Surg Endosc (2014) 28:2368–2373
DOI 10.1007/s00464-014-3471-4

Role of endoscopic stents and selective minimal access drainage in oesophageal leaks: feasibility and outcome

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Received: 18 October 2013 / Accepted: 18 January 2014 / Published online: 8 March 2014

Abstract
Background Leaks following oesophageal surgery are considered to be amongst the most dreaded complications and contributory to postoperative mortality. Controversies still exist regarding the best option for the management of oesophageal leaks due to lack of standardized treatment protocols. This study was designed to analyse the feasibility outcome and complications associated with placement of removable, fully covered, self-expanding metallic stents for oesophageal leaks with concomitant minimally invasive drainage when appropriate.
Methods The study group included 32 patients from a prospectively maintained database of oesophageal leaks, with the majority being anastomotic leaks after minimally invasive oesophagectomy ($n = 28$), followed by laparoscopic cardiomyotomy ($n = 3$) and extended total gastrectomy ($n = 1$). The procedures took place between March 2007 and April 2013.
Results Most patients had an intrathoracic leak ($n = 22$), with a mean time to detection of the leak following surgery of 7.50 days (SD = 2.23). Subsequent to endoscopic stenting, enteral feeding via a nasojejunal tube was started on the second day and oral feeding was delayed until the 14th day ($n = 31$). Six patients underwent thoracoscopic ($n = 5$) or laparoscopic drainage ($n = 1$) along with stenting for significant mediastinal and intra-abdominal contamination. The stent migration rate of our study was 8.54 %. The overall success in terms of preventing mortality was 96 %.
Conclusion Endoscopic stenting should be considered a primary option for managing oesophageal leaks. Delayed oral intake may reduce the incidence of stent migration. Larger stents (bariatric or colorectal stents) serve as a useful option in case of migrated stents. Combined minimally invasive procedures can be safely adapted in appropriate clinical circumstances and may contribute to better outcomes.

Keywords Minimally invasive oesophagectomy · Anastomotic leaks · Endoscopic stent placement · Stent migration · Oesophageal leak

Leaks following oesophageal surgery are considered to be amongst the most challenging complications and contribute to postoperative morbidity and mortality. The incidences of anastomotic leaks after minimally invasive oesophagectomy (MIO) and open oesophagectomy are comparable (10.1 vs. 10.7 %), with associated mortality rates of 2.4 and 3.8 %, respectively [1]. Many authors reported post-oesophagectomy leaks in 4–30 % cases, with a subsequent mortality rate of 35–70 % after leak [2–7].

Until recently the gold standard management modality for oesophageal leaks has been either surgery or conservative management. However, surgery is associated with a high mortality rate of between 60 and 100 % [3, 6, 7]. Conservative management also is associated with morbidity and mortality rates of up to 40 % [8]. Controversies still exist regarding the best option for managing oesophageal leaks due to a lack of standardized treatment guidelines.

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Over the last decade, endoscopic stenting has evolved as an alternate option for the management of benign and malignant oesophageal strictures. The use of self-expanding covered metallic stents in the management of anastomotic leaks has been mentioned in a small number of studies. The first report of endoscopic stenting for the treatment of intrathoracic anastomotic leaks after oesophagectomy was published by Kauer et al. [2]. Multiple series have followed thereafter and endoscopic stenting has become a viable and acceptable option for the management of oesophageal leaks.

The aim of this study was to analyse the feasibility outcome and the complications associated with the placement of removable, fully covered, self-expanding metallic stents (FC-SEMS) for oesophageal leaks, with concomitant minimally invasive drainage when appropriate.

Methods

Study population

All patients with anastomotic leaks following MIO, antireflux surgery, and surgery for achalasia between March 2007 and April 2013 formed the study group. The institutional setting is a tertiary-care referral hospital that provides advanced surgical procedures in gastrointestinal surgery with a dedicated department of upper gastrointestinal surgery and therapeutic endoscopy. The endoscopic approach to treating anastomotic leaks with the placement of removable FC-SEMS commenced in March 2007. A retrospective analysis of a prospectively maintained database was performed. The study was approved by the local institutional review board.

