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Single Case

Three Cases of Boerhaave's Syndrome Treated via Laparoscopic Transhiatal Esophageal Repair

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Keywords
Esophageal perforation · Boerhaave's syndrome · Minimally invasive surgery · Laparoscopic surgery

Abstract
Spontaneous esophageal perforation in Boerhaave's syndrome results in significant morbidity and mortality. The gold standard treatment for this disease is thoracotomy and laparotomy because it can be a life-saving procedure that can be performed in emergencies; however, minimally invasive surgery has recently been reported. This report describes three cases of Boerhaave's syndrome that were treated using laparoscopic transhiatal suture and omental patch. One patient recovered uneventfully and was discharged from the hospital after 12 days. The other 2 patients had postoperative complications, such as minor leakage and remnant abscess (Clavien-Dindo Grade II), but were discharged from the hospital after 17 days and 30 days, respectively. In the case of Boerhaave's syndrome with localized mediastinal collections, a good clinical course can be obtained by laparoscopic transhiatal esophageal repair to avoid surgical invasion due to thoracotomy.

Introduction

Boerhaave's syndrome is a spontaneous esophageal perforation that was first reported by Herman Boerhaave in 1724 [1]. It is a life-threatening disease with significant morbidity and mortality because mediastinitis leads to sepsis and multiple organ failure [2]. Surgical

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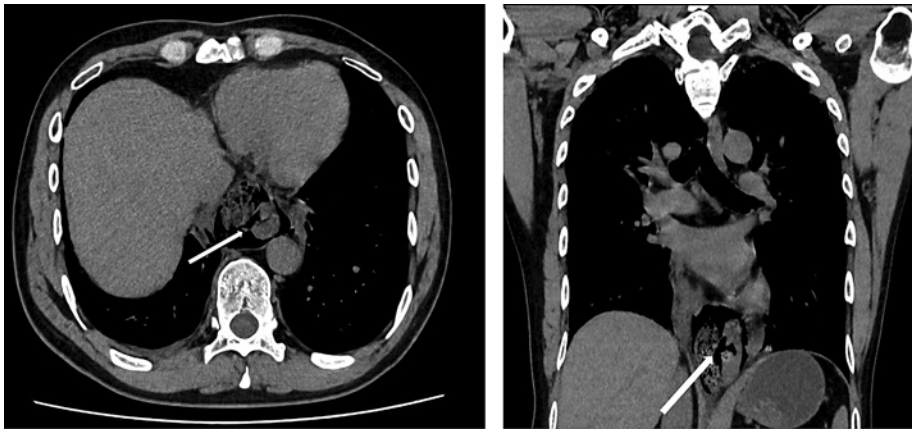

Fig. 1. CT scan showing pneumomediastinum and perforation site of lower thoracic esophageal right wall (arrow).

therapy is generally classified into transthoracic or transhiatal approaches, and the gold standard is esophageal repair and drainage of the mediastinum and pleural cavity by thoracotomy and laparotomy. However, these approaches are associated with a significantly high degree of physical stress and poor wound healing. Previous studies have shown that minimally invasive surgery for esophageal cancer appears to be associated with improvement of postoperative complications and overall morbidity compared to thoracotomy or laparotomy [3]. Recently, it has been reported that these techniques can be applied to cases of Boerhaave's syndrome with stable vital signs. For patients with a perforation site in the lower esophagus and localized in the mediastinum, laparoscopic surgery via the transhiatal approach is an effective alternative therapy that reduces lung-related postoperative complications. Herein, we describe three cases of Boerhaave's syndrome that were treated by laparoscopic transhiatal closure at our institution and summarize the presentations of previously reported cases.

Case Presentation

Case 1

A 46-year-old man with no notable medical history visited our emergency center with chief complaints of acute back pain and breathing difficulty after a heavy cough. His body mass index (BMI) was 21.55. His vital signs were stable (blood pressure, 127/73; pulse, 98 bpm). Contrast computed tomography (CT) revealed pneumomediastinum and food residue around the esophagus above the diaphragm. A rupture of the esophageal wall was found on the right wall of the lower esophagus (Fig. 1). Blood examination revealed a white blood cell count of 16,500/mL and C-reactive protein of 0.24 mg/dL. The time from symptom onset to diagnosis was 4 h.

Case 2

A 48-year-old man with a history of alcoholic hepatitis visited our emergency center with a chief complaint of acute epigastric pain after vomiting. His BMI was 18.37. His vital signs were stable (blood pressure, 160/93; pulse, 103 bpm). CT revealed pneumomediastinum and fluid collection in the lower mediastinum with a small amount of pleural effusion. Blood examination revealed a white blood cell count of 7,400/mL and C-reactive protein of 0.33 mg/dL. The time from symptom onset to diagnosis was 6 h.

