The Use of a Self-Expandable Plastic Stent for an Iatrogenic Esophageal Perforation

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Case Report

A 48-year-old woman presented to the clinic with ascending colon carcinoma that had been diagnosed 6 months earlier. The disease had metastasized to the axial and peripheral skeleton in multiple locations. Radiation therapy was administered to the cervical and thoracic spine with 30 fractions of 200 g each. Within 6 weeks of the completion of radiation, the patient developed dysphagia, chest pain, bouts of regurgitation, nausea, and a weight loss of 15 pounds. An esophagogastroduodenoscopy revealed a tight inflammatory, likely radiation-induced, stricture in the distal esophagus that had narrowed the lumen to 8 mm. The patient underwent balloon dilation of the lumen to 13 mm. She developed chest discomfort in the recovery area, and a hypaque esophagogram revealed a perforation (Figure 1). A nasogastric tube was placed endoscopically, and the patient received broad-spectrum antibiotics and intravenous fluids. Within 24 hours, a Polyflex stent (18-mm wide × 9-cm long, with a 23-mm proximal mouth; Boston Scientific) was placed and attached to the proximal esophagus with nylon ligatures and 2 Resolution clips. The patient was able to eat soft solids within 48 hours of the stent's placement and was discharged on the fourth day. She gained weight and reported no chest pain or dysphagia. Chemotherapy was started due to an abnormal positron emission tomography/computed tomography scan and a rising carcinoembryonic antigen level. The stent was removed 6 weeks later. The leak had repaired itself endoscopically, and inflammatory mucosa with an intact lumen was noted with a barium esophagogram (Figure 2).

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Discussion

Esophageal perforation is a life-threatening situation and requires a rapid diagnosis and prompt intervention. Iatrogenic causes account for nearly 75% of cases. Management of the perforation depends upon the site of the leak, the time from the injury to the intervention, and the skill and experience of both the surgeon and endos-

Figure 1. Barium esophagogram revealing a perforation in the distal esophagus.

Figure 2. Follow-up esophagogram obtained 1 month after Polyflex stent removal.

copist. Recent conservative approaches have included observation, broad-spectrum antibiotics, radiologic drainage, and total parenteral nutrition as needed. With the advent of self-expanding plastic stents (SEPS), surgical intervention can often be eliminated. Esophageal stents have been part of endoscopic practice for decades, but the plastic, removable Polyflex stent has aided in the treatment of benign and malignant strictures, leaks, and fistulae. The use of this stent early on can prevent mediastinal and pleural space soiling, thereby eliminating the need for urgent surgical drainage, repair, resection, or diversion. Over the past 15 years, self-expanding metal stents (SEMS), made of nitinol or stainless steel, have evolved. These devices should not be used for benign strictures or iatrogenic perforations.[1]

In recent years, the treatment of benign, inflammatory strictures has taken center stage in the endoscopy community. The use of SEMS for benign esophageal strictures has been problematic in the past. Granulation tissue in-growth, migration, bleeding, and perforation have been described. Woven SEPS with a thin silicone coating are popular. Ease of insertion, the need for minimal preparatory esophageal dilation, and the formation of an occlusive seal within the lumen have been reported with SEPS.[2] SEPS have been placed for a variety of postoperative esophagectomy and bariatric surgery leaks,[3,4] benign strictures,[5] perforations following left atrial catheter ablations,[6] Boerhaave tears, cervical dissections,[7] and esophageal fistulae. As with the patient discussed above, esophageal perforation can follow balloon- or wire-guided dilation, particularly in the radiated esophagus. Perforation may also follow endoscopic mucosal resection for neoplastic lesions or Barrett esophagus, as well as surgical fundoplication and myotomy.

The use of SEPS to close an iatrogenic perforation has been described only rarely in the literature as of yet. Polyflex has been used for disruptions following routine esophageal dilation, pneumatic dilation, perforations following transesophageal echo probes during cardiac surgery, or transmediastinal trauma from gunshot wounds. This material has been utilized to treat benign radiation-induced strictures, caustic substance ingestion injuries, peptic lesions, malignant obstruction, anastomotic strictures, and a variety of postsurgical leaks and fistulae.[8] Repici and colleagues[5] described 15 benign strictures that were stented with Polyflex. Four of these strictures were induced by radiation. Temporary placement for a mean of 6 weeks was successful in all 15 patients. In this study, 80% experienced long-term resolution of the stricture, with a follow-up of nearly 2 years. All of these patients had failed repeated esophageal dilations.

