

Research Article

Endoscopic Vacuum Therapy to Seal Recalcitrant Esophageal Leak After Esophageal Surgery in Children

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Abstract

Postoperative esophageal leak is a serious adverse event that occurs in up to 20% following esophageal surgery. Increasingly, endoscopy is utilized to manage leaks refractory to surgical washout and drainage including endoscopic vacuum-assisted closure (EVAC) using negative pressure therapy to achieve source control and granulation. In this report, successful use of this endoscopic strategy to seal a persistent leak after esophageal diverticulectomy is described. A two-year-old male born with esophageal atresia and

tracheoesophageal fistula underwent primary anastomosis on the first day of life. Two years later, he presented symptomatic from a diverticulum at the anastomosis and underwent diverticulectomy complicated by esophageal leak at the diverticulectomy site. Despite multiple surgical interventions to seal the leak and obtain source control, the esophageal leak persisted. A multidisciplinary team of surgeons, gastroenterologists, and radiologists determined in consensus with the family of the patient

to proceed with EVAC beginning with intracavitary placement of a dressing sponge secured on a nasoesophageal tube. After six endoscopic sessions, the esophageal leak was determined to be closed on endoscopic and fluoroscopic imaging. The patient was ultimately discharged home nine days after removal of the endoscopic vacuum. The leak site remained closed on fluoroscopic esophagram studies performed 6 months later. Negative pressure therapy successfully closed a refractory esophageal leak in a child resulting from diverticulectomy. Future investigations should employ larger series to compare the efficacy, tolerance, and duration of therapy needed to close leaks from EVAC versus stenting.

Keywords: Esophageal leak; Endoscopy; Endoscopic vacuum

1. Introduction

Postoperative leak is a serious adverse event associated with esophageal surgery, occurring in up to 20% of patients [1]. Esophageal leak management practices vary among institutions due to surgeon and endoscopist experiences. The optimal strategy has shifted from predominantly surgical to favoring endoscopic intervention first [2]. For refractory esophageal leaks, a new strategy has emerged using endoscopic vacuum-assisted closure (AC). This involves placing a surgical sponge on suction locally at the site of leak in an endocavitary or endoluminal position to aid in source control and to promote faster wound healing [3]. In this report, this novel endoscopic strategy resulted in successful resolution of a recalcitrant leak despite multiple surgical interventions in a child with tracheoesophageal fistula (TEF) and esophageal atresia (EA).

2. Materials and Methods

2.1 Patient History

The patient was born with VACTERL disorder including tetralogy of Fallot, ventricular septal defect, tracheomalacia, imperforate anus, and EA/TEF. He underwent an uneventful EA/TEF repair on day one of life. By 2 years old, he developed a proximal esophageal diverticulum at the repair site that resulted in choking and regurgitation. The patient then underwent right thoracotomy with diverticulectomy which was closed primarily in two layers. One week later, an esophageal leak was detected with an adjacent 2.8 cm gas and fluid collection directly communicating with the site of diverticulectomy. This prompted two redo right thoracotomies for chest washout and one attempt at esophageal repair with a bovine pericardial patch. The leak persisted thus the options of endoscopic stenting, EVAC, and diverting cervical esophagostomy were considered. A multidisciplinary team of surgeons and gastroenterologists determined in consensus with the family to proceed with EVAC.

2.2 Placement of the Endoscopic Vacuum-Assisted Closure Device

In the supine position, a neonatal Olympus XP190 gastroscope was advanced into the esophagus, where a diverticulum measuring 5.8 mm with suture material was visualized draining through two small fistula tracts into the right chest (**Figure 1**). Fluoroscopic views highlighted an irregular extraluminal tract extending toward the right lower lung base with pooling of contrast material. Based on these findings, suction tubing was advanced through the nares to the posterior pharynx and withdrawn from the mouth. The free end of this suction tubing was attached to a VAC GranuFoam dressing sponge (KCI USA, San Antonio, TX). The sponge size was matched to the size of the

diverticulum cavity on fluoroscopic views and secured to the tubing with a silk suture. The sponge was advanced back through the mouth and down into the esophagus. A video laryngoscope and the Olympus pediatric gastroscope facilitated visualization. The pediatric gastroscope was introduced into the esophagus and rat tooth forceps were used to

maneuver the foam sponge into the fistula cavity (Figure 2). Contrast was injected to confirm placement of the EVAC system. The suction tubing was connected to the vacuum unit (3M, KCI USA) to 125 mmHg negative pressure, and fluoroscopy visualized contrast evacuation from the diverticulectomy site.



Figure 1: Endoscopic view of the esophageal diverticulum measuring larger than 5.8 mm containing two perforation sites. Day 0 – prior to placement of negative pressure therapy at initiation.



Figure 2: Endoscopic view of negative pressure sponge measuring 2.0 cm x 3.5 cm seated within the esophageal diverticulum. Day 0 – after placement of negative pressure therapy.

