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Original article

Aortic injuries following stents in bariatric surgery: our experience

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Abstract

Background: Due to the large number of laparoscopic sleeve gastrectomy (LSG) performed over the last decade, the management of the leak following LSG has been increasingly reported. The role of covered Self Expandable Metal Stents (cSEMS) for the treatment of the leak is still controversial because of the poor tolerance and high risk of complications.

Objectives: The aim of the present study was to analyze the foregut wall perforation and aorta injuries, a very rare but potentially fatal complication, related to the treatment of the leak following LSG using cSEMS.

Setting: Private hospital, France.

Methods: An audit was conducted in 2 French tertiary bariatric endoscopic centers focusing on aortic injuries after cSEMS use for leak. We examined and classified the initial procedure, leak characteristics, primary endoscopic treatment, and outcome of endoscopic complication for each eligible case.

Results: A total of 5 patients were identified with foregut wall perforation and aorta injuries. All stents were deployed for staple line leak following LSG. The recorded mortality in case of esophageal-aortic injuries related to cSEMS use was 80%.

Conclusion: cSEMS are potentially effective tools for the management of foregut leaks in bariatric surgery. The biggest challenges with this approach are stent migration and poor quality of life. Caution is required due to the risk of fatal complications such as foregut wall perforation and aortic injury. (Surg Obes Relat Dis 2020; ■:1–5.)

Keywords: Sleeve; Leak; SEMS; Stent; Endoscopic treatment; Aortic injury

The increasing prevalence of morbid obesity and the success of surgery in treating this condition have led to a subsequently increased number of bariatric procedures worldwide. Even if Roux-en-Y gastric bypass (RYGB) was considered the criterion standard in bariatric surgery for many years, laparoscopic sleeve gastrectomy (LSG) has progressively evolved into the most frequent bariatric procedure both in France starting in 2011 and the United States starting in 2013 [1,2]. LSG is generally considered a straightforward procedure, but the surgical technique is one of the major determinants of the postoperative complications. The staple line gastric leak (GL) is estimated to be the most serious complication of this procedure due to a difficult healing process when using a nonstandardized endoscopic approach. Its rate decreased in recent series [3,4] to ≤1%–2% [5].

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According to sleeve consensus meeting [6], the first step of the GL after LSG is the endoscopic treatment. Numerous articles have been written about the different approaches in the management of the GL, but only a few articles describe an algorithm for the endoscopic treatment of GLs [7,8]. We consider it should be tailored according to the leak's size, the presence of concomitant stenosis, the timespan since primary surgery, and probably to the endoscopist's experience.

In the last years, covered self-expandable metal stents (cSEMS) have evolved with commensurable improvements [9] with the purpose to decrease the migration rate and to correct the angular stenosis. However, migration rate and patient's clinical tolerance remain an important concern for stent use [10–20]. Aorto-foregut injuries are an extremely rare complication of the cSEMS employment to treat bariatric surgery leaks, but considering its potential high fatality, it cannot be underestimated. This is probably underreported in the literature, recording only 1 case of aorto-esophageal fistula produced by a stent used for a leak after LSG [21]. The aim of the present study is to report the foregut perforations and aortic injuries related to the insertion of cSEMS following staple line leaks in LSG in our departments.

Methods

Our initial analysis represents a retrospective review of patients treated with cSEMS for complications of bariatric surgery in 2 of the major bariatric endoscopic centers in France with >200 cases of leaks after LSG treated per year. All the procedures were performed by 1 senior endoscopist surgeon (GD) and one senior gastroenterologist (TM). Both authors have an experience of >10 years for endoscopic treatment of complications following bariatric surgery, with numerous reports on this topic. In 2010–2014, all patients addressed for leak were included in a prospective clinical database that was retrospectively analyzed. The study had Institutional Review Board approval by institutional ethical committees of both healthcare facilities. A total of 287 patients were treated with cSEMS for leak and fistula following SG. We identified the relevant cases with aorto-foregut fistula. Two other independent reviewers further assessed the complete files of these patients. The extracted information included details of the initial bariatric procedure, clinical characteristics of the complication, the endoscopic management, and details of the intervention (e.g., type of stent, length). The stents were placed in the acute setting, after surgical drainage if needed. Every patient's postinterventional outcome following endoscopic treatment was presented in details as clinical case. A parallel review of the literature was done and compared with our actual series.