In recent years, closure of traumatic, nonmalignant perforations of the esophagus smaller than 50–70% of the circumference has been described with SEPS Polyflex. This stent may be better tolerated in the proximal and distal esophagus, as it can narrow under pressure, is more malleable than SEMS, and appears to cause less tissue inflammation and proliferation at the mucosal level.

In addition to hemostatic clips, acrylic glues, and argon plasma coagulation, both SEMS and SEPS have been utilized to close a variety of leaks, fistulae, and large-caliber perforations.[9-12] Polyflex stents have been shown to occlude perforations quickly, thus allowing the patient to commence oral nutritional intake, which shortens hospital stays, avoids costly and morbid surgical interventions, and results in a large healthcare cost savings. The material of the stent provides balanced radial force and adapts elastically to the native esophageal wall.[9] Radio-opaque markers in the proximal, mid-, and distal esophagus allow for easy deployment either under direct vision or with fluoroscopic assistance. The stent can easily be removed with a rat-tooth forceps or a snare once healing has been completed (as determined by endoscopy, contrast studies, or cross-sectional imaging).[10] Migration rates in inoperable strictures with this stent range from 6% to 18% but can easily be managed endoscopically with removal, replacement, or manipulation and repositioning.[11] Migration of SEPS (in up to 30% of cases in the literature) can be minimized by oversizing the length by at least 4 cm and, as described in the patient above, attaching the proximal mouth to the esophageal wall with ligatures and hemostatic clips.

Summary

Esophageal perforation is a significant risk with dilation of previously irradiated esophagus. Prompt detection of the perforation is vital. Treatment with broad-spectrum antibiotics, continuous acid suppression, nasogastric suction, and consideration of prompt placement of a SEPS may avoid surgical intervention. The Polyflex stent has been shown to be safe, easy to deploy, efficacious, and cost-effective for an iatrogenic esophageal perforation. SEPS should be placed for a minimum of 4–6 weeks and can be removed with a forceps or a snare once the sealing of the leak is confirmed. To avoid migration, it is suggested that the SEPS Polyflex stent be attached to the esophagus at its proximal opening via ligatures and hemostatic clips.

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Review

Management of Esophageal Perforation After Therapeutic Endoscopy

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Iatrogenic injuries account for up to 60% of all cases of esophageal perforation.[1] The risk of perforation increases significantly from 0.6% for purely diagnostic endoscopy to 6% for operative procedures.[2]

There are three main methods for reducing the burden of esophageal perforation due to operative endoscopy: improving training, particularly for advanced therapeutic procedures; respecting the indications of each procedure for each patient; and demonstrating prompt recognition of complications and their early and appropriate management. The interesting case report by Petersen[3] focused on the last method by demonstrating the successful management of a linear perforation that developed after pneumatic dilation of postradiation esophageal stricture, by using a self-expanding plastic stent.

Management of perforations traditionally involves surgery or an aggressive approach, particularly for patients with significant mediastinal contamination who are not suitable for conservative management. Despite meticulous surgical techniques, a reduction in operating time, adequate antibiotic therapies, and advances in anesthetic management and postoperative care, the incidence of postoperative complications for these patients remains high.

Because many endoscopic perforations are small, well-defined, and have limited contamination, both the repair of the perforation and the diversion of luminal contents can now be accomplished via endoluminal means, which allows for the avoidance of surgery and its morbidity. Unfortunately, clinical evidence regarding the endoluminal closure of perforations is limited to case reports and case series; there have been no randomized controlled clinical studies in this area.

