



Advances in minimal invasive treatment for esophageal perforation

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Before discussing the combined approach presented by Chiu *et al.* (1), I would like to remind all readers of the dangers associated with esophageal perforation and modern treatment options. Esophageal perforation is a true surgical emergency, occurring spontaneously as well as after various endoscopic procedures. With a mortality of 17–25% due to mediastinitis and multiorgan failure, this is the most lethal gastrointestinal perforation (2,3). Treatment recommendations vary from urgent surgical treatment (4) to endoscopic stenting (5,6) and in certain cases conservative treatment. As esophageal perforations often occur in frail individuals, the use various of minimal invasive techniques to close the perforation site, and thus prevent further mediastinal contamination, is key to a successful outcome. Endoscopic stenting has become common practice but is often complicated by stent migration, sometimes occurring repeatedly. Several techniques, including the novel alternative in the present work (1), have therefore been developed to reduce this problem. Finding a reliable method is important as stenting, in contrast to placing an end-cervical esophagostomy, results in esophageal preservation and superior long-term outcome (7).

Reducing migration in esophageal stenting

To start with, esophageal stents, often referred to as self-

expandable metallic stents (SEMS) are designed to alleviate obstructing symptoms caused by inoperable cancers. When used for sealing perforations, in an otherwise normal esophagus, they are prone to migrate as they lack their intended mechanical fixation. In a large systematic review of 66 studies on 1,752 patients having SEMS due to esophageal anastomotic leaks or benign perforations, the overall migration rate was found to be 16% (8). To overcome this, several techniques have been tried. Firstly, the upper border of the stent can be fastened to the esophageal mucosa by endoscopic clips, a technically easy but often non-functioning strategy. Secondly, over-the-scope clips, providing more force, have been suggested. This somewhat more demanding approach has been demonstrated to reduce stent migration (8.3% *vs.* 35.4% without fixation) but at a higher cost (9,10). Moreover, the clip can be difficult to remove, and this process might require special equipment. Thirdly, simultaneous endoscopic suture fixation of the stent to the esophageal mucosa has been tried. In a meta-analysis of 14 studies on 212 patients, mainly with esophageal leaks, the migration rate was still high, 15.9% (11). In an animal model, the risk with full thickness suture penetration was eliminated (0/10) when performing a submucosal injection before placing the stent (12). Finally, various additional procedures have been tried, for example by placing an Endo loop around the upper part of the stent before fixating the

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loop to the esophageal wall with multiple clips (13) or using a SEMS equipped with an anchoring silk thread, which is to be pulled through the nose and attached to the ear lobe by tape (14). Although the latter method provides excellent fixation, it is only tolerated by very few patients. Thus, despite multiple existing endoscopic strategies, the problem with stent migration is not solved.

Other minimal invasive options in sealing esophageal perforations

Endoscopic vacuum therapy (EVT), achieved by placing a sponge-catheter with continuous suction in the opening of the perforation or intraluminally, has been introduced as an alternative method. In a recent meta-analysis of 8 studies with 357 patients, EVT was found superior to stenting concerning successful leak closure [odds ratio (OR): 2.58 (1.43–4.66)], and with lower mortality rates [OR: 0.47 (0.24–0.92)] (15). On the downside, EVT requires rather frequent sponge changes (every 3–5 days), performed under general anesthesia, disabling peroral intake as well as outpatient treatment.

A new hybrid stent, combining the benefits of EVT and SEMS, has recently been introduced. The outer central part of the stent is coated with sponge material, connected to a suction catheter. The stent is basically deployed as a standard SEMS, over a stiff guide wire during fluoroscopy. In pilot trials, various types of esophageal leaks could be sealed in 60% to 80% (16,17) and the vacuum stent has been considered superior to standard SEMS in a systematic review (18). Considering the risk of stent migration, it should be reduced by the continuous negative pressure between the stent and the esophageal wall as well as the fixation provided through the remaining suction catheter. Furthermore, in one study (17), 87% (13/15) of the patients tolerated peroral intake, while the other study found it difficult due to clogging in the suction tube (16). Time will tell in which type of esophageal perforations this concept is most valuable.

Comments on the hybrid approach presented in the present paper

In the present paper, the authors present a hybrid approach including minimal invasive debridement by thoracoscopy and endoscopic stenting, followed by gastric decompression and placement of a feeding jejunostomy, and last but not least, a simple but ingenious technique to fixate the stent.

The stent is merely fastened by an absorbable suture, placed through the esophageal wall and into the lumen of the stent before it is tied on the outside. This single full-thickness suture prevented stent migration in all five cases, without hampering stent removal at eight weeks later. Thus, this simple technique might trump more sophisticated solutions such as endoscopic clips and other special-designed devices described above. However, by placing an endoscopic clip in the esophageal mucosa, just above the stent, and not including the stent itself, stent migration can be monitored by chest X-ray or fluoroscopy. Please note that intubated patients are in extra need of surveillance, relying only on indirect signs as saliva/air in the chest tube or installation of methylene blue via a naso-esophageal tube, to ensure that the perforation is totally sealed.

By performing the debridement by thoracoscopy, a significant development in minimal invasive surgery, the authors have improved patient care by reducing the physical burden on the compromised patient. Despite a thorough thoracic debridement, ultrasound-guided pigtail drains are often needed to overcome pleural abscess, diagnosed by repeated computed tomography-scans. In addition, broad spectrum antibiotics and intensive care, if needed, are utterly important adjuncts to the surgical management of these critically ill patients. Respiratory support with continuous positive airway pressure (CPAP) and daily physiotherapy are, together with optimized nutrition, cornerstones in obtaining a successful outcome. Finally, as in the present paper, enteral nutrition through a feeding jejunostomy is desirable for enhanced and optimized nutrition (19).

Take home messages

This paper demonstrates that endoscopic stents, in combination with adequate debridement and drainage, can be a successful treatment option also in late esophageal perforations. Furthermore, instead of using various high-tech devices to prevent stent migration, a simple suture can be ingenious. I have included the presented technique in my surgical toolbox.

However, despite the successful outcome in the present patients, I would like to emphasize the need for close surveillance and consideration of definite surgical treatment with esophageal diversion when treating patients with esophageal perforation, as this is a truly life-threatening condition.

Furthermore, it is crucial to maintain a high level of

suspicion of this difficult diagnosis in all patients with sudden retrosternal pain. Mediastinitis with fever as well as subcutaneous emphysema are very late signs. Therefore, when in doubt—perform a thoraco-abdominal CT-scan with peroral water-soluble contrast.

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