Evaluation of early complications after laparoscopic sleeve gastrectomy for the treatment of morbid obesity: a single-center experience

Mahmoud Abdella Abdel Razek, Omnia Mohamed H. Rabie

Background Laparoscopic sleeve gastrectomy (LSG) nowadays is one of the most popular operations for the treatment of morbid obesity. It has good effect in weight reduction and has less complications. The most common complications include leakage, hemorrhage, splenic injury, gastric stenosis, and gastroesophageal reflux.

Aim To evaluate our experience in LSG in the management of morbid obesity as regards intraoperative and early postoperative complications.

Patients and methods One hundred and fifty patients with morbid obesity and/or obesity-related comorbidities were included in this study. Their BMI range from 35 to 60 kg/m^2 and were managed at Al-Zahraa University Hospital from July 2015 to June 2018. Preoperative demographic data, operative procedure, intraoperative, and short-term follow-up results of LSG are analyzed.

Results LSG was performed successfully on 149 cases while conversion to open was done in one case due to intraoperative bleeding. The mean operative time was 105 ±25 min. The mean postoperative hospital stay was 4 days (3–10 days). There was no intraoperative mortality but in two cases mortality was recorded in the postoperative period. Hemorrhage in 1.3%, leakage in 2%, and other complications such as vomiting in three cases and pulmonary embolism in one case were recorded.

Conclusion LSG safe operation in the management of morbid obesity and the hazards of its complications can be avoided if diagnosed early and managed well. Leakage is the most serious complications which may end by death if not probably treated.

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Department of General Surgery, Al Azhar University, Cairo, Egypt

Correspondence to Dr. Omnia Mohamed H. Rabie, MD, lecturer of G. surgery, Department of General Surgery, Al Azhar University, Nasr, Cairo, 11762, Egypt.
e-mail: O_rabie2003@yahoo.com

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Introduction

The number of patients with morbid obesity all over the world increases which leads to continuous increases in the number of bariatric procedures. The number of procedure performed in 2011was 340 000 all over the world [1]. Laparoscopic sleeve gastrectomy (LSG) was introduced into bariatric surgery in the early 1990s as part of biliopancreatic diversion with duodenal switch. In the early 2000s, it is used as a stand-alone procedure, with some concerns about its long-term results [2]. LSG represents more than half of the bariatric procedures performed in USA and Europe [3]. LSG has gained popularity because it is considered a technically less demanding operation and has potential benefits as the intestinal passage is left intact, allowing the endoscopy of the remaining stomach and the access to the duodenum, and there are no bowel diversions, thus eliminating the risk of internal hernia [4]. Recent studies reported a substantial decrease in LSG complication rates. However, complications after LSG can be severe and even fatal in some cases [5].

Patients and methods

Between July 2015 and June 2018, 150 obese patients were submitted to LSG in the Department of General Surgery at Al-Zahraa University Hospital.

Consent of the patients was taken and data were collected prospectively and included: age, sex, BMI, and comorbid conditions at the time of admission. They were 110 (73.3%) cases with BMI from 40 to 60 kg/m^2 and in 40 (26.7%) cases their BMI ranged from 35 to 40 kg/m^2 with comorbidities related to obesity (diabetes and hypertension). All patients had attempted weight loss with diet, exercise, and behavior modification. The patients excluded from this study included patients with endocrinological cause for obesity, extremely high risk for operation, psychological disturbance, and patients who cannot be compliant with lifelong diet, exercise, and behavior modification and patients with contraindications for laparoscopic surgery. Preoperative evaluation included sex, age, BMI, chest, and heart examination. Laboratory investigations mainly included complete blood picture, blood glucose level, liver and kidney function. Pulmonary function tests, chest radiography, abdomen, and pelvis ultrasound also were done. Intraoperative and early postoperative complications such as bleeding, leakage, splenic injury,

vomiting, wound infection, malrotation, and mortality were recorded.

