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CLINICAL REPORT

Nonsurgical Treatment of Staple Line Leaks after Laparoscopic Sleeve Gastrectomy

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Abstract
Background Laparoscopic sleeve gastrectomy (LSG) is gaining popularity as a "per se" bariatric procedure due to its effectiveness on weight loss and comorbidity resolution. The most feared and life-threatening complication after LSG is the staple line leak and its management is still a debated issue. Aim of this paper is to analyze the incidence of leak and the treatment solutions adopted in a consecutive series of 200 LSG.
Methods From October 2002 to November 2008, 200 patients underwent LSG. Nineteen patients (9.5%) had a body mass index (BMI) of >60 kg/m^2. A 48-Fr bougie is used to obtain an 80–120-ml gastric pouch. An oversewing running suture to reinforce the staple line was performed in the last 100 cases. The technique adopted to reinforce the staple line is a running suture taken through and through the complete stomach wall.
Results Staple line leaks occurred in six patients (mean BMI 52.5; mean age 41.6 years). Leak presentation was early in three cases (first, second, and third postoperative (PO) day), late in the remaining three cases (11th, 22nd, and 30th PO day). The most common leak location was at the esophagogastric junction (five cases). Mortality was nihil. Nonoperative management (total parenteral nutrition, proton pump inhibitor, and antibiotics) was adopted in all cases. Percutaneous abdominal drainage was placed in five patients. In one case, a small fistula was successfully treated by endoscopic injection of fibrin glue only. Self-expandable covered stent was used in three cases. Complete healing of leaks was obtained in all patients (mean healing time 71 days).
Conclusion Nonoperative treatment (percutaneous drainage, endoscopy, stent) is feasible, safe, and effective for staple line leaks in patients undergoing LSG; furthermore, it may avoid more mutilating procedures such as total gastrectomy.

Keywords Morbid obesity · Bariatric surgery · Sleeve gastrectomy · Complication · Leak

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Introduction

Laparoscopic sleeve gastrectomy (LSG) is the first step of the two-stage laparoscopic biliopancreatic diversion with duodenal switch (BPD-DS). It was first performed laparoscopically in 2000 [1]; its purpose was to reduce operative morbidity and mortality in high-risk superobese patients undergoing BPD-DS [2].

Results obtained in terms of weight loss and resolution of comorbidities encouraged and stimulated the diffusion of sleeve gastrectomy inducing several authors to propose this procedure as a primary bariatric procedure [3–5]. The effect has been attributed to the reduction of the gastric capacity (restrictive effect) and/or to the orexigenic and anorexigenic intestinal hormone modification (hormonal effect) [5, 6]. LSG is a technically simple surgical procedure with a low complication rate and negligible long-term nutritional deficiencies [7–10]. However, staple line leaks may occur and represent the most dangerous and life-threatening

complication after LSG, with an incidence between 1.4% and 2.4%, despite the fact that bariatric surgeons frequently use buttressing materials (bovine pericardial strips or Seamguard-Gore) or running oversewing suture to reinforce the staple line and to reduce the risks of leaks or bleedings [8, 11].

Suture line leaks have been managed endoscopically, using fibrin sealants, microcoil emboli, and self-expandable intraluminal stents or by reoperation. An unsuccessful control of the leak, at occasion, required total gastrectomy or creation of a Roux limb [12, 13].

The aim of this paper is to report the incidence rate of suture line leaks after LSG in a series of 200 consecutive patients and the strategies adopted for the treatment of this complication.

Materials and Methods

From October 2002 to November 2008, 200 patients underwent LSG in our surgical unit. Nineteen patients (9.5%) had a body mass index (BMI) of >60 kg/m^2. In 11 patients (5.5%), LSG was revisional surgery for insufficient weight loss: after adjustable gastric banding in ten cases and after vertical gastroplasty in one case.

Surgical Procedure

Five trocars are placed. The division of the vascular supply of the gastric greater curvature is carried out with LigaSure™ Vessel Sealing device (Valleylab™, Boulder, CO, USA) and starts at 6–8 cm from the pylorus, proceeding upwards to the angle of His,.

The gastric pouch is created by using a linear stapler (EndoGIA®, US Surgical, Norwalk, CT, USA), with two sequential 4.8/60-mm green load firings for the antrum, followed by two or three sequential 3.5/60-mm blue cartridges for the remaining gastric corpus and fundus. The stapler is applied alongside a 48-Fr calibrating bougie tightly positioned against the lesser curve, to obtain an 80–120-ml gastric pouch. In the first 100 cases, the suture line reinforcement was used only in four patients (in three cases bovine pericardium, Synovis, St. Paul, MN, USA, and in one case SeamGuard, Gore, Flagstaff, AZ, USA). In the last 100 cases, an oversewing running absorbable suture (Polydioxanone) was routinely performed by taking the complete stomach wall.

