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ORIGINAL CONTRIBUTIONS

Management Algorithm for Leaks Following Laparoscopic Sleeve Gastrectomy

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Abstract
Background Leak after laparoscopic sleeve gastrectomy (LSG) is a serious complication. No clear algorithm has been described for management.
Methods We reviewed our prospective database for all leaks after LSG treated at the Bariatric and Metabolic Institute (BMI) Abu Dhabi from 2010 to 2014. Our management algorithm is based on the timing of the LSG leak, nutritional status of the patient, and the presence of stenosis or peritonitis. Acute leaks with or without peritonitis are treated by operatively or utilizing endoscopic stenting, respectively. LSG leaks with stenosis not amenable to endoscopic stenting are treated with laparoscopic Roux en Y esophagojejunostomy (LRYEJ).
Results We performed 236 LSG without a leak, and 14 LSG leaks were referred to our unit. Mean age was 35.6 years, and 50 % of patients were males. Mean BMI was 37 kg/m^2. The patients presented on average 13.9 weeks after LSG. Enteral feeding was used as the primary nutrition route in 85.5 % of patients. Our management strategy was operative in 78.4 % of patients (jejunostomy feeding in 57 % and LRYEJ in 21.4 % of patients) and conservative with or without stents in 21.6 % of patients. Mean in hospital length of stay (LOS) was 5.6 weeks. Our reoperation rate was 7 %. There were no mortalities and one patient 7 % developed pulmonary embolism. None of the patients treated returned with a leak or collection after a mean follow up of 23.6 months.
Conclusion Treating leaks following LSG based on the timing of presentation, presence of stricture, and malnutrition is safe and effective.

Keywords Sleeve gastrectomy · Leaks · Algorithm for management

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Introduction

Laparoscopic sleeve gastrectomy (LSG) is commonly used as a stand-alone procedure to treat morbid obesity [1]. In addition, LSG is increasingly performed and is currently the second commonest procedure performed worldwide and the commonest in our region [2]. The overall complication rate of LSG has been shown to be lower than laparoscopic Roux en Y gastric bypass (LRYGB). However, leak after LSG is one of the most devastating complications [3]. In addition, leaks after LSG leaks are more common and more difficult to treat than leaks after LRYGB. Several strategies are used to treat leaks following LSG [4–8]. Theses strategies range from nonoperative management, endoscopic stenting, operative exploration with jejunostomy feeding or Roux en Y reconstruction with or without a proximal gastrectomy. The strategies proposed by several authors are used to treat a very diverse group of patients with leak after LSG. However, no algorithm has been proposed to the best strategy to treat leaks following LSG. In addition, most series include a diverse group of leaks after LSG. For example, most series include acute and chronic leaks in septic and stable patients. Hence, different strategies are used to treat leaks after LSG. In this study, we present our experience in treating leaks after LSG and our proposed management algorithm based on this small series of patients.

Methods

Following IRB approval, we reviewed our prospectively maintained database for all leaks after LSG treated at BMI Abu Dhabi as well as all primary and revisional LSG performed at BMI Abu Dhabi from April 2010 to October 2014. In addition, we reviewed the literature for reports of management strategies to treat patients with leaks following LSG, and we describe our proposed management algorithm to treat leaks following LSG.

All consecutive patients with leak after LSG demonstrated on radiographic imaging were included in our study, and no patients were excluded from our analysis.

Our operative technique of LSG and a comparison of our outcomes compared to the outcomes from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) hospitals have been described previously [9]. In summary, we perform our LSG over an adult 32 Fr endoscopy and we do not staple very close to the endoscope. We start our transection 3–4 cm from the pylorus, and we oversew and invert the entire staple line utilizing absorbable sutures. At the end of the LSG, we perform an intra-operative endoscopy and do not use drains. Postoperatively, all patients are started on clear liquids once they are awake, and we do not utilize radiographic studies routinely. Our technique for laparoscopic Roux en Y esophagojejunostomy (LRYEJ) is started by dissecting on the right side of the hiatus and performing limited mediastinal dissection. Next, we identify the splenic vessels on the left side and resect the chronic LSG fistula and complete the limited mediastinal dissection from the left side. Next, we transect the esophagus above the LSG fistula and transect the LSG, leave the antrum, and place a feeding tube in the antrum. Finally, we perform retrocolic RYEJ utilizing absorbable suture hand sewn.

