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Endotherapy for a 5-cm mid-esophageal perforation with tandem stenting above the lower esophageal sphincter (with videos)

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Abstract
Background Esophageal perforation, whether spontaneous or more commonly as a result of instrumentation, is a life-threatening condition and carries high mortality despite recent advances. Outcome is dependent on etiology, location of injury, and interval between perforation and initiation of therapy. Successful management of esophageal perforation entails combination of: (1) control of the leakage site either surgically or endoscopically to prevent further contamination, (2) drainage of contamination, and (3) appropriate antibiotics along with nutritional support.

Methods We report one case with a 5-cm-long iatrogenic mid-esophageal perforation. The perforation was successfully managed with esophageal tandem stenting above the lower esophageal sphincter (LES).

Results The radial expansile force of the inner stent and its anchorage by LES holds the outer stent in place and prevents the tandem stents migrating distally.

Conclusions Successful management of esophageal perforation depends on early diagnosis, control of site of leak, drainage of accompanying collections, and antibiotic and nutritional support.

Keywords Esophagus · Perforation · Endoscopy · Esophageal tandem stenting · Stenting · Lower esophageal sphincter · Bariatrics · Gastric banding · Obesity · Surgery

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Because of the high prevalence of obesity in the USA, bariatric surgery has increased dramatically in this country [1, 2]. Bariatric surgery appears to increase overall life expectancy and decrease the rate of obesity-related comorbidities such as hypertension and diabetes [2]. Laparoscopic gastric banding (Lap-Band) procedure is gaining popularity in the USA. During Lap-Band procedure, a calibration tube in the device kit is usually inserted perorally into the esophagus prior to band placement. Here, we report one case with a 5-cm-long iatrogenic mid-esophageal perforation due to calibration tube insertion. The perforation was successfully managed with esophageal tandem stenting above the lower esophageal sphincter (LES). To the best of our knowledge such case and method has not been reported in the medical literature.