The resected stomach was extracted through the 15-mm port-site wound. A methylene blue dye test is routinely performed through a nasogastric tube. No drains are placed and the nasogastric tube is removed at the end of the procedure. Upper gastrointestinal contrast (Gastrografin®) study was performed on the first to third postoperative day.

When a fistula was detected, a computed tomography (CT) scan was performed to estimate the size of the abdominal collection. The collection was drained by the interventional radiologist during the same procedure using a pigtail catheter (Fig. 1). Twice daily, through the catheter, the abdominal collection was irrigated with saline solution until clear liquid was obtained. When the fistula persisted more than 4 weeks or the size of the abdominal collection did not diminish appreciably, a self-expandable coated stent was placed.

All patients had X-ray control 1 month after healing of the fistula.

All data, sex, age, BMI, comorbidities, duration of surgery, use of staple line reinforcement, and type of treatment of complications with outcome for each patient were prospectively collected on a computerized database.

Results

Staple line leaks occurred in six patients (3%). The patient characteristics are shown in Table 1. In these six cases, no intraoperative complications had occurred and the methylene blue test was negative for staple line leakage. In four cases, no reinforcement of the suture line has been performed, while, in two cases, an oversewing reinforcement has been carried out. In three of these patients, Gastrografin® swallow between the first and the third

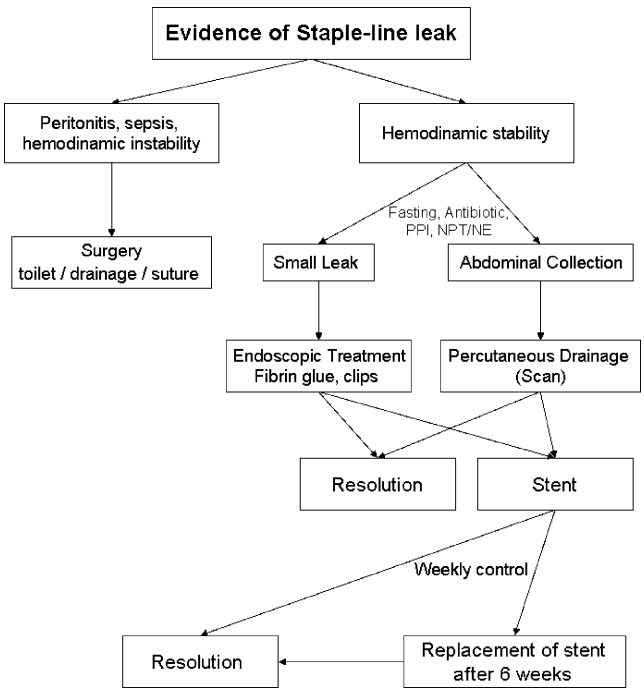

Fig. 1 Flow chart for the management of staple line leak after laparoscopic sleeve gastrectomy in our center

Table 1 Characteristics of six sleeve gastrectomy patients with staple line leak

Pt	Sex	Age	BMI	Comorbidities	Reinforcement	Duration of surgery (min)	Fistula location	Timing (PO day)	Treatment	Healing time (days)
1	F	38	50	No	No	110	Midgastric	30th	PD	30
2	M	40	55	T2DM, hypertension, OSAS	No	100	G–E junction	First	PD+endoprosthesis	98
3	M	50	60	T2DM, hypertension, OSAS	No	120	G–E junction	Third	PD+endoprosthesis	124
4	F	28	53.7	No	No	80	G–E junction	22nd	Endoscopic fibrin glue	21
5	F	44	40.6	No	Oversewing	70	G–E junction	First	PD+endoprosthesis	110
6	F	50	55.5	T2DM, hypertension, OSAS	Oversewing	80	G–E junction	11th	PD	44

T2DM type 2 diabetes, *PD* percutaneous drainage

postoperative day showed a fistula (early presentation). The remaining three patients were discharged on the fourth postoperative day with negative upper gastrointestinal series and were readmitted on the 11th, 22nd, and 30th postoperative day, respectively, with clinical symptoms suggesting a fistula formation (late presentation; Fig. 2). In all cases but one, the leakage developed at the esophagogastric junction. Clinical presentation of leakage is described in Table 2.

No patient developed general sepsis or peritonitis.

Antibiotics therapy, proton pump inhibitor (PPI), and total parenteral nutrition/enteral nutrition were instituted in all cases.

In one case, an asymptomatic small fistula was successfully treated by endoscopic injection of fibrin glue without any additional therapeutic measure. In the remaining five cases, a pigtail drainage was placed under CT scan guidance.