BMI Abu Dhabi is the main tertiary referral center for complications of bariatric surgery in the UAE. Our management algorithm for leaks following LSG is based on the timing of the leak at presentation to our unit, the presence of a distal stenosis/stricture based on a gastrograffin upper gastrointestinal (UGI) study or upper endoscopy, the presence of peritonitis, and the nutritional status of the patient.

Management Algorithm (Fig. 1)

All patients presenting with suspicion of a leak after LSG are resuscitated and then evaluated with CT scan of the abdomen and pelvis with oral and intravenous contrast, UGI study, and upper endoscopy (EGD). If a collection is seen on CT scan of the abdomen, then percutaneous drainage is done prior to performing an UGI study and upper endoscopy.

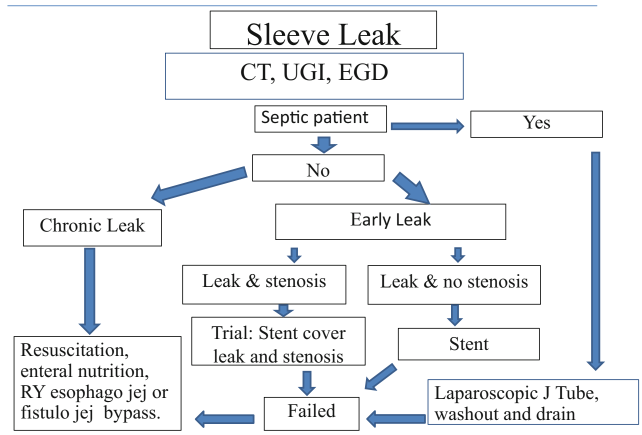

Fig. 1 Algorithm of sleeve leak management

If the patient has peritonitis clinically (hypotension, significant tachycardia, peritoneal irritation on abdominal examination etc.…), we would resuscitate the patient and then perform laparoscopic exploration. We have described previously our operative management of leaks after LSG presenting with peritonitis without the use endoscopic stents [10]. In summary, we perform laparoscopic exploration and intra-operative endoscopy and place a jejunostomy tube and wide drainage of the peritoneal cavity.

In contrast, if the patient does not have peritonitis clinically, our strategy is non operative. Initially, we perform a gastrograffin UGI study to evaluate the size of the leak and whether the patient has only a leak or a leak and a stricture. Following the UGI study we perform an EGD to look for a stricture, twist, or kink and place a nasojejunal feeding tube at the same time if we are not planning to place an endoscopic stent. We try to use enteral nutrition and avoid parenteral nutrition at all cost.

If the patient presents acutely but is stable and without a stricture on EGD, then we would place an endoscopic stent. However, if the patient has an acute leak with a stricture or a chronic leak [11] (more than 12 weeks) not amenable to endoscopic stenting, this group represents the most difficult group of patients to treat. We treat this group of patients by optimization followed by LRYEJ. Finally, patients who fail laparoscopy, wash out and feeding jejunostomy, fail endoscopic stenting, or fail conservative management with nasojejunal feeding are treated with LRYEJ. Again, the management algorithm depends on the timing of the presentation, presence of a stricture, presence of peritonitis, and the nutritional status of the patient.

Results

During the study period, we performed 236 LSG cases without a leak, and during the same time period, we treated 14 leaks following LSG referred to our unit. Mean age for the patients with LSG leaks was 35.6 years SD±11.6, and 7 patients (50 %) were males. Mean BMI was 37 kg/m [2] SD± 11.9. The patients presented to us on average 13.9 weeks after LSG SD±24.7 days. Enteral feeding was used as the primary nutrition route in 12 patients (85.5 %) (Table 1). Our management strategy was operative in 11 patients (78.4 %) (the operative strategy was jejunostomy feeding in 8 patients (57 %) and LRYEJ in 3 patients (21.4 %) and conservative with or without stents in 3 patients (21.6 %). At the initial presentation, 3 patients (21.4 %) presented with peritonitis and 3 patients with a tight stricture (21.4 %). Two of these 3 strictures were not amenable to endoscopic stenting, and both patients needed laparoscopic subtotal gastrectomy and Roux en Y esophagojejunostomy). Mean in hospital length of stay (LOS) was 5.6 weeks SD±6.1 days. Mean time from presentation to healing (patients resuming oral diet with negative radiographic studies) was 7.1 weeks SD±10.1 days. We used endoscopic stents in 4 patients (28.5 %) and enteral feeding in 12 patients (86 %). Only one patient needed reoperation (7 %). There were no mortalities, and one patient (7 %) developed a pulmonary embolism. All patients were successfully treated, and no patients treated returned with a leak or collection after a mean follow up of 23.6 months SD±17.3 (Table 1).

