Successful Endoscopic Vacuum-Assisted Closure Therapy for Esophageal Perforation: A Case Report

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Esophageal perforation can lead to serious complications, and rapid diagnosis and treatment significantly affect the prognosis. Endoscopic vacuum-assisted closure (EndoVAC) therapy is widely accepted as a safe, well-tolerated, effective, versatile and practical procedure for the management of esophageal perforation in selected patients. We report the successful use of EndoVAC therapy for management of an esophageal perforation secondary to foreign body removal. A 56-year-old man presented to the emergency department for evaluation of chest pain after swallowing the plastic shell of a pill. Emergency endoscopy revealed an esophageal wall laceration (approximately 3 cm) and microperforation. The esophageal laceration and microperforation were limited to the mid-esophagus. The patient underwent EndoVAC therapy, which was repeated every 3–4 days for a total of six sessions over a period of 21 days. We observed improvement in the esophageal injury with granulation tissue formation during the fifth session. Subsequent follow-up evaluation, including esophagography and chest computed tomography confirmed complete healing of the esophageal injury. Following resumption of diet, the patient was discharged without any complications.

Keywords: Endoscopic vacuum-assisted closure therapy; Esophageal perforation; Foreign body.

INTRODUCTION

Esophageal perforation is a serious and potentially life-threatening medical emergency. Prompt management is crucial as the morbidity and mortality rates rise with delays in diagnosis and the initiation of appropriate therapy.1 In a recent systematic review conducted in 2017, which assessed a pooled analysis of 39 studies, an overall mortality rate of 13.3%
was reported. This mortality rate varies depending on the location of perforation, with the lowest rate (5.9%) observed for cervical, an intermediate rate (10.9%) for thoracic, and the highest rate (13.2%) for abdominal. Most cases of esophageal perforation result from accidental damage caused during medical procedures like endoscopy or surgery. Non-iatrogenic esophageal perforations primarily result from spontaneous or effortful rupture, representing the second most common cause of such perforations. Other rare causes of non-iatrogenic perforations include trauma and malignancy. According to one systematic review that assessed 1933 patients with esophageal perforations, 46.5% were iatrogenic, 37.8% were postemetic, 6.3% were caused by foreign bodies, and 1.8% resulted from corrosive ingestion.

Since its initial description in 2008, endoscopic vacuum-assisted closure therapy (EndoVAC) has emerged as a promising alternative in the management of esophageal wall defects. The technique, which draws on the principles and experience of topical negative pressure in the management of superficial wounds, involves the transoral endoscopic placement of a polyurethane sponge connected to an external continuous negative pressure device via a nasogastric tube (NGT) to promote defect healing, facilitate cavity drainage, and ameliorate sepsis.

In this article, we report on the successful use of EndoVAC therapy as a technique for the treatment of esophageal perforation caused by foreign body removal.

**CASE REPORT**

A 56-year-old male patient, with no significant medical history other than diabetes, presented to the emergency room after accidentally swallowing the plastic shell of a pill along with the medication. He complained of severe anterior chest pain and a foreign body sensation with each swallow. At the time of visit, the lab test findings were within normal range with no inflammation. Emergent endoscopy was performed, the plastic pill shell with air-filled capsule was observed in the mid-esophagus. It was carefully removed using a mesh net and alligator, but unfortunately, the sharp shell scraped the esophageal wall on all four sides, raising the suspicion of laceration and microperforation (Fig. 1A).

Since the location of the esophageal laceration and microperforation was limited to the mid esophagus, treatment was started using EndoVAC therapy, which is less invasive than surgical treatment. The defect site was identified through an endoscope at upper incision 25 to 28 cm. The defect measured approximately 3 cm, with a 2 mm tunnel observed at the lowest point, suggestive of a perforation site (Fig. 1B). Endoscopic irrigation was then performed.

Subsequently, a NGT was inserted into the esophagus. A NGT (Levin, 16F) was inserted into the nasal orifice, and its tip was extracted through the mouth. The tip of the NGT was cut with scissors (Fig. 2A). The polyurethane sponge was designed to cover the esophageal defect, with a length 4 cm longer and a diameter 1.5 to 2 cm wider than the defect size, ensuring adequate coverage. The hole was made by scissor on the tailored sponge (Fig. 2B). The cut end of the NGT was inserted into the sponge hole, then it was sutured to the sponge at three points by nylon 3-0 (Fig. 2C). The sponge was inserted into the esophagus using an endoscope. The EndoVAC system was introduced through the luminal defect, and negative pressure was applied at 100 mmHg before withdrawing the scope. An L-tube was positioned at 43 cm (Fig. 2D).