Diagnostic evaluation

Leaks were identified either during routine contrast swallow studies on postoperative day 5 or during an endoscopic or radiologic examination when it was clinically appropriate. Endoscopic examination enables direct visualization, confirmation (Fig. 1), and estimation of the size of the leak, and assessment of vascularity and/or ischemia of the gastric conduit and is hence preferred in certain clinical situations. Patients with gastric conduit ischemic necrosis and complete anastomotic dehiscence were not considered suitable for placement of an endoscopic stent. A chest and abdominal computerised tomographic (CT) evaluation was done to assess the degree of mediastinal contamination or collection that dictated the need for further thoracoscopic drainage in the same or a later sitting along with the stent placement as felt appropriate.

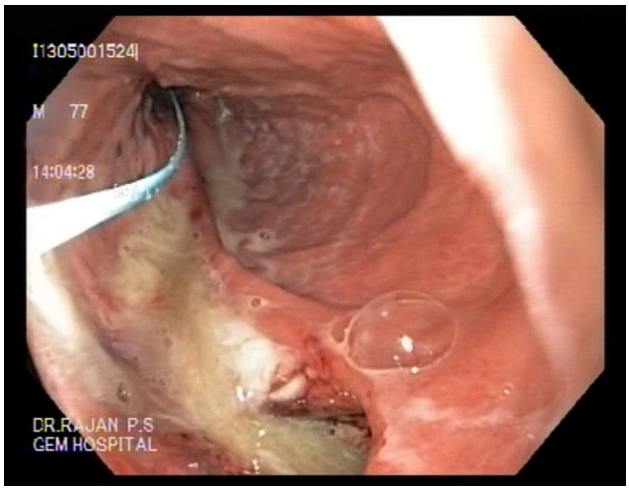

Fig. 1 Endoscopic view of post anastomotic leak in thorax

Endoscopic stent placement

All procedures were performed by an experienced surgeon endoscopist under fluoroscopic guidance. The procedures were done with the patient in the left lateral decubitus position and under sedation. Leaks were localized according to anatomical landmarks that were visualized on fluoroscopy and external skin marking clips were placed for later guidance in stent positioning and deployment. Stents were placed using an over-the-wire (OTW) distal delivery stent deployment system (Taewoong Medical, Gyeonggi-do, South Korea) (Figs. 2, 3). The size of the stent was determined by the width of the conduit and the size of the leak. The fully covered stent was deployed with at least 4–6 cm of overlap proximal and distal to the leak. We tend to position the stent more proximally to counteract potential distal migration. A nasojejunal (NJ) tube was placed in all patients after successful stent placement for early commencement of enteral feeding.