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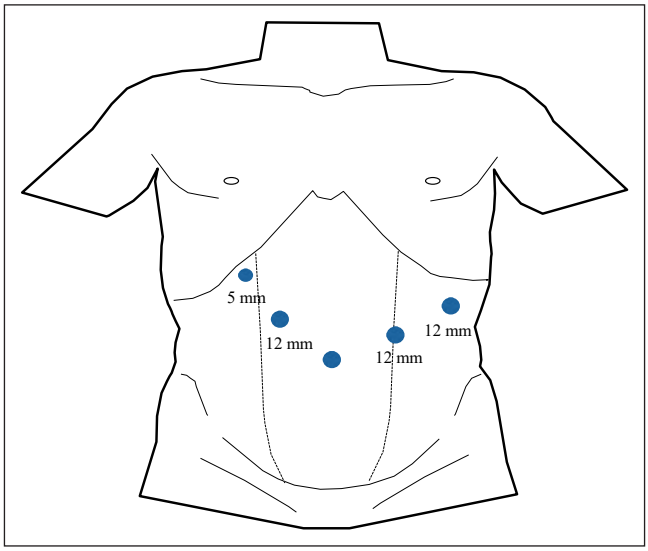

Fig. 2. Port placement for laparoscopic surgery.

Case 3

A 65-year-old man with no notable medical history visited our emergency center with chief complaints of acute chest pain and hematemesis after vomiting. His BMI was 17.47. His vital signs were stable (blood pressure, 124/65; pulse, 112 bpm). CT revealed a pneumomediastinum. Blood examination revealed a white blood cell count of 5,600/mL and C-reactive protein of 0.18 mg/dL. The time from symptom onset to diagnosis was 6 h.

Surgical Treatment

Three patients were diagnosed with Boerhaave's syndrome of the mediastinal localized type. Laparoscopic esophageal repair and mediastinal debridement via a transhiatal approach were performed in all cases because the area of perforation was localized to the mediastinum and the vital signs were stable. In all cases, endoscopy under general anesthesia was performed prior to laparoscopy to identify the perforation site. The ports were inserted using the 5-hole approach, and artificial pneumoperitoneum was created using carbon dioxide at a pressure of 10 mm Hg (Fig. 2). The surgical field was expanded by abducting the lateral area of the liver. We found blood clots in the lesser omentum in patients 1 and 3, but no contaminated ascites were found in either of the cases. Dissemination, such as fundoplication, was performed, in which the lesser omentum, gastrophrenic ligament, and peritoneum overlie the esophagus. We exposed the lower thoracic esophagus by placing a vessel tape around the esophagus and pulling it downward. The hiatus was split anteriorly from the diaphragm to improve the exposure of the lower thoracic esophagus. After contaminated fluid collection and food residue around the perforation sites were debrided, the mucosal perforation site was ensured with intraoperative endoscopy of the upper gastrointestinal tract (Fig. 3). Muscular layers were incised to clearly visualize the perforation site from the outside of the esophagus. The perforations were situated at the right wall of the lower thoracic esophagus just above the gastroesophageal junction in patients 1 and 3 and the left wall of the lower thoracic esophagus in patient 2. The length of the perforation sites in patients 1, 2, and 3 were 40 mm, 30 mm, and 50 mm, respectively. We sutured the mucosa and muscular layers of the esophagus by one-layer repair using running sutures with absorbable 3-0 V-Loc® and covered the perforation site with an omental patch for reinforcement (Fig. 4). A drain was placed in the lower mediastinum through the hiatus. Patient 1 recovered uneventfully. Except for the small remnant abscess in the mediastinum found in patient 2 and minor leakage found in patient 3,

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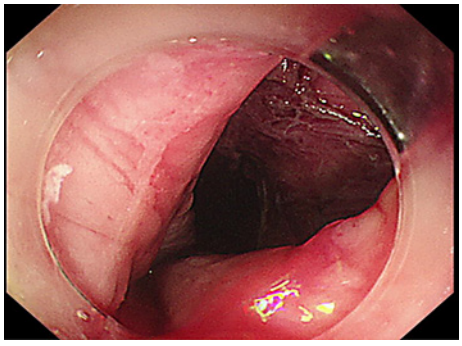

Fig. 3. Intraoperative endoscopy showing a gap between mucosal perforation and muscular perforation (arrow).

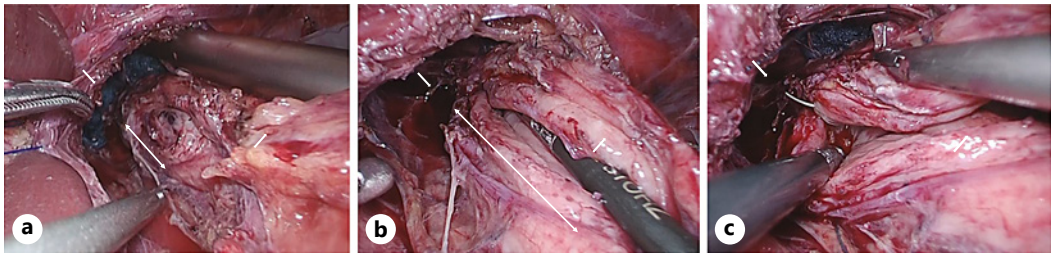

Fig. 4. Intraoperative picture. **a** Perforation site in all layers (arrow), (**b**) the mucosal perforation site after incised mucosal layer (arrow), and (**c**) the perforation site sutured repaired by running suture.

which were treated with drainage and antibiotics, all patients had no other complications (Clavien-Dindo ≥ Grade III). Patients 1, 2, and 3 were discharged from the hospital on postoperative days 12, 17, and 30, respectively.