Discussion

LSG is now the second most common procedure performed worldwide and the most common in Asia [2]. This was evident from a recent review of the world wide trend in bariatric surgery from 2003 to 2011 in the USA, South America, Europe, and Asia [2]. Several reasons contribute to the popularity and sudden rise in LSG numbers from an obscure operation in 2003 to the second most common in 2011. First, the learning curve for LSG is less steep than LRYGB. In addition, patients perceive LSG as more effective than laparoscopic adjustable gastric band (LAGB) and less complicated than LRYGB without any re routing of the food passage or surgery on the small intestine. Furthermore, the morbidity, mortality, and weight loss outcomes for LSG are positioned between the LAGB and the LRYGB [3].

Despite the overall lower morbidity of LSG compared to LRYGB [3], leak after LSG is more common than LRYGB, and it is more difficult to treat and takes longer time to heal when compared with LRYGB. In most series, the leak rates after LSG ranges from 0.7 to 5 %, and it may reach 20 % in some series [4–6]. In addition, the consequences of leak after LSG can be devastating, and leaks after LSG are not all the same. In a series of 22 LSG leaks referred to a tertiary referral center with extensive experience in managing bariatric surgery complications, a stent was tried in nine patients with chronic leak after LSG but failed in 84.6 % of cases. In addition, one third of the patients needed a total gastrectomy, and

Table 1 LSG leak algorithm

Index operation	Age/gender	BMI	Timing from LSG in weeks	Enteral feeding	Stent	Stenosis	Peritonitis	LOS*	Reoperation		Follow up in months	Time to healing in a week
LAGB to LSG	49 F	64	6	J tube	No	No	Yes	26	No	Laparotomy resection EFC** and J tube	48	42
LAGB to LSG	34 F	33	4	J tube	Yes	No	No	4	No	Open J tube	46	6
LAGB to LSG	30 M	51	5	J tube	No	No	No	3	No	Laparoscopy, T tube and J tube	39	5
Primary LSG	27 F	32	4	J tube	No	No	No	3	No	Laparoscopy J tube	27	4
Primary LSG	20 M	25	72	J tube	No	No	Yes	2	Yes	Laparotomy J tube	26	3
Primary LSG	38 M	46	4	J tube	No	No	No	4	No	Laparoscopy J tube	21	6
Primary LSG	39 F	34	4	J tube	No	No	No	3	No	Laparoscopy J tube	39	6
LAGB to LSG	37 F	34	3	TPN	No	No	No	2	No	Conservative management NPO TPN	36	2
Primary LSG	28 F	20	72	NJ	Yes	No	No	6	No	Laparoscopic RY esophagojejunostomy	14	4.5
Primary LSG	44 M	37	1.5	TPN	No	No Yes	No	5	No	Laparoscopic RY esophagojejunostomy	7	4.5
Primary LSG	21 M	39	3	NJ	No	Yes	No	4	No	Laparoscopic RY esophagojejunostomy	2	3.5
Primary LSG	29 F	31	12	NJ	Yes	Yes	No	9	No	Endoscopic stent	1	9
Primary LSG	39 M	37	2	Oral TPN	Yes	Yes	No	4	No	Endoscopic stent only	1	7
Primary LSG	64 M	36	1	J tube	No	No	Yes		No	Laparoscopy, T tube and J tube	2	5

NJ nasojejunal in weeks, *ECF* enterocutaneous fistula

*Length of stay in weeks

general anesthesia was needed in 41 % of patients, half of the patients developed organ failure, and close to half had central venous device infection and the mortality rate was 4.5 %. Furthermore, the time to cure was 310 days (9–546 days) [4]. The failure of endoscopic treatment in this study is in contrast to the success rate of endoscopic stents in treating acute leaks after LSG (approaching 85 %) [8]. This discrepancy can be explained by the timing of the leak, chronic in the first study with failure of endoscopic stunting, and acute in the second study with an excellent success rate.

Our management algorithm depends on several factors, and one of them is the timing of the leak after LSG. In contrast to the severe morbidity and 4.5 % mortality described by Moszkowicz et al. [4] in treating leaks after LSG, our algorithm allowed us to treat patients with leak after LSG with low morbidity (7 % reoperation, 7 % Pulmonary embolism, 0 % recurrence of recurrence of leak, and 0 % central line infection), and 0 % mortality. In addition, 21 % of our patients compared to 32 % in the Moszkowicz study [4] needed an extensive complicated procedure like laparoscopic subtotal gastrectomy and Roux en Y esophagojejunostomy. Furthermore, we did not encounter any central line infection compared to 40 % in the Moszkowicz study [4]. We did not encounter any central line infections because we did not utilize parenteral nutrition in most patients, and instead, we used enteral feeding through nasojejunal or jejunostomy tube feeding in 12/14 of our patients (87 %).