Largely based upon our understanding of the principles of surgical management, there are 3 important goals when treating patients with esophageal perforation: preventing ongoing soilage; providing debridement of devitalized tissue; and performing wide drainage.[4]

Choosing a therapeutic option for an esophageal perforation also requires differentiating between acute and chronic cases of perforation, as they are distinct clinical entities. Acute perforations are potentially life-threatening emergencies in which prompt closure is required to eliminate contamination of visceral spaces. In contrast, chronic perforations are smoldering problems complicated by abscesses and fistulas. In addition, damaged tissues have different susceptibilities to endoscopic handling. A vital and elastic tissue, just like new lesions, can easily be clipped or sutured. On the other hand, in older lesions, where the tissue is friable, necrotic, or callous, it is often easier to promote closure via secondary intention.

Currently, endoscopic clips are the only devices available on the market for closure of perforations. Suturing and stapling devices are not yet available for clinical use. Endoclips may be adequate and may significantly reduce the need for surgery, particularly for the closure of linear or regular esophageal perforations from several millimeters to 2 cm in size. Multiple clips and/or

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multiple separate endoscopic sessions are required to close larger perforations.[5]

For cases of irregular perforations or deep-penetrating lacerations of the esophageal wall, a powerful nitinol over-the-scope clipping system (OTSC system, Ovesco Endoscopy) was developed to ensure the full-thickness approximation of the edges. This device has also been used to successfully close gastrointestinal leaks and bleeding lesions refractory to standard treatment.[6]

Sewing devices are in the preclinical phase of evaluation. Experience with endoscopic suturing of esophageal perforations and fistulas is limited or nonexistent.

Esophageal stent insertion has been shown to be successful in the closure of acute esophageal perforation immediately after its detection and in the closure of long-standing perforations in patients who are not candidates for surgery.[7]

Stents may be a better option in perforations or fistulas larger than 2 cm, in defects with everted edges (because the wingspan of current clips fail to close such defects), and in patients with a leak occurring in the setting of a malignant lesion (because clips tend to tear through neoplastic tissue, failing to hold the edges of the perforation).[8] Overall therapeutic outcome depends both on successful sealing of the wall defect and the success of subsequent self-expanding metallic stent removal or self-expanding plastic stent migration.

Recently, the concept of stent-guided regeneration and re-epithelialization of digestive perforations emerged for the completion of postoperative disunion with a fully covered stent.[9] The authors postulated that a covered stent may act as a support to guide tissue regeneration and re-epithelialization alongside the external membrane of the covered stent by stimulating mucosal regrowth. However, this concept has not yet been proven by experimental models.

The repair of chronic esophageal perforations or recalcitrant fistulas with endoscopic therapy can be obtained by targeting the site from the inside and outside. This inside-outside approach can be a useful option to ensure both external closure of the defect by mean fibrin glue, sealants, or newly developed acellular matrix graft, as well as internal protection of the breach by using stents and the OTSC system.[10]

A successful outcome of endoscopic sealants for esophageal fistulas is dependent upon the size of the fistula and the absence of active infection around the site of the leak, cancer, or obstruction distal to the site of the leak. Chronic fistulas benefit from clearance of mediastinal infection with debridement and drainage before endoscopic closure.[11] In our opinion, brushing the fistulous tract and correct placement of the sealant application catheter inside the fistulous orifice are critical for successful closure of the fistula.[10]

Endoscopic insertion of strips of Surgisis (Cook Biotech, Inc), an acellular matrix derived from porcine submucosa promoting fibroblast proliferation without stimulating a foreign-body reaction, has also been shown to be successful in the closure of chronic esophageal anastomotic leaks not suitable for closure by stents and fibrin glue.[10]

For large esophageal defects with extravisceral collection that could be endoscopically explored, vacuum-assisted closure was recently reported.[12] As with infected abdominal wounds, this method allows regular visualization of the leak and infected cavity and promotes tissue granulation to obtain a secondary-intention closure of the fistula. The regular debridement and, therefore, control of the septic focus appears to be another major advantage over stent therapy.

In conclusion, recent advances in endoscopic closure devices have increased therapeutic options in selected patients. A multidisciplinary approach involving the surgeon, endoscopist, interventional radiologist, and intensivist remains mandatory in all patients with esophageal perforations in order to reduce mortality and complications. Due to the continuous implementation of technological resources at our disposal, dedicated training programs in endoscopic closure of perforations are needed.

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