In three cases, the fistula persisted for more than 4 weeks. A self-expanding stent was placed under fluoroscopic and endoscopic control (coated metallic stents Ultraflex™ Esophageal NG Stent System-Boston Scientific in one case and NITI-S Esophageal covered Stent-Taewoong Medical in two cases). Radiological controls were performed weekly in order to check the correct stent position (Fig. 3). In two patients, in order to avoid prosthesis migration and to allow resumption of a liquid diet, a second stent was placed inside the first one 29 and 10 days after the first stenting. In case no. 3, after 28 days, the X-ray control showed a stent migration and the persistence of the fistula. The migrated stent was removed endoscopically and a new stent was positioned. Stents were left in place for a mean time of 55 days (range 50–62 days) with healing of the leaks in all patients.

Mean hospital stay was 41 days. Stent placement and removal was performed in hospital regimen while the weekly radiological controls were performed in day-hospital regimen. Mean healing time was 71 days (range 21–124). No patient required reoperation and mortality was nihil. One month after fistula healing, X-ray control showed no abnormalities. At a mean follow-up of 19.5± 18.7 months, there were no clinical signs of recurrence.

Fig. 2 Case no. 4. Rx Gastrografin swallow shows a small leak at the G–E junction and a medio-gastric substenosis

Table 2 Clinical presentation of staple line leak

	No. of patients (6)
Epigastric pain	4
Vomiting	4
Fever	3
Dyspnea	2
Pleural effusion	2
No symptoms	1

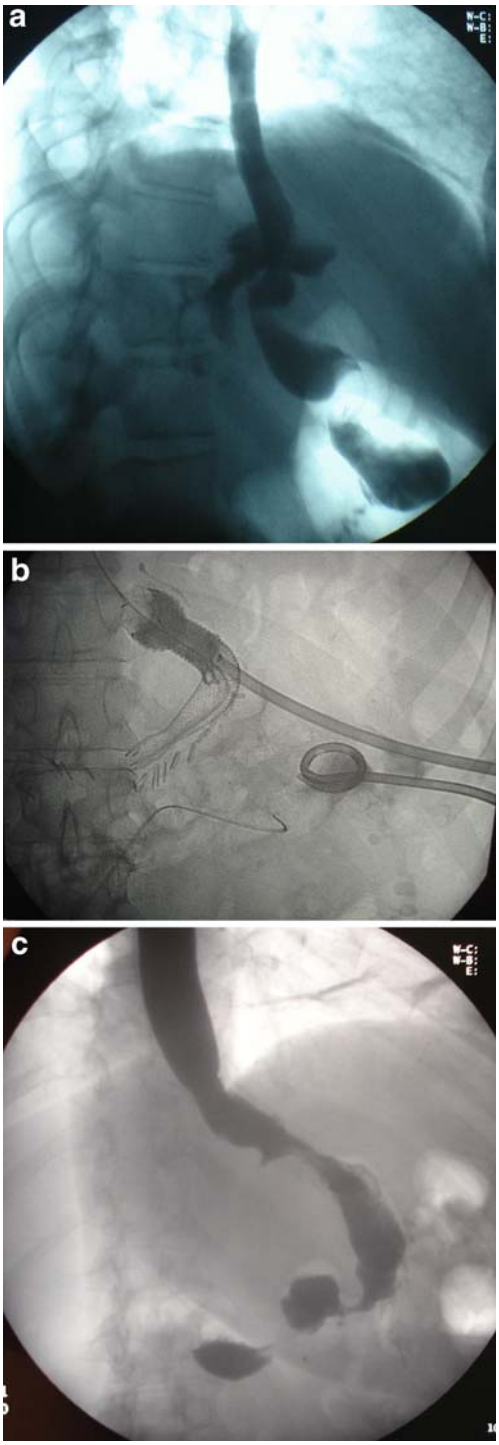

Fig. 3 Case no. 3—**a** leak at the upper portion of staple line; **b** leak was treated with percutaneous drainage and stent placement; **c** complete healing of the staple line leak

Discussion

LSG as a "per se" procedure is gaining popularity for the surgical management of morbid obesity. Several data suggest that LSG is effective on weight loss and comorbidities and has a low complication rate [3–5]. The American Society for Metabolic and Bariatric Surgery Statement gave a detailed review on SG: in 775 operations, the overall complication rate ranged from 0% to 24% and the mortality rate was 0.39% [9]. Staple line leak is the most feared postoperative complication, requiring reoperation in some cases and a long hospitalization time [7, 14]. Gumbs et al. in 646 SG reported <1% mortality, 4.5% reoperation rate, and 0.9% leak rate [10]. In recently reported series, there were one leak in 146 patients (0.7%) and three leaks in 216 (1.4%) [7, 15]. In our experience, leak presented in six patients (3%) and it occurred early (on the first to third postoperative day) or late (1 week or more after the operation). The different timing may be due to different etiological mechanisms: mechanical or technical for leakage occurring within 48 h and ischemic (tension, poor wound healing) for leakage occurring 5–7 days postoperatively [8]. The most common location of the leak was just below the esophagogastric junction (five out of six cases) possibly related to the high intragastric pressure with impaired peristaltic activity and ischemia [8, 13, 16]. In one patient, the fistula location was at the antrum at the junction of the sequential stapler firings as seen by other authors [8, 13].