Our length of stay was on average 5.6 weeks; this LOS is long mainly because most patients presented in severe malnutrition and needed resuscitation and correction of nutritional status prior to surgery. For example, the average LOS after laparoscopic Roux en Y esophagojejunostomy was 5 weeks, but all 3 patients presented with severe malnutrition and needed 3–4 weeks of optimization, nutritional support prior to definitive surgical repair.

Several factors contribute to the higher risk of leak in LSG as compared to LRYGB. In a recent meta-analysis of 9991 cases of LSG, the size of the bougie used to gauge the size of the LSG correlates with the leak rate. The bougie size of more than 40 Fr was associated with less leaks following LSG [11]. In the same meta-analysis, the distance from the pylorus, and the use of buttressing material did not affect the leak rate following LSG or the short term weight loss. It appears that staple line reenforcement and suturing may decrease the risk of bleeding following LSG, but they may not decrease the leak rate [11].

The most common site for leaks following LSG is at the gastro-esophageal (GE) junction [12, 13]. Similarly, 92.8 % of leaks in our series were at the GE junction. We believe that leaks at the GE junction happen due to errors of stapling at the incisura or energy device injuries near the GE junction. Hence, the presence of a stricture, twist, or kink at the incisura is a very important factor to consider in patients with leaks following LSG. In our series, 28.5 % of the patients we treated had a tight stricture near the incisura evident on both UGI studies and EGD. Two of these patients were not amenable to endoscopic stenting and needed to have an esophagojejunostomy. The other patients were stented and then healed with enteral feeding alone.

Our management algorithm is either conservative in 21.6 % (with or without endoscopic stents) or operative in 78.4 % (with jejunostomy feeding placement in 57 % or Roux en Y esophagojejunostomy in 21.4 %). We decide the operative strategy based on several factors. For example, for acute leaks without peritonitis, clinically, we utilize endoscopic stents. Endoscopic stent placement is a potential management strategy for LSG leaks and has the best results in acute leaks. However, endoscopic stent placement has a learning curve, may not heal chronic leaks, and can lead to stent migration or significant dysphagia in some patients [4, 13–15]. Most stent series are small involving leaks from LSG, RYGBP, esophageal, and upper gastric surgery. In addition, the best time for stent removal is not known. In most studies it ranges from 22 to 88 days after insertion, and in one study, the mean LOS was 91.4+8.2 days. One great advantage of endoscopic stents is the ability to resume oral feeding in 61 to 79 % of patients. However, not all leak patients can maintain adequate calories with oral intake alone [8, 14, 15].

Our operative strategy in treating patients with LSG leaks without strictures has been described previously [10]. In summary, we start laparoscopically if possible by placing the J tube and create a tunnel using the jejunum to minimize the chance of leak from the tube. Then, an EGD is done to rule out stenosis, stricture, and document the size and location of the leak intra-operatively. If a large distal leak is found, then a T tube is placed inside the leak if it can be identified clearly. Otherwise, the area of the leak was drained adequately, and a jejunostomy tube was inserted in a standard. No attempts were made at suturing the leak site.

We feel developing an algorithm to treat leaks following LSG is important because leaks following LSG are not the same. Leaks following LSG differ depending on the presence of a tight stricture, peritonitis, or severe malnutrition. Hence, it is important that one chooses the best strategy on a case-by-case basis and decide on the management strategies described above based on the presentation of the patient. We feel the most critical steps in managing LSG leaks are excluding the presence of a stricture and establishing an enteral feeding route. In addition, the use of endoscopic stents for early LSG leaks is very effective, while endoscopic stents are not as effective in treating chronic leaks (>12 weeks). Furthermore, correcting malnutrition with an enteral route is the best strategy in patients with leak following LSG.

Our study has several limitations including its retrospective design, relatively small number of patients, and being from a single center. Further, larger multi center studies are needed to confirm our findings.

Conclusion

Treating leaks following LSG based on the timing of presentation, presence of stricture, and malnutrition is safe and effective.

Conflict of Interest The authors declare that they have no competing interests.

Informed Consent For this type of study, formal consent is not required.

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