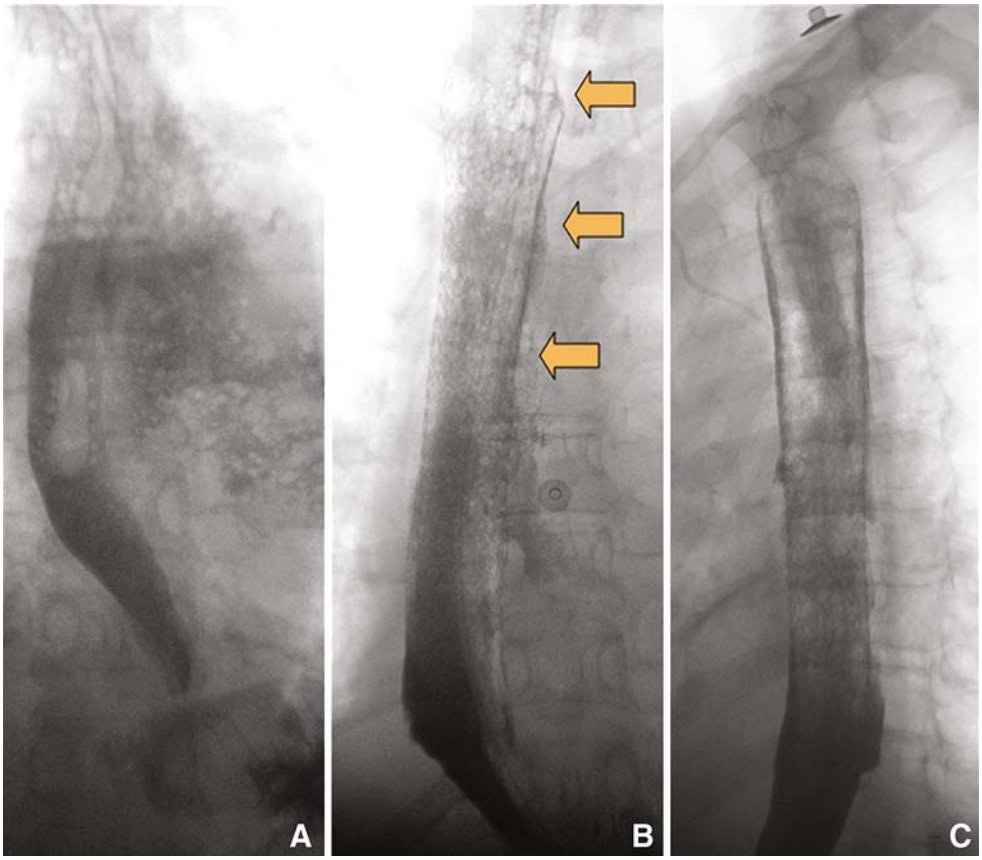

Fig. 1 Fluoroscopic images showing Gastrografin swallow studies before and after stenting. A large leak is seen before the stenting (**A**). Traces of contrast extravasation between the stent and esophagus on the first follow-up study (**B**). No leak demonstrated on the second follow-up study (**C**)

Case report

A 61-year-old Caucasian female with body mass index (BMI) of 44.5 kg/m^2 underwent Lap-Band procedure. Other significant past medical illnesses included hypertension, type 2 diabetes mellitus, and obstructive sleep apnea. During surgery, anesthesia was asked to insert the calibration tube and inflate the balloon to 20 mL, but there was difficulty inserting the tube and the balloon could not be satisfactorily inflated. On postoperative day 1, the patient complained of substernal chest pain and dysphagia but was clinically stable with no tachycardia or fever. An urgent amidotrizoate–meglumine (Gastrografin) swallow study revealed a large leak in the thoracic or mid-esophagus (Fig. 1A). The patient was started on intravenous antibiotic (piperacillin and tazobactam) and evaluated by the cardiothoracic surgery team. The primary reason that direct open operation was not entertained was due to the location of the injury behind the arch aorta, with the tear on the left side of the esophagus with flow into the left pleural space, where direct surgical access would be impossible. The only open surgical approach would have required a right thoracotomy, complete mobilization of the intrathoracic esophagus, and rotation of the esophagus for two-layered repair. In addition, should this lady ever come to esophagectomy, having had that procedure would have increased the difficulty of subsequent operations. After discussing with the patient and the surgery team, urgent endoscopic stenting was requested.

During upper endoscopy with a diagnostic gastroscope, the Z line was at 42 cm from the incisors and the LES at 40 cm (Video 1). A 5-cm-long esophageal perforation was seen from 31 to 26 cm from the incisors (Fig. 2). Considering there was no esophageal stricture and the perforation was at the mid-esophagus, we came up with the concept of tandem stenting above the LES (Fig. 3). We chose two 22 × 120 mm fully covered metal stents (Alimaxx-E® stent, Alveollus, Charlette, NC). Under fluoroscopic guidance three paper clips were placed percutaneously to mark the location of LES, and distal and proximal margins of the perforation (Fig. 4). A Savary wire was placed for stent deployment. The proximal stent was placed first and it covered the entire length of perforation. The proximal end of the stent was about 3 cm distal to the upper esophageal

Fig. 2 Endoscopic view of the mid-esophageal perforation

sphincter (Fig. 5). The second or distal stent was then placed inside the first stent to hold the first stent in place, minimizing the risk of distal migration of the proximal stent. The distal end of the distal stent was placed above the LES, preventing distal migration of both stents. Finally, a nasogastric tube was placed under direct endoscopic and fluoroscopic guidance.