A laboratory test conducted on the day of admission revealed a systemic inflammatory response, characterized by leukocytosis and elevated C-reactive protein (CPR) levels. The white blood cell (WBC) count increased to 15170, and the CPR level rose to 15. Follow-up chest computed tomography (CT) scans...
confirmed mediastinal air densities and soft tissue thickening, confirming acute mediastinitis (Fig. 3). Broad-spectrum antibiotics such as piperacillin/tazobactam and metronidazole, capable of covering both aerobic and anaerobic bacteria, were administered.

On the second day of hospitalization, a follow-up endoscopy was conducted. The EndoVAC was observed covering the area of the mucosal tear. The extent of the tear remained similar, but there was an improvement in depth, while the tunnel remained unchanged. We replaced the EndoVAC (Fig. 4A). On the 6th day of hospitalization, the chest pain had slightly subsided, CRP levels decreased from 15 to 1, and WBC count returned to normal. Another follow-up endoscopy was performed, revealing that the tunnel of the lesion was still present (Fig. 4B). The EndoVAC pressure was increased from 100 to 125 mmHg because the tissue recovery was slower than anticipated.

On the 8th day of hospitalization, the third follow-up endoscopy was conducted, revealing further improvement in depth, although the tunnel was still observed (Fig. 4C). CRP levels were normalized. Between the 13th and 15th days of hospitalization, two additional follow-up endoscopies were performed. The extent of the lesion slightly decreased, and there was improvement in depth. The tunnel was not promi-
Gently observed for the first time (Fig. 4D).

On the 21st day of hospitalization, the sixth follow-up endoscopy was performed. The mucosal tear site exhibited signs of healing, with granulation tissue present, and the tunnel was no longer visible (Fig. 4E). Since the tunnel was no longer present, the EndoVAC was removed. Esophagography showed satisfactory passage of contrast medium without any signs of leakage (Fig. 5A). Furthermore, on the chest CT scan, the extent of mediastinal air density and mid-esophageal wall thickening decreased, indicating improvement in mediastinitis and resolution of esophagitis. The perforation was deemed completely healed (Fig. 5B).
For 3 weeks, intravenous antibiotics of piperacillin/tazobactam and metronidazole were administered. Despite improvement in clinical symptoms and CRP level, spiking fever in the 39-degree Celsius range occurred. Since drug fever could not be ruled out, antibiotics were changed to ciprofloxacin and metronidazole. Following the antibiotic change, the fever improved, so ciprofloxacin and metronidazole were discontinued after 1 week.

On the 27th day of hospitalization, the patient initiated a diet, and on the 31st day of hospitalization, approximately one month after admission, the patient was discharged without any complications following the diet. About three weeks after discharge, the patient attended a follow-up appointment at the outpatient department. An endoscopy was performed, revealing complete healing of the mucosal tear in the esophagus, with no signs of erosions or perforations (Fig. 4F). The patient reported maintaining a good diet, normal bowel movements, and the absence of abdominal pain. Therefore, no additional medication was prescribed, and the patient continued with follow-up appointments at the outpatient department.

**DISCUSSION**

Endoscopic treatment of esophageal foreign bodies is a safe and effective method, and the treatment success rate is known to be over 95%. Complications arising from ingestion may include ulcers (21%), lacerations (15%), erosions (12%), perforations (2%), or migration. The likelihood of complications has been linked to the type and size of the object ingested, the time to presentation, and host factors such as age. In case of sharp foreign bodies, such as a fish bone or a plastic pill shell like in this case, there is a high possibility of causing esophageal perforation. Complications accompanying perforation were mediastinitis and mediastinal abscess, and surgical treatment is required if there is no improvement with conservative treatment. Non-operative management of acute esophageal perforation consists of intravenous fluid resuscitation, systemic antibiotics, and withholding all food and drink by mouth. Approximately 25% of esophageal perforations can be treated non-operatively, particularly if the patient lacks signs of systemic infection and imaging confirms either pneumomediastinum without extravasation or a contained perforation. During conservative treatment, watchful observation and repeated CT scans are necessary. If patient’s condition deteriorate or abscess or mediastinitis progress, surgical intervention or percutaneous drainage are warranted. In this case, conservative treatment could have been attempted, but EndoVAC therapy was selected because frank perforation was observed on endoscopy and there were signs of systemic infection.