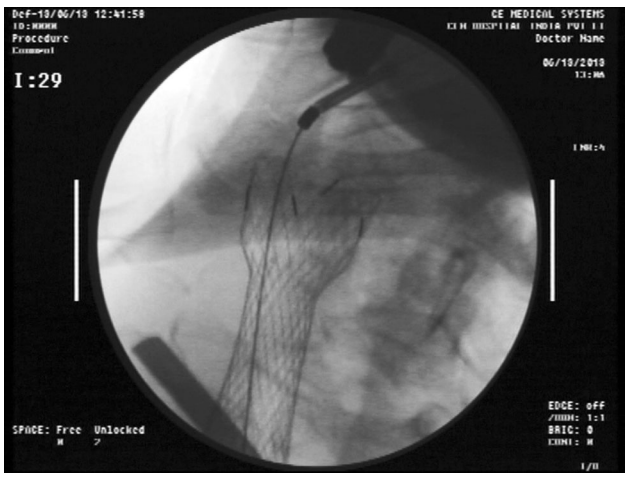

Fig. 2 Fluoroscopic visualization of placement of FC-SEMS

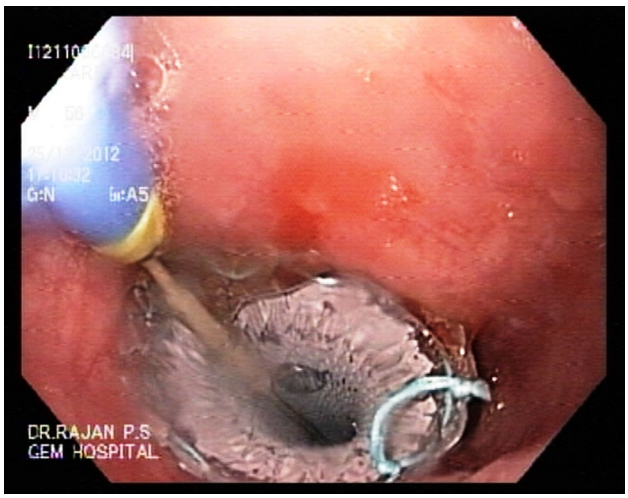

Fig. 3 Endoscopic view of FC-SEMS after placement

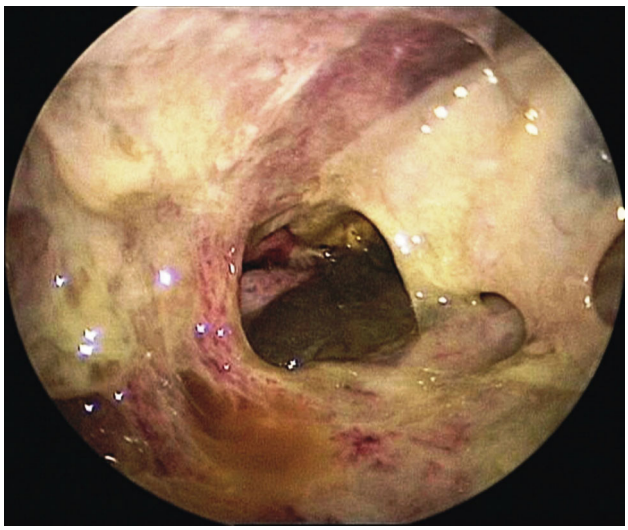

Fig. 4 Thoracoscopic view of mediastinal contamination

FC-SEMS (Taewoong Niti-S^{TM} oesophageal stents, Taewoong Medical) are available in different lengths (8, 10, 12, 14, and 15 cm) and diameters (16, 18, 20, 22, 24, and 28 mm) and were used depending on the need. In case of migration of the primary stent, the Taewoong MEGA^{TM} oesophageal stent, with a larger diameter (24 and 28 mm) and longer (23 and 24 cm) length was used to prevent recurrent migration or leak.

Minimally invasive drainage procedure (thoracoscopy/ laparoscopy)

In selected patients with significant mediastinal contamination on CT with associated clinical evidence of sepsis, a minimally invasive route was adopted. A prone-position thoracoscopy was performed using ports similar to those used for a previous thoracoscopic oesophageal mobilisation. Septa were broken down and thorough lavage was performed with the placement of drainage tubes (Fig 4). This would not have been possible in radiologically guided drainage procedures. Laparoscopy and drainage were also performed when appropriate.

Outcomes measured

Outcomes analysed were successful stenting, complications of stenting, time to commencement of oral and enteral feeding, time to discharge, stent removal related issues and stent related mortality.

Results

Of the 32 patients with oesophageal leaks, 28 were diagnosed following MIO for carcinoma of the oesophagus (lower third, 28 %; middle third, 22 %; and OG junction, 38 %). Three patients were referred with leaks following Heller's cardiomyotomy and one with an oesophageal leak following extended total gastrectomy for stomach carcinoma. Most patients ($n = 22$) had an intrathoracic leak and seven had a cervical leak. Three patients had leaks following Heller's myotomy: two into the abdomen and one into the chest and abdomen (Table 1).

Mean time to detection of the leak following surgery was 7.50 days (SD = 2.21) and mean time to placement of the stent after surgery was 9.53 days (Table 2). Stent placement was successful in the first attempt in all 34 patients (Table 2). Enteral feeding via a (NJ) tube was started on the second postoperative day (median value) and oral feeding for 31 patients started 14 days (median value) after stent placement.

Patients were discharged (31 of 32) a mean of 19 days (SD = 2.78) after stent placement and placed under regular follow-up. The stent was removed a mean of 53.47 days after stent placement (95 % CI = 49.31–57.63 days) (Table 2).

Table 1 Location of leak and distribution

Location of leak	Procedure performed	*N* ($n = 32$)
Abdomen	Laparoscopic Heller's cardiomyotomy with fundoplication	2 (6 %)
Abdomen + thorax	Laparoscopic Heller's cardio myotomy with fundoplication	1 (3 %)
Cervical	MIO	7 (22 %)
Thorax	MIO ($n = 21$) + extended total gastrectomy ($n = 1$)	22 (69 %)

MIO minimally invasive oesophagectomy

Table 2 Placement of stent and its outcome

	Overall outcome ($n = 34$)	Drainage + stenting ($n = 6$)	Stenting alone ($n = 28$)
Interval to detection of leak ($n = 32$)	7 (4–12)	8.5	7
Interval to placement of stent after operation ($n = 32$)	8 (5–39)	13.5	8
Day of enteral feed via NJ tube after stent placement ($n = 32$)	2 (1–6)	4.5	2
Day of oral feeding after stent placement ($n = 31$)	14 (12–19)	17.5	14
Discharge after stent insertion ($n = 31$)	19 (16–26)	23	18
Stent removal after placement of stent ($n = 31$)	49 (41–162)	68	48