On postoperative day 2, the patient was started on total parenteral nutrition (TPN) and did relatively well. Serial chest X-rays noted a worsening left-sided pleural effusion. Left thoracostomy was performed and a chest tube was placed. During a follow-up Gastrografin swallow study on postoperative day 9, the vast majority of the contrast passed through the stent lumen and there was no stent migration. However, very small amount of contrast extravasated between the proximal end of the first stent and the esophagus and leaked through the perforation (Fig. 1B). This was due to incomplete sealing between the stent and the esophagus due to stent configuration and design, and relative size discrepancy between the stent and esophagus. More time was given to allow better sealing between the stent and the esophagus. She was kept on TPN and remained clinically stable. Due to mild but persistent leucocytosis, clindamycin and Diflucan were added to her antibiotic regimen. Pleural decortication and drainage through video-assisted thoracoscopic surgery was performed. On postoperative day 19, chest tube was removed. On postoperative day 25, the patient underwent a second follow-up Gastrografin swallow study and there was no contrast extravasation (Fig. 1C). She was started on a clear liquid diet and all antibiotics were discontinued. Three months after the initial stenting, she underwent routine scheduled esophagogastroduodenoscopy (EGD) for stent removal. She denied any dysphagia or odynophagia. Endoscopically, the proximal stent did not migrate at all (Fig. 6, Video 2). The overlapping stents were in good position with the distal end of the distal stent about 1 cm above the LES (Fig. 7). Both stents were removed very easily. There was some esophagitis and granulation tissues at

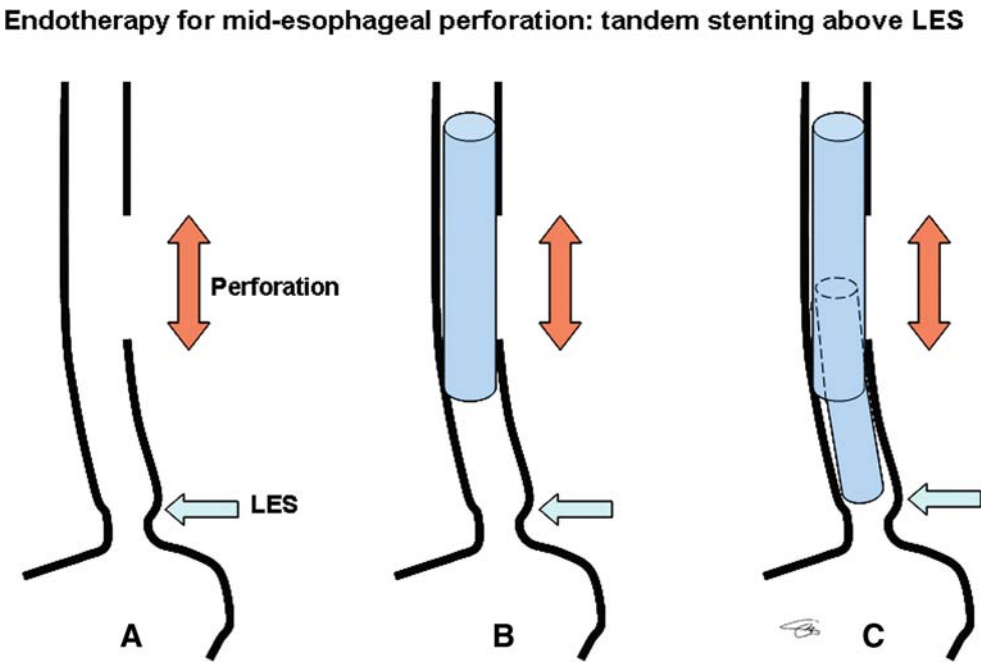

Fig. 3 Schematic illustrations demonstrating tandem stenting above the LES for the treatment of mid-esophageal perforation