Surgical procedure

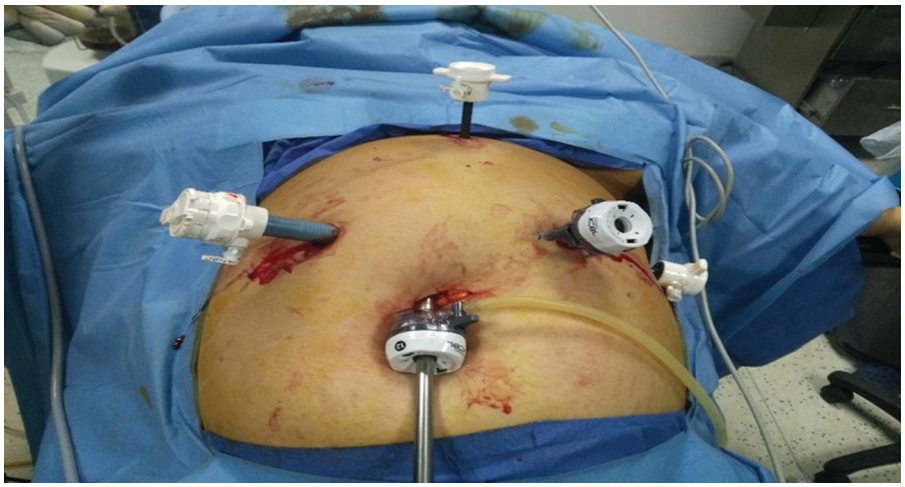
Anti-embolic precautions were taken and appropriate preoperative antibiotics were administered. Under general anesthesia with endotracheal intubation, the patient was in supine position. A pneumoperitoneum was achieved using the closed technique with Veress needle. Five ports were used (Fig. 1); three ports of size 12 mm were placed as an arc at 15–18 cm below the xiphoid and 3 cm to the left of the midline (optical port) and right and left mid-clavicular lines (working ports). A 5-mm trocar port was placed along the left subcostal margin (assistant port) another 5-mm port was placed in the epigastric region for liver retraction. The operating table was placed in reverse Trendelenburg position and the left lobe of the liver was retracted cephalic to expose the esophageal hiatus. A 30° angled laparoscope was used. Evacuation of gastric secretion and gas by nasogastric tube was done. The pylorus of the stomach was identified and the greater curve of the stomach was elevated. Devascularization of the greater curvature of the stomach was done using the laparoscopic ultrasonic scalpel. A 35 Fr orogastric bougie was placed adjacent to the pylorus. The dissection was started 5–8 cm from the pylorus and proceeds to the angle of His. A 60 mm black or green cartridge was used for stapling at the beginning (proximal to pylorus). The second cartridge, black or green, was applied proximal to the angularis with care taken to avoid stenosis here. Stapling continued until 1–2 cm gastroesophageal junction by using a golden cartridge. The resected stomach was grasped by a laparoscopic grasper through one of the working port site. Testing for leakage by injection of methylene through the orogastric bougie was achieved. Drain was placed routinely. Upper gastrointestinal contrast study (oral gastrografin) was performed on the second postoperative day. Oral intake started on the second postoperative day and the patient was discharged on the third day. All patients were submitted to a routine postoperative oral multivitamin for life, H2 blocker for 6 months, and diet regimen schedule. The mean operative time, hospital stay, intraoperative, and early postoperative complications (within first months) were recorded in the form of bleeding, vomiting, leakage, splenic injury, stenosis, gastric malrotation, wound infection and excess weight loss (EWL) and comorbidity.

Result

One hundred fifty patients were included in this study: 23 (15.3%) men and 127 (84.6%) women, their BMI ranged from 35 to 60 kg/m^2 while the mean age was 30 ±11 years. The preoperative character of the patient is listed in Table 1.

The operation was performed successfully on 99 cases by laparoscopy while conversion to open was done in one case due to intraoperative hemorrhage. The mean operative time was 105±25 min (60–120 min). The mean postoperative hospital stay was 4 days (3–10 days). No intraoperative mortality was seen. As regards postoperative mortality there was one case presented to the emergency room after 1 week by severe vomiting. The patient was dehydrated; no anemia, no intra-abdominal collection and gastric stenosis excluded by oral gastrografin were seen. Kidney function test showed high levels and the case was diagnosed as acute renal failure indicated for

Figure 1



Port sites.

dialysis. The patient was stable after dialysis and rehydration, stayed for 1 week in the hospital and on the day of discharge the patient had acute pulmonary embolism with sudden arrest although she was on anticoagulants. Also, there were other two cases with severe vomiting resolved by antiemetic drugs.

Leakage occurred in three (2%) cases: two near the gastroesophageal junction and other more down (Fig. 2). The first case was diagnosed in the male patient with a BMI of 54 kg/m^2 on postoperative day (POD) 4; routine postoperative upper gastro intestinal (UGI) contrast swallow study with gastrografin was not available, so on POD 4 when the patient started oral intake leakage was suspected by the color of the drain. UGI contrast swallow study with gastrografin and ultrasonography of the abdomen and pelvis diagnosed leakage near the gastroesophageal junction with no intra-abdominal collection. A self-expanded endoscopic stent was placed (Fig. 3). The subsequent postoperative course was unimportant and the patient was discharged on POD 8 without complication. The stent was removed on POD 65. The second case was a man also with a BMI of 50.6 kg/m^2 presented to the emergency room on POD 9 with abdominal pain, vomiting, tachycardia, and fever (39°C) and leukocytosis (19 000). Routine postoperative UGI contrast swallow study with gastrografin on POD 1 was negative. Computed tomography (CT) with oral contrast showed leakage in the gastroesophageal junction with collection in the left subdiaphragmatic area and pelvic. Urgent exploration, peritoneal drainage and wash, and primary repair were done and two large catheter drain were inserted. The patient in the ICU was stable but UGI contrast swallow study with gastrografin on POD 4 showed leakage again. A self-expanded endoscopic stent was placed. The subsequent postoperative course passed well and the patient was discharged on POD 8 without complication.