All values are median number (range) of days

Outcome of patients who underwent concomitant drainage procedure with stenting

Five patients (15.62 %) underwent simultaneous thoracoscopic drainage for significant mediastinal contamination as suggested by CT examination. One patient (3.12 %) underwent laparoscopic drainage for intra-abdominal contamination following Heller's cardiomyotomy with enterocutaneous fistula. It was observed that the six patients who underwent the concomitant procedure had intervention later after primary surgery (13.5 days) as compared to the 26 patients in the stent-alone group who had intervention earlier (8 days), signifying that the delay may have contributed to the added need for a drainage procedure.

Though there was delay in enteral feeding, discharge after stent insertion, and stent removal for the patients who had the concomitant drainage procedure compared to stenting-alone group (Table 2). However, the overall outcome in terms of preventing further morbidity and mortality was similar for both the groups.

Complications

A total of 35 stents were used in 32 patients, the stent:-patient ratio being 1.1:1. In two patients (1 post TLE anastomotic leak and 1 post Heller's cardiomyotomy with enterocutaneous fistula), the stents migrated in the initial postoperative days after placement, followed by releak in both patients (Table 3). The second stent was a MEGA oesophageal stent, 28 mm in diameter and 23 cm long. Successful closure of the leak was obtained. One of these two patients was lost to follow-up and the other presented with late migration of the MEGA stent into the stomach after 5 months due to development of a stricture at the OG junction. The migrated stent in the stomach was retrieved by laparoscopic gastrostomy subsequently, stricture was managed using endoscopic balloon dilation 162 days after insertion (Fig. 5). The stent migration rate of our study was 8.57 % (3 of 35 stents).

There was one mortality secondary to sepsis and severe pneumonitis for a success rate of 96 % in terms of preventing mortality. There was no procedure-related mortality.

Stent removal

Planned stent removal usually occurred 6–8 weeks after primary stent placement. There was technical difficulty in four stent removals (12.5 %). The default method of removal was to grasp the removal suture (Teflon-coated

Table 3 Complications of FC-SEMS in leaks

Complications of stent	Total ($N = 32$) [n (%)]
Technically difficult retrieval of stent	4 (12.5)
Releak after first attempt	2 (6.25)
Stricture	1 (3.12)
Migration of stent	3 (9.37)
Sepsis-related death	1 (3.12)
Mild tissue ingrowth	1 (3.12)

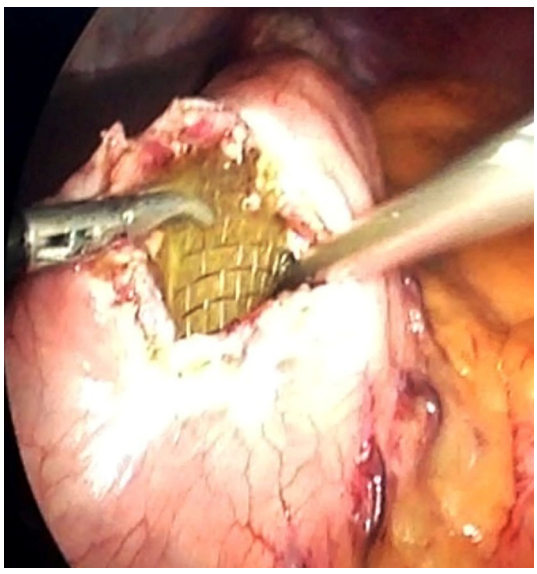

Fig. 5 Laparoscopic gastrostomy with retrieval of migrated stent

polyester suture) provided at the end of the stent. When difficulty was encountered, the stent was removed endoscopically by holding the flare end of the stent with grasping forceps and gently rotating the stent. In one patient, mild surrounding tissue growth into stent was noted and was removed using above method.

Discussion

Leaks following upper gastrointestinal surgery are the most feared and dreaded complications and considered the major reason for postoperative morbidity and mortality following oesophagectomy. Postoperative oesophageal leaks remain challenging to manage [6–8]. Controversies still surround the best management of oesophageal leaks. The choice between surgery (primary repair, oesophageal exclusion, or oesophagectomy) and an aggressive conservative treatment with mediastinal drains remains a grey area because of the high morbidity rates associated with them [9, 10].