Technical description

The upper endoscopy was performed with the patient in supine position and orotracheal intubation, under fluoroscopic control using a standard scope. A direct exploration of the esophagogastric junction and staple line was performed to identify any defect. The rest of the stomach and duodenum were explored. We performed an upper foregut swallow study through the scope starting at lower esophagus and an extravasation was identified. A stiff 450-cm guidewire was left in place and a long cSEMS was introduced over the guide and deployed between the lower esophagus (to stay watertight in place) and the distal part of the sleeve gastrectomy and/or transpyloric, under fluoroscopy control.

The final procedure was rechecked by a second upper swallow study through the scope to confirm the absence of medium contrast extravasation and the well emptying of the cSEMS, finding no effect of its distal part against the foregut wall. In some cases, the stent was anchored to the esophageal wall by standard endoscopic clip and a nose feeding tube was inserted for enteral nutrition. Some patients were started on an oral diet at day 1, depending on clinical presentation. We scheduled routine endoscopic controls at 4 weeks.

Statistical analysis

We performed an analysis of the data from the included studies. Descriptive statistics (simple counts and mean values) were used to report the study-, patient-, and treatment level data. The number of patients enrolled was used in the calculation of the study and patient demographic characteristics.

Results

Analyzing a total of 287 patients treated with cSEMS for leak and fistula following LSG, the major adverse events such as aortic injuries and distal migration needing surgery for removal was reported in 5.6% of cases (16/287). Minor adverse events such as migration (needing endoscopy repositioning), impaction against the foregut gastrointestinal wall and ingrowth of distal tissue happened in 88 patients (30.7%).

A total of 5 cases (1.7%) were identified in our 2 bariatric centers using our search criteria for screening of aortic injuries after stent treatment. The baseline patient characteristics, initial bariatric procedure, the outcome and clinical presentation of the complication, as well as the initial type of drainage are summarized in Table 1. The stents were deployed for leak following LSG in all cases. The mortality rate by aorto-foregut injuries complicating stents was 80% (5 of 6 patients).

The first case was a 27-year-old female patient suffering from persistent leakage after LSG who was diagnosed at postoperative day (POD) 4 and confirmed by exploratory laparotomy with drainage. Three days later, an 18-cm fully covered stent (Niti-S BetaTM, TaeWoong Medical, Goyang-si, South Korea) was deployed with a favorable

Table 1
Baseline demographic characteristics and outcomes of surgical procedure

Age	Sex	POD complication	Clinical characteristics	Surgical drainage
27	F	POD 4	Fever and abdominal pain	Yes
50	F	POD 8	Tachycardia	Yes
43	M	POD 5	Sepsis (transferred from outside)	Yes
29	F	POD 11	Peritonitis	Yes
34	F	POD 5	Fever and left shoulder pain	Yes

POD = postoperative day; F = female; M = male.

outcome in the first week. On POD 15, she presented at the emergency department in another institution with intense abdominal pain, acute hematemesis, and massive bleeding through the abdominal drain. A computed tomography scanner identified a peri-stent hematoma. An upper endoscopy was performed, and a blood clot was seen on the proximal end of the stent, but there was no active bleeding. During the cardiovascular exploration, a thoracic aorta injury and a perforation of the oesophagus were identified. A short segment of tense fibrosis between the distal esophagus and the aorta, with a 2–3 mm communication between them was seen. A graft of the damaged area was attempted, but unfortunately the patient did not survive the procedure.

The second case, a 50-year-old woman, underwent LSG that was complicated by a leak at POD 8 and treated by exploratory laparotomy and lavage. The initial endoscopic approach consisted in an 18-cm fully covered stent (Niti-S BetaTM, TaeWoong Medical, Goyang-si, South Korea) deployment for 4 weeks. Confronted with the persistence of the fistula, a second similar stent was deployed for another month. The next endoscopic evaluation found the persistence of the leak, motivating the decision to deploy a third stent. After a few hours, the patient presented with massive hematemesis and collapsing shock. Exitus occurred before any other exam or surgical exploration. The autopsy found an esophageal perforation with aortic injury.