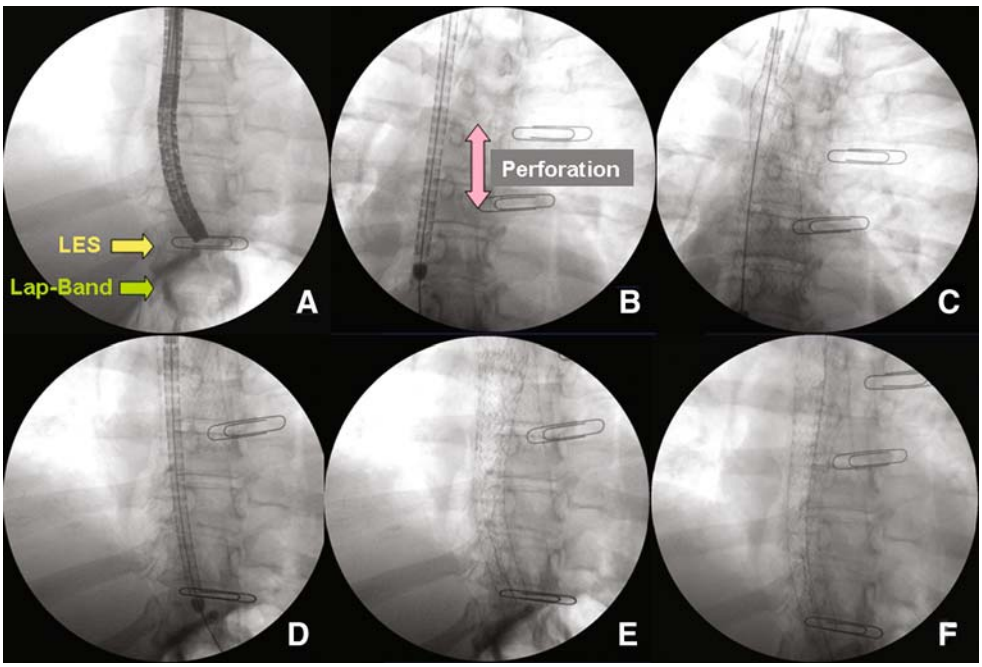

Fig. 4 Fluoroscopic images showing tandem stenting above the LES. The location of the LES is marked percutaneously with a paper clip (**A**). The margins of the perforation are marked with paper clips and the first stent is being deployed traversing the entire perforation (**B** and **C**). The second or distal stent is being deployed with the distal end above the LES and it overlaps the first stent (**D** and **E**). Fully deployed stents are above the LES (**F**)

Fig. 5 Endoscopic view of the proximal end of the proximal stent immediately after deployment. There is small space between the stent and the esophagus

Fig. 6 Endoscopic view of the proximal end of the proximal stent prior to stent removal. There is small space between the stent and the esophagus

the end of the stents that are due to chronic stent placement. The perforation had completely healed and there was no luminal narrowing (Fig. 8). Postprocedural barium swallow study confirmed no leak or other abnormalities.

Discussion

Esophageal perforation, whether spontaneous or more commonly as a result of instrumentation, is a life-threatening condition and carries high mortality despite recent

Fig. 7 Endoscopic view of the overlapping stents with the proximal end of the distal stent expanding inside the proximal stent

Fig. 8 Endoscopic view of the mid-esophagus after stent removal showing complete healing of the perforation

advances. Outcome is dependent on etiology, location of injury, and interval between perforation and initiation of therapy. Overall mortality associated with esophageal perforation ranges from 16% to 35% [3]. Mortality rates increase up to 50% when time to diagnosis and initiation of treatment is delayed by more than 24 h [4]. Successful management of esophageal perforation entails combination of: (1) control of the leakage site either surgically or endoscopically to prevent further contamination, (2) drainage of contamination, and (3) appropriate antibiotics along with nutritional support [5]. The optimal management remains an issue of debate. Lately, there has been increasing use of endotherapy in the management of esophageal perforations. These include fibrin-glue injection, clip application, and covered self-expanding metallic or plastic stents [6].