More recently, the use of various types of fully and partly covered stents for oesophageal anastomotic leaks has been substantiated in various studies [1, 2, 11–13]. The most important benefit of the insertion of a FC-SEMS is that it prevents further leakage, thus preventing the further contamination of the mediastinal cavity.

Retrospective studies with small numbers of patients have been published with variable but encouraging rates of success in managing upper gastrointestinal leaks [14–17]. The success rate varied from 61 to 94 % in various studies [18–21]. Our study had a success rate of 88.57 % in sealing of the leak in single attempt, which is comparable to other studies.

There continues to be a lack of standardization with respect to the type of stent to use, technique of stent placement, and when the stent should be removed. We have presented our stent selection, technique of placement, and timing of enteral or oral feeding after stent placement. In addition, the role and results of concomitant minimal access drainage have also been studied.

Timing of enteral or oral feeding

An optimal time to begin enteral feeding after stent placement has not been described. Dai et al. [22] have mentioned early oral feeding at 3–4 days, but we delay oral feeding for 2 weeks. We believe that early oral intake induces gastric conduit peristalsis which could contribute to early stent migration and potential releak. Moreover, conduit dilation may not allow circumferential opposition of the stent with the conduit creating a potential space for leakage. Insertion of a NJ tube done at the time of stent placement allowed early enteral feeding.

Migration and choice of stents

Studies have quoted a stent migration rate after oesophagectomy leaks of between 23 and 40 % [1, 2, 11, 12]. The stent migration rate of 8.10 % (3 of 37) in our series was much lower. This can be attributed to selecting the proper stent size (slightly wider and longer stents are preferred depending on the local anatomy visualized endoscopically), technique of stent placement, and delayed oral feeding after stent placement. Use of larger stents (e.g., MEGA stents) when the primary stent migrates is a successful strategy in sealing leaks. Recently, Leenders et al. [23] discussed the use of colorectal self-expanding stents in case of migrating stents.

Removal of stents

There are no particular guidelines for the timing of stent removal, though various studies mention removal by 4–6 weeks [22–24] to prevent disintegration of stent and ingrowth of mucosa. Most of the stents in our series were removed in 6–8 weeks without much difficulty. Ingrowth of mucosa leading to difficulty in stent retrieval was encountered in only one patient. In one interesting case, stent removal was done by laparoscopic gastrotomy as the stent had completely migrated into the stomach. A similar stent migration was described by Eubanks et al. [25], where the stent migrated into the small intestine and was removed laparoscopically.

Other complications with stents are sudden death due to stent-related vascular erosion [26], airway oesophageal fistula [26], chest pain and dysphagia [24], gastro-oesophageal reflux [24], and hyperproliferation of mucosa around the edges of the stent.

The use or need of a combined procedure

Combined thoracoscopic or laparoscopic drainage and stenting in a single procedure in selected cases of large mediastinal collection or empyema has not been mentioned before. This approach can be used successfully in selected cases ($n = 6$) as shown in our series. However, our data also show that early intervention with stenting alone may have obviated the need for additional drainage procedures, as noted by the difference in intervention timing between the two groups, which was significant (14 vs. 8 days).

Dai et al. [22] discussed CT- or US-guided drainage, which is usually the norm in most situations. However, we believe that drainage of multiloculated collections under direct vision provides more effective drainage with irrigation as well as placement of the drain in a safe and more effective manner. Schweigert et al. [26] recently did a comparative analysis between subgroups of patients who underwent surgical re-exploration or endoscopic stenting

after oesophageal leaks and reported a mortality rate of 40 % after surgical re-exploration compared to 22 % in patients who received a stenting; this contributed to a change in their practice.

We believe that combined minimal access drainage of mediastinal or abdominal collections may be done safely and effectively in a select group of patients as evident by our results.

Conclusion

Oesophageal stenting has evolved over the last few years, with successful outcomes in managing upper gastrointestinal leaks, and it has established itself as a viable alternative. Endoscopic stenting should be considered a primary option for managing oesophageal leaks. Delayed oral intake after stenting may reduce the incidence of stent migration. Larger stents (bariatric or colorectal stents) serve as a useful option in case of migrated stents. Combined minimally invasive procedures can be safely adapted to appropriate clinical circumstances and may contribute to better outcomes.

Disclosures Drs. Rajan, Bansal, Balaji, Rajapandian, Parthasarathi, Senthilnathan, Praveenraj, and Palanivelu have no conflicts of interest or financial ties to disclose.

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