The third case, a 43-year old male, presented a 2-cm staple line leak situated at the gastroesophageal junction. The leak was initially treated with a 23-cm cSEMS (Niti-S BetaTM, TaeWoong Medical, Goyang-si, South Korea) for 6 weeks. The patient remained in an intensive care unit for all this period. One day before stent removal, he presented a cataclysmic hematemesis. An endoscopy was immediately performed in the intensive care unit, identifying a huge amount of blood clots and an active bleeding at the proximal part of the stent. The patient was transferred in the operating room, but the cardiovascular arrest occurred just before the surgical exploration. At the autopsy, an aorto-oesophageal fistula was diagnosed, most likely due to an ulceration of the oesophageal stent.

The fourth case is a 29-year-old female patient who underwent LSG. On POD 11, she was readmitted with signs of peritonitis. A laparoscopy was performed the same day. A leakage of the vertical staple line of the gastric tube was seen and the defect was closed with sutures. Because of a persistent leak on POD 13, an endoscopic evaluation of the leak was performed and a fully-cSEMS (Niti-S BetaTM, TaeWoong Medical, Goyang-si, South Korea) was deployed. After 5 weeks, the patient presented with hematemesis, hypotension, and tachycardia. An emergency exploration was performed. The stomach was opened distally, and the stent was removed but the patient continued to bleed proximally, necessitating opening of the stomach completely up to the level of the gastroesophageal junction, where the bleeding source was identified. A pinpoint hole at the base of a small ulcer in the distal esophagus was bleeding profusely. The diagnosis of aorto-esophageal fistula was made, and confirmed later, by the cardiovascular surgeon. The defect was corrected by a left thoracoabdominal incision. A concomitant eso-jejunal anastomosis with gastric resection was performed. The outcome was favorable.

The fifth case, a 34-year-old female patient, underwent LSG complicated at POD 5 by leakage, which was confirmed by exploratory laparotomy with drainage. Three days after, an 18-cm fully-cSEMS (Niti-S BetaTM, TaeWoong Medical, Goyang-si, South Korea) was deployed with a favorable outcome. Fifteen days later, she suddenly presented intense abdominal pain with acute hematemesis. Before any resuscitation measures, she had a syncope with cardiovascular arrest. The diagnosis of aorto-esophageal fistula with perforation of the aortic arch was established during the autopsy. This finding suggested an acute upward migration of the prosthesis.

Discussion

The esophagogastric junction represents an anatomic area of weakness for any digestive suture. The fundic wall is thinner, and the vascularization is more precarious than for the rest of the stomach. This area under the cardia is more sensitive to technical failure or to any increase in the intragastric pressure [13]. Experience showed us that almost all leaks after bariatric surgery originate in this location, namely just below the gastroesophageal junction [14].

When faced with a GL, the surgeon must consider all options to confront it adequately. According to the literature, after leak diagnosis, all unstable patients need drainage of the collection and lavage of peritoneal cavity by laparoscopy, laparotomy, or percutaneous approaches.

Instead, for stable patients, a conservative approach by collection drainage with Endoscopic Internal Drainage or interventional radiology could be a valid alternative as first choice. Blood and electrolyte imbalance restoration, alimentary tract resting, optimal nutrition launching, and sepsis management must also be an absolute priority. If the endoscopy was not the primary treatment, we should proceed to the endoscopic exploration of the gastric area to assess for different methods of endoscopic treatment.

The main limitation of the leak treatment lies in the lack of standardization in the management of the fistula, in particular using an endoscopic approach. The advent of brand new, longer endoscopic stents with other latest innovations such as pigtail drains or Ovesco clips are facilitating the leak treatment. However, migration rate and patient's clinical tolerance remain an important problem for stents. Table 2 presents summarized data regarding different rates of stent migration reported in the literature. Fully-cSEMS may have higher rates of migration, while partially-cSEMS stimulate tissue ingrowth, helping to secure the stent in situ. The use of a partially-cSEMS mandates removal and replacement, if required, at shorter, regular intervals, to prevent robust tissue ingrowth and difficult extraction [21].

At the beginning of the experience, the use of stents in bariatric surgery was suggested for 48 weeks, to be efficient for the resolution of a staple line or anastomotic leak. Edges mucosal ulceration an in and overgrowth integration of the stent into the mucosa were 2 complications that have historically been attributed to stents inserted for longer periods and placing stents that were not fully covered.