Discussion

Spontaneous esophageal perforation, also known as Boerhaave's syndrome, is a rare disease. The leakage of contents in the esophagus and stomach into the mediastinum and pleural cavity may result in a necrotizing inflammatory process, which leads to sepsis and multi-organ failure [4]. This disease is divided into two types: (1) the esophageal perforation leads to localized mediastinitis and (2) the esophageal perforation leads to contamination of the pleural cavity due to the rupture of the overlying pleura. In cases where esophageal perforation has penetrated into the pleural cavity, an emergent thoracotomy is recommended because they often have vital signs and require intrathoracic drainage. However, in cases where the perforation site is localized in the mediastinum, minimally invasive surgery may be an alternative treatment because it does not have empyema and vital signs are relatively stable. We suggest that laparoscopic esophageal repair via the transhiatal approach may be a good option for patients with a perforation localized in the mediastinum and stable vital signs.

Studies on laparoscopic transhiatal approaches are limited. Landen and El Nakadi [5] presented a pilot study of 3 cases of Boerhaave's syndrome repaired using a laparoscopic surgery technique in 2002. Two patients followed a good postoperative course, but 1 patient subsequently succumbed to multi-organ failure. Since then, Kimberley et al. [6], Yeo et al. [7], Hayakawa et al. [8], and Aiolfi et al. [9] have reported a total of 5 cases of Boerhaave's syndrome repaired by only laparoscopic surgery via the transhiatal route. There were no reports of

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Table 1. Reported cases of Boerhaave's syndrome treated by only laparoscopic surgery

Author	Patients, *n*	Age, years	Size, mm	Operative method	Postoperative complications	Mortality, *n*
Landen El Nakadi [5]	3	48–74	30	Primary repair Primary repair + posterior fundoplication Posterior fundoplication	None Sepsis, empyema Leakage	1
Kimberley et al. [6]	1	35	–	Primary repair	Abscess	0
Yeo et al. [7]	2	35–70	–	Primary repair	Abscess Pleural effusion	0
Hayakawa et al. [8]	1	70	20	Primary repair	None	0
Aiolfi et al. [9]	1	49	14	Primary repair	None	0
Our cases	3	46–65	30–50	Primary repair + omental patch	None Leakage Abscess	0

mortality, and good postoperative results were obtained, except for the early case of Landen and El Nakadi [5] (Table 1) [6–9]. When performing the laparoscopic esophageal repair via the transhiatal route, avoiding penetrating the pleura is vital as it is important not to spread the inflammation in the thoracic cavity. Laparoscopic transhiatal esophageal repair is less invasive than thoracotomy for Boerhaave's syndrome. Lung-related complications are thought to be suppressed by the transabdominal approach without thoracotomy, and these complications were not observed in our cases.

Recently, the efficacy of endoscopic and conservative treatments has been reported. However, some reports of conservative treatment, including stenting, showed more fatal outcomes than surgical treatment [10]. Increased mortality has also been reported in the absence of appropriate interventions within 24 h of onset [11]. Surgical treatment is considered necessary for more reliable treatment, including lavage drainage in the mediastinum and for not missing a suitable time for surgery. Treatment using laparoscopic surgery, including lower mediastinal procedures for esophagogastric junction cancer, has increased. This surgical technique can also be applied to surgery for Boerhaave's syndrome.

To decide on operative procedures via a transthoracic or transhiatal approach, we performed endoscopy under general anesthesia before surgery to identify the perforation site. If the perforation site is the lower thoracic esophagus, it can be repaired via transhiatal, and if it is other than that, thoracotomy or thoracoscopic surgery should be considered because it is considered difficult to reach the perforation site and repair using a transhiatal approach. Intraoperative endoscopy is also necessary to identify the accurate perforation site during suturing because mucosal defects are often more extensive than muscular layer defects. In all our cases, mucosal fissures were found beyond the perforation site of the muscular layer, so more accurate suturing was possible using intraoperative endoscopy.

We encountered three cases of Boerhaave's syndrome that could be treated without major postoperative complications by minimally invasive surgery approaching the mediastinum laparoscopically. However, further studies with larger sample sizes are necessary to investigate the efficacy of this technique. In selected patients with Boerhaave's syndrome

without signs of sepsis and with localized mediastinal collections, laparoscopic transhiatal esophageal repair may be a good alternative for thoracotomy and laparotomy.

Statement of Ethics

This study was reviewed and approved by the Ethics Committee of the Kobe City Medical Center General Hospital on 22 January 2022, approval number zn220306. Written informed consent was obtained from all patients for publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Ryosuke Kita, corresponding author, wrote the manuscript, and reviewed the literature. Hiroyuki Kobayashi, Kai Nakao, Kentaro Iwaki, Masato Kondo, and Satoshi Kaihara edited the manuscript and approved the final version of the manuscript.

Data Availability Statement

All data that support the findings of this study are included in this article.

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