In the present series the methylene blue test, performed intraoperatively in all cases, was positive in two cases. The leak was repaired intraoperatively without further postoperative sequelae. In all cases with leak, even when the leak was shown on the first postoperative day, the intraoperative methylene blue test was negative. For this reason, we consider the methylene blue test reliable only when positive. A negative blue test cannot exclude the development of a postoperative leak.

The use of bovine pericardium has been shown not to secure consistently suture line [17, 18]. The same was shown for oversewing reinforcement in two recent studies [8, 11]. In the 100 consecutive cases in which routinely a running suture taking the complete stomach wall as staple line reinforcement was performed, leak presented in two cases. Oversewing successfully prevented staple line bleeding in all cases and diminished the incidence of leak formation but did not prevent it completely, confirming previous data published by us [19].

Operative treatment in patients with staple line leak is mandatory when hemodynamic instability and peritonitis are present. In these cases, the operative treatment of leak recurrence is intended as "rescuing surgery." Peritoneal toilet and proper drainage are recommended. Reinterventions to simply repair the fistula have a high recurrence rate possibly because of the surrounding inflammatory tissue and high intraluminal pressure. Surgical options for repair are high gastric bypass, Roux limb, or total gastrectomy [8, 13, 14]. Chen et al. reported two cases of leak in a series of

35 LSG, treated with early reoperation. Both patients required revisional surgery after 4–6 weeks [8]. The results of the present series suggest that the staple line leak can be safely and successfully managed without reoperation in patients with hemodynamic stability. All patients were treated with antibiotic therapy, TPN/EN, and high-dose intravenous proton pump inhibitor (PPI). The CT scan was useful to detect the presence and the size of the abdominal collections so that a proper drainage was performed radiologically. In one case, a small asymptomatic leak was approached and successfully treated by endoscopic injection of fibrin glue only.

In the series by Eubanks et al. the drainage procedure was performed surgically; the healing time was 30 days, shorter than the one of the present study (41 days) [16]. However the patients in our study were discharged 3 days after stent placement and they were allowed a semiliquid diet. It remains to be evaluated whether it is more convenient a X-ray mini-invasive drainage with a longer healing time or a surgical drainage with an apparently shorter healing time.

When leakage persists for more than 4 weeks or the size of the abdominal collection does not diminish appreciably, the use of self-expanding stents may be considered as a feasible and effective treatment option (Fig. 1). The stent allows oral nutrition and discharge of the patient. Serra et al. reported six cases of gastric leaks after sleeve gastrectomy. The gastric leaks completely healed in five patients by positioning self-expandable coated stents, while the patient treated with the wall stent required a total gastrectomy after 3 months for the persistence of fistula [12]. Eisendrath et al. reported a success rate of 75% (three fourths) for the treatment of fistulas with the use of stents [20]. In a series published by Eubanks et al., 19 staple line complications after bariatric surgery (including 11 acute leaks, two chronic fistulas, six strictures) were treated with endoscopic stents. Resolution rate was higher in acute leaks (89%). Migration required replacement or repositioning of the stent in 42% of patients. Three patients required surgical removal of the stent from the small bowel [16]. The high migration rate of the prosthesis can be explained by the "abnormal" placement of the stent along the last portion of the esophagus and the gastric pouch since the gastric pouch does not ensure a proper containment of the prosthesis. In the present experience, an endoprosthesis was used in three cases. The stents were left in place for a mean time of 55 days (range 50–62 days) and withdrawn after complete healing of the fistula. Weekly X-ray controls are mandatory to evaluate the correct stent position. In gastric bypass patients with gastrojejunal anastomotic leak after gastric bypass, it has been shown that mortality, complication rate, and incidence of rescuing operations (total gastrectomy, etc.) are much higher in the surgery-treated group of patients when compared to the stent placement group of patients, although the healing time is much longer in the second instance [21–23]. The data of the present study, in accord to literature data, confirm that simple drainage, alone or in combination with stent placement, is a safe and effective treatment for suture line leaks in patients undergoing LSG. Furthermore, it is a minimally invasive technique with low complication rate and little discomfort for the patients, avoiding more invasive procedures or even total gastrectomy.

Disclosure The authors have no conflict of interest.

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