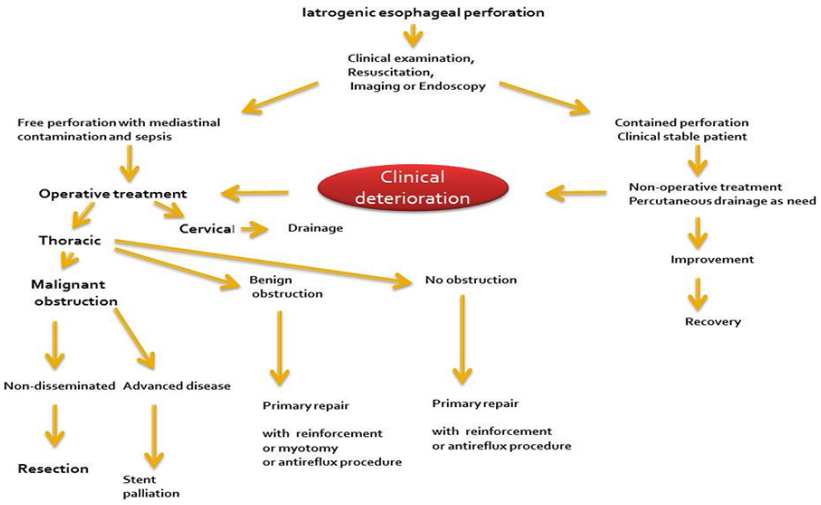

Fig. 3 The algorithm for therapeutic strategies in patients with iatrogenic esophageal perforation.

Conclusion

Iatrogenic esophageal perforation is still considered as a potential life-threatening condition despite the advance in radiology, endoscopic and surgical technique. Early diagnosis, using the appropriate investigation, selection of the optimum treatment options, and optimal critical care are the best way to improve outcomes.

What is already known on this topic ?

Iatrogenic esophageal perforation associated with high a mortality rate of 19%. Factors associated with mortality include time of presentation, site of injury, the extent of contamination, and the presence of underlying esophageal disorder.

What this study adds ?

Early aggressive management within the first 24 hours after diagnosis of esophageal perforation is crucial for patient's survival.

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Potential conflicts of interest

None.

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ภาวะหลอดอาหารทะลุด้วยสาเหตุจากหัตถการทางการแพทย์

ธวัชชัย ตุลวรรธนะ

ในปัจจุบันภาวะหลอดอาหารทะลุด้วยสาเหตุจากหัตถการทางการแพทย์เป็นสาเหตุของการทะลุของหลอดอาหารที่พบได้บ่อยที่สุด และมีอัตราการเสียชีวิตของผู้ป่วยสูงถึง 19% ผู้ป่วยส่วนใหญ่ มักมีอาการปวดแบบเฉียบพลันภายหลังการทำหัตถการส่องกล้องทางเดินอาหาร ซึ่งการตรวจสืบค้นโดยการใช้การตรวจวินิจฉัยทางรังสีวิทยาเช่น การกลืนสารทึบแสงหรือการเอกซ์เรย์คอมพิวเตอร์ และการส่องกล้องทางเดินอาหารมีความแม่นยำในการวินิจฉัย ภาวะหลอดอาหารทะลุด้วยสาเหตุจากหัตถการ ทางการแพทย์ได้สูง การรักษาโดยวิธีการไม่ผ่าตัดมีความปลอดภัยและได้ผลดีในผู้ป่วยที่ได้รับการวินิจฉัยภายใน 24 ชั่วโมง และไม่มีอาการแสดงของภาวะติดเชื้อในกระแสเลือด อย่างไรก็ตามในผู้ป่วยที่มีอาการไม่เข้ากับข้อบ่งชี้ของการรักษาแบบวิธีการไม่ผ่าตัด ควรทำการรักษาโดยวิธีการผ่าตัดเช่น primary repair, esophageal exclusion and diversion, esophagectomy นอกจากนี้ยังมีทางเลือกในการรักษาภาวะหลอดอาหารทะลุด้วยวิธีการส่องกล้องโดยการใช้ clip หรือ esophageal stent โดยพบว่ามีผลการรักษาที่ดีสามารถปิดรูทะลุของหลอดอาหารได้ถึง 80-90% โดยหลักสำคัญที่จะช่วยลดอัตราการเกิดภาวะทุพพลภาพ และอัตราการเสียชีวิตของผู้ป่วยกลุ่มนี้คือ ผู้ป่วยควรได้รับการวินิจฉัยและทำการรักษาอย่างเหมาะสมอย่างทันท่วงทีภายใน 24 ชั่วโมง หลังมีการทะลุของหลอดอาหารเกิดขึ้นและควรมีการเฝ้าระวังติดตามอาการของผู้ป่วยอย่างใกล้ชิด