2.3 Serial Management of Endoscopic Vacuum-Assisted Closure Device

In subsequent procedures, the sponge was replaced with progressively smaller pieces as the fistula tracts granulated and diminished in size. Overall, five sponge exchange procedures were performed. With each exchange, the pediatric gastroscope visualized EVAC sponge removal. Contrast was introduced into the lumen to measure the size of the defect (**Figure 3**) and a new sponge was cut to fit the shrinking defect. Initially, exchanges were done within 3-5 days of each

other, and then spaced out to 6-7 days as the healing process improved. Complete closure was achieved by 25 days following the initial procedure. Nine days after removal of the EVAC apparatus, the patient was discharged home without drains. Fluoroscopic esophagram studies obtained up to 6 months from discharge revealed no persistent leak or stricture. The patient receives the majority of their nutritional requirements through gastrojejunostomy tube bolus feeds with very little oral intake due to oral aversion.

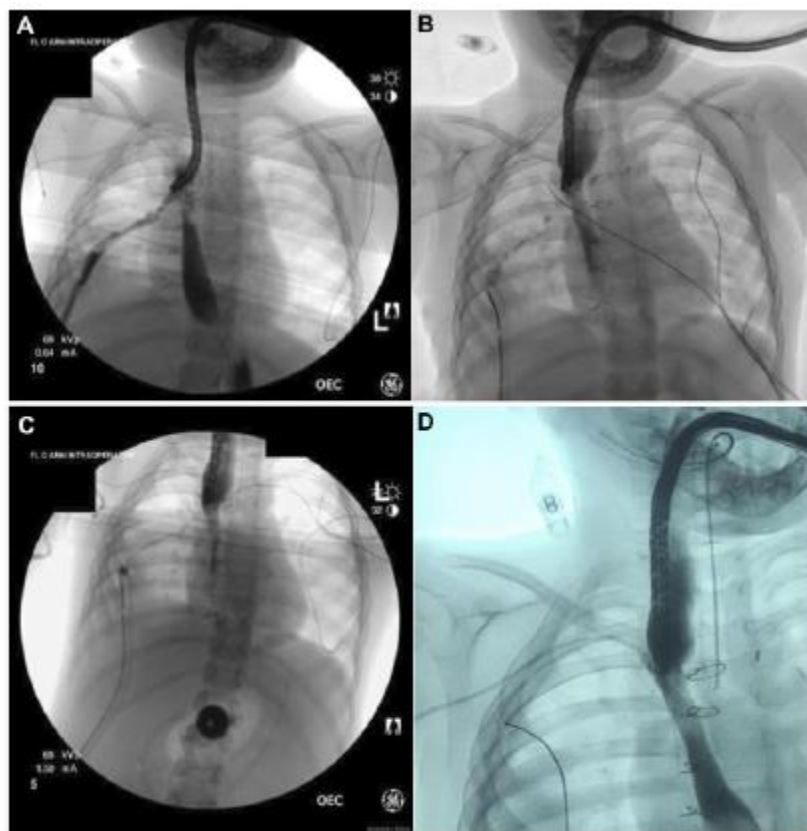


Figure 3: Serial fluoroscopic images illustrating closure of esophageal perforation over time. A: Day 8 – prior to placement of negative pressure therapy at the third endoscopic session. B: Day 14 – prior to placement of negative

pressure therapy at the fourth endoscopic session. C: Day 17 – prior to placement of negative pressure therapy at the fifth endoscopic session. D: Day 25 – following removal of negative pressure therapy at sixth and final endoscopic session.

3. Discussion

This report details successful use of EVAC to seal a refractory leak from an esophageal diverticulum failing multiple operative interventions. Esophageal leak closure was successful after 25 days of EVAC with six endoscopic sessions. This device has not been approved by the FDA for intraluminal use and thus, this indication remains investigational. Several physiologic benefits arise from use of EVAC over stenting. First, the negative pressure system counteracts the physiologic low intrathoracic pressure created with breathing that pulls secretions through the perforation and into the chest [4]. Additionally, removal of necrotic material and fluid from the site of the perforation by EVAC promotes blood flow by activating cells that promote angiogenesis, granulation, and early closure [5]. Finally, EVAC generally requires a shorter duration of therapy than stenting, which is usually left in place for 6-8 weeks [6]. Relative to endoscopic stent placement, EVAC does carry the disadvantage of requiring multiple endoscopic sessions for exchange of the sponge as the fistula tract diminishes in size. However, the alternative option - endoscopic stent placement - is associated with complications including stent migration and erosion, which may also require repeated endoscopic interventions. Leaving a nasoesophageal tube in for EVAC additionally poses challenges related to displacement of the apparatus, particularly for the pediatric population. To address this issue, retrograde placement of the EVAC sponge inserted through a pre-existing gastrostomy site has been described [7] and may be better tolerated by

children. Given the cylindrical shape of the sponge, if there is inadequate contact between the sponge and the esophageal wall, the VAC unit may fail to hold its seal. Serial endoscopic sessions are thus essential not only for sponge exchange, but also to ensure that the EVAC unit is properly functioning and not eroding at the site of the leak. Future investigations should seek to compare children treated with endoscopic negative pressure therapy with others managed with stenting or diverting cervical esophagostomy to compare morbidity, technical details, and success rates for each approach.

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Declarations of Interest

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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