Over the past two decades, advancements in endoscopic technologies have made it possible to salvage the native esophagus in cases of perforation. Endoscopic clipping with both through-the-scope (TTS) and over-the-scope clips has been successfully used for treatment of esophageal perforations. Closure of iatrogenic esophageal perforations and fistulas with endoscopic clipping has reported success rates ranging from 59% to 83%. For small perforations under 1 cm in size, TTS clips are the preferred approach. However, in this patient’s case, the defect was about 3 cm, and the surrounding tissue was very friable, so it was considered difficult to apply clips. Esophageal stenting is common endoscopic approach for the treatment of esophageal perforations given its proven efficacy and safety, even in the setting of mediastinal contamination. Stents typically are left in place for 2–4 weeks to allow for healing of the perforation. Multiple studies have documented the success of stenting in the management of esophageal perforation, with some reporting an esophageal salvage rate of over 80%. However, complications including migration and stent obstruction are not uncommon and re-intervention is necessary in 20% to 30%.

EndoVAC therapy is a newer strategy being advocated for the management of acute esophageal perforation. It entails the use of a sponge connected via a tailored NGT and placed endoscopically through the mucosal defect into the perforation cavity. The EndoVAC promotes formation of granulation tissue, leading to obliteration of the cavity over time, though it often requires frequent changes. In a recent meta-analysis including 423 patients across 18 studies, EndoVAC was associated with successful closure of esophageal defects in 89.4% of cases, with an average treatment duration of 20 days. The most common adverse events reported were stenosis, bleeding, sponge dislocation, and visceral injury, which occurred in 13.6% of patients.

EndoVAC demonstrates effectiveness not only in facilitating the closure of esophageal wall defects but also in swiftly controlling sepsis by efficiently draining the associated infected wound cavities. In this case, CRP was normalized and WBC count returned to normal on 6th day of admission. The timing of EndoVAC therapy holds significance, with prompt treatment widely recognized as a key factor influencing its therapeutic outcome. In a case series focusing on acute iatrogenic endoscopic perforations, Loske et al. reported a 100% success rate, which is remarkable, partly due to the prompt diagnosis of perforation and initiation of treatment within 24 hours in every case.

EndoVAC’s effectiveness has also been directly assessed against the utilization of self expandable metal stent, a commonly employed alternative approach for managing esophageal perforations.
gall wall defects. A systematic review reported that EndoVAC demonstrated superiority to stent across multiple domains, including a higher closure rate (84% vs. 53%), a lower mortality rate (15% vs. 25%), and a shorter treatment duration (median 23 days vs. 33 days).\textsuperscript{2,3} However, these results have not been replicated in all studies. Therefore, the treatment method should be selected considering the patient’s condition and the location and size of the lesion.

In conclusion, we reported a case in which EndoVAC therapy was applied to treat esophageal perforation caused by foreign body removal. Esophageal perforation is a disease that can lead to serious complications, and rapid diagnosis and treatment have a significant impact on prognosis. EndoVAC therapy has been extensively demonstrated to be a safe, well-tolerated, effective, versatile, and practicable procedure in the management of selected patients with esophageal perforation.

**Authors' Contribution**

Conceptualization: Yong Won Seong, Kwang Woo Kim. Data curation: Jung Huh, Bokyung Kim, Hyeon Jong Moon. Project administration: Hyoun Woo Kang. Supervision: Ji Won Kim, Kook Lae Lee, Su Hwan Kim. Writing—original draft: Jung Huh, Jinsun Yang, Seung Joo Kang. Writing—review & editing: Kwang Woo Kim, Yong Won Seong. Approval of final manuscript: all authors.

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**Ethics Statement**

This case report was written after obtaining consent from the patient to transfer their clinical information for academic purposes, with the intention of contributing to the advancement of medicine, including diagnoses and treatments of other patients.

**REFERENCES**