Foregut perforation secondary to radial force of stent, consequent ischemia, and serious erosion have been documented in the literature. One study reported major erosions causing tracheo-esophageal fistulas in 2 of 23 patients [22], and another described a cohort where stent erosion into pulmonary artery occurred in 1 of 31 patients, requiring a major operation [23]. Certainly, the formation of the aorto-foregut injuries implies many other factors. The radial force of the cSEMS may erode through the wall of the esophagus/stomach/duodenum and result in an injury and fistulous tract between the aorta and viscus. This is also the combined effect of infection, local ischemia due to surgery and local pressure on the oesophagus/duodenum caused by the cSEMS. The Niti-S BetaTM stent was specifically designed for staple line leakage after bariatric surgery. It is uncertain if the double bump mechanism created to prevent migration can cause specific complications and whether this contributes to ischemia and wall ulceration and the development of an aorto-oesophageal/duodenal fistula [10]. Puli et al. [13] reported a comprehensive review regarding the use of stents in the treatment of bariatric surgery leaks. At that time, no case of aortic injury or aorto-esophageal fistula after stent use was reported. In a recent review, we identified 4 cases [21,23–25] of such dreaded complication of stent use in bariatric surgery and the statement of "no stent associated mortality" must be revised. Surprisingly, 3 of 4 cases were after RYGB. Probably, many of the complications following LSG were also case reports and probably, there were many unreported.

A high index of suspicion for this complication is necessary when patients present hematemesis at a computerized tomography scan or upper endoscopy, and there is bleeding around the stent placement site or if the patient is hemodynamically unstable. Appropriate workup is needed to assess for aorto-esophageal fistula with emergent vascular management if present. Ideally, the management of aorto-esophageal

Table 2
Literature review with stent migration rate

Author, yr	Patients	Stent migration	Initial procedure
Swinnen et al. [10] 2011	88	11.1%	N/A
El Mourad et al. [11] 2013	47	14.9%	15 LSG; 10 RYGB 3 minigastric bypass 19 revisional surgery
Bège et al. [12] 2011	27	59%	2 RYGB 25 LSG
Puli et al. [13] 2012	67	16.9%	N/A
Edwards et al. [14] 2008	6	83%	RYGB
Simon et al. [15] 2013	9	11.1%	LSG
Salinas et al. [16] 2006	17	5.88%	RYGB
Donatelli et al. [17] 2012	15	33.33%	2 RYGB 7 LSG 4 TG 2 esophagectomy
Puig et al. [18] 2014	21	47%	5 leaks (4 LSG) 16 strictures (15 RYGB)
Sharaiha et al. [19] 2014	38	42.1%	20 strictures 18 leaks
Alazmi et al. [20] 2014	17	6%	17 leaks (LSG)

N/A = not available; LSG = laparoscopic sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass; TG = total gastrectomies.

fistulas is by endovascular aortic repair to control bleeding in the acute setting, either as a stand-alone procedure or combined with a more definitive management in an elective setting [26]. In our experience, only 2 of 5 patients underwent a rescue surgical procedure, but only 1 with a favorable outcome. No patient had an endovascular approach.

In a recent survey [27], despite poor quality of life and different techniques of fixation, 56% of responders are still using fully-cSEMS as their usual first option. Surprisingly, 28.4% answered that the common dwell time is $\geq$6 weeks and for 16.4% is $\geq$8 weeks.

On the ground of our experience, we highly recommended to avoid the use of cSEMS for leak and fistula after LSG, because of ischemia and inflammation caused by the stent. This could be responsible for ulceration or risk of aorto–foregut fistula, a fatal complication. Definitely, stents could have still a place in treating stenosis following LSG, for a short time ($<$4 wk). However, some teams are still recommending stents for a certain type of leak following LSG.

Conclusion

cSEMS are potentially effective tools for the management of leaks after foregut bariatric surgery. The biggest challenge with this approach is stent migration and poor quality of life. For these 2 reasons, nowadays, in our experience, the use of stents for leaks following LSG has been forgotten and replaced with pigtails/septotomy. Caution is required due to the risk of fatal complications such as aorto-foregut fistula formation. Aortic injury is a rare but possible complication after stent use. Despite its exceptional character, bariatric surgeons and endoscopists should be aware of this life-threatening complication.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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