We successfully, applied these principles of management of esophageal perforation in our case. Patient had a large (5-cm-long), transmural, iatrogenic esophageal perforation. Control of further contamination from the perforation site was managed by endoscopic therapy, i.e., metallic stenting. Drainage of contamination should be performed if the patient is symptomatic from pleural effusion or the pleural effusion is increasing on serial/daily chest X-ray films. In vast majority of the cases, drainage will be needed. The choice of local endoscopic therapy is usually guided by the size of perforation. In general, endoclips are reserved for perforations less than 1 cm and stents for perforation more than 1 cm in size. To the best of our knowledge, tandem esophageal stenting above the LES for such mid-esophageal perforation has not been described. Tuebergen et al. reported management of 32 patients with esophageal leaks and perforation by endoscopic metal stenting [6]. The mean leakage diameter in their series was 7.3 ± 5.5 mm (1–22 mm, median 5 mm).

Stent migration and tissue overgrowth are obvious issues in patients with esophageal stent placement. Stent migration rates are higher in patients with esophageal perforation (30%) compared with patients with esophageal cancer, presumably due to lack of anchorage [7]. Endoclips, although described to hold Ultraflex stent (Boston Scientific, Natick, MA) to the wall of the esophagus, have not been widely applied [8, 9]. We describe a novel approach of tandem metal stenting for mid-esophageal perforations to take advantage of the natural anchorage offered by the LES. The esophageal perforation in our case extended from 26 to 31 cm from the incisors and the LES was at 40 cm. Placement of single 12-cm stent with its distal end at LES would not have covered the perforation site, and at the same time placement of single mid-esophageal stent to completely cover the perforation site was prone to high chance of migration. We first placed a covered metal stent below the upper esophageal sphincter (UES) to cover the perforation and then another stent through the proximal stent to anchor its distal end at the LES. We assumed that the radial expansile force of the inner stent and its anchorage by LES would hold the outer stent in place and the tandem stents would not migrate. This concept of tandem stenting showed favorable results on repeat endoscopy at 3 months after stent placement. The tandem stents were easily removed, there was no migration at all, and the large esophageal perforation had completely healed. Tissue overgrowth is another entity commonly seen after long-term stent placement and is due to chronic granulation tissue. We also noted granulation tissue at both

ends of the stents; however, there was no luminal narrowing.

The optimal duration of stent placement for esophageal perforation is not clear. Reported duration in the literature ranges from about 3 to 36 months [5]. Also, there are no clear guidelines about timing of initiating oral feeding after esophageal stenting. We elected to monitor the patient by Gastrografin swallow study. When Gastrografin study was negative for esophageal leak on day 25, oral feeding was initiated and antibiotics discontinued. At 3 months repeat Gastrografin study was negative for leak and the stents were removed. Stent removal was uncomplicated; the lasso of the inner stent was grabbed with endoscopic rat-tooth forceps to collapse the stent and gently pulled out, removing both stents with the endoscope.

We chose metal fully covered metal stent (Alimaxx-E) for its removability, no stent loading prior to stent insertion, and easy deployment mechanism. However, an optimal stent for different clinical situations is not available yet. As described in our case, esophageal leak persisted for some time after stent placement, likely due to the gap between upper end of the stent and esophageal wall, which distends to 3 cm laterally to accommodate a swallowed bolus. This inability to achieve immediate leak occlusion has been observed in other case series as well: one patient out of nine patients had persistence of leak [10]. The esophageal lumen is larger than the external diameter of the Alimaxx-E stent. We propose that development of fully covered stents with larger upper and lower diameters (flanges) may prevent this "peri-stent" extravasation and may lead to quicker and better healing.

In conclusion, successful management of esophageal perforation depends on early diagnosis, control of site of leak, and drainage of accompanying collections along with supportive care in the form of antibiotics and nutritional support. Primary aim of esophageal stent placement is to cover the perforation site to prevent contamination and allow healing. This method of tandem stent placement above the LES for mid-esophageal perforations should be considered as a viable alternative to primary surgical repair.

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