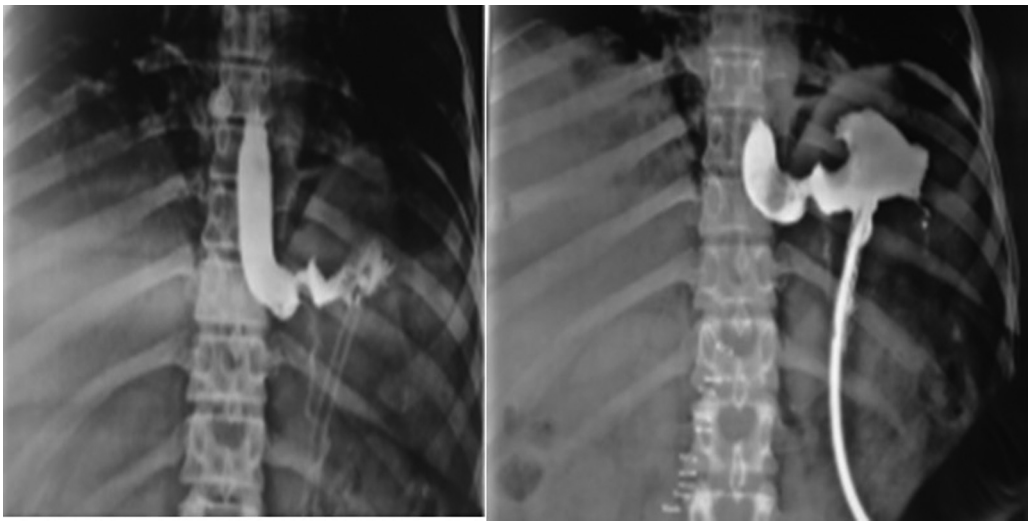
Table 1 Preoperative characters of the patients undergoing LSG

Patients	100
Men/women	23/127
Age (years)	21–55
BMI (kg/m^2)	35–60
Hypertension	9% (nine cases)
DM	16% (16 cases)

DM, diabetes mellitus.

The third patient presented to the emergency room with abdominal pain, tachycardia, and fever (38°C) on POD 10. The routine postoperative UGI contrast swallow study with gastrografin on POD 1 was negative. CT with oral contrast showed small leakage slightly more down towards the gastroesophageal junction with minimal collection in left subdiaphragmatic area and mild leukocytosis (12 000). Drainage-guided CT was done; the patient had conservative management in the form of NPO and third generation broad-spectrum antibiotic. The general condition of the patient improved, total leukocyte was normal, and the drain stopped discharge. Repeated CT was done with oral contrast was done after 1 week; there was no leakage, oral intake started, and continued without complication. The patient was discharged on the 10th day after the

Figure 2

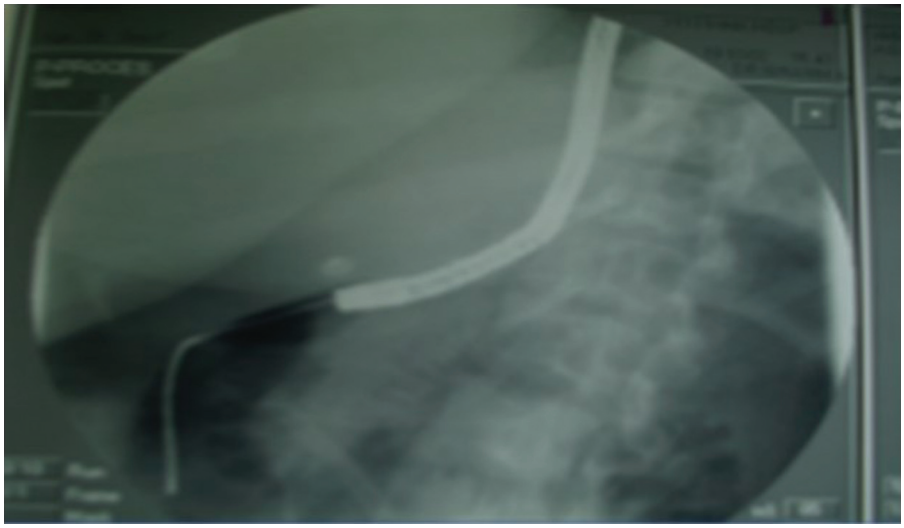


Post-LSG leakage. LSG, laparoscopic sleeve gastrectomy.

removal of drain. Stenosis in the gastric outlet was recorded in one case at the fourth week (Fig. 4). The patient presented with epigastric pain and repeated vomiting. Stenosis after LSG was diagnosed by upper gastrointestinal swallow study with oral gastrografin. Reux-en-Y gastrojejunostomy was done and the postoperative period passes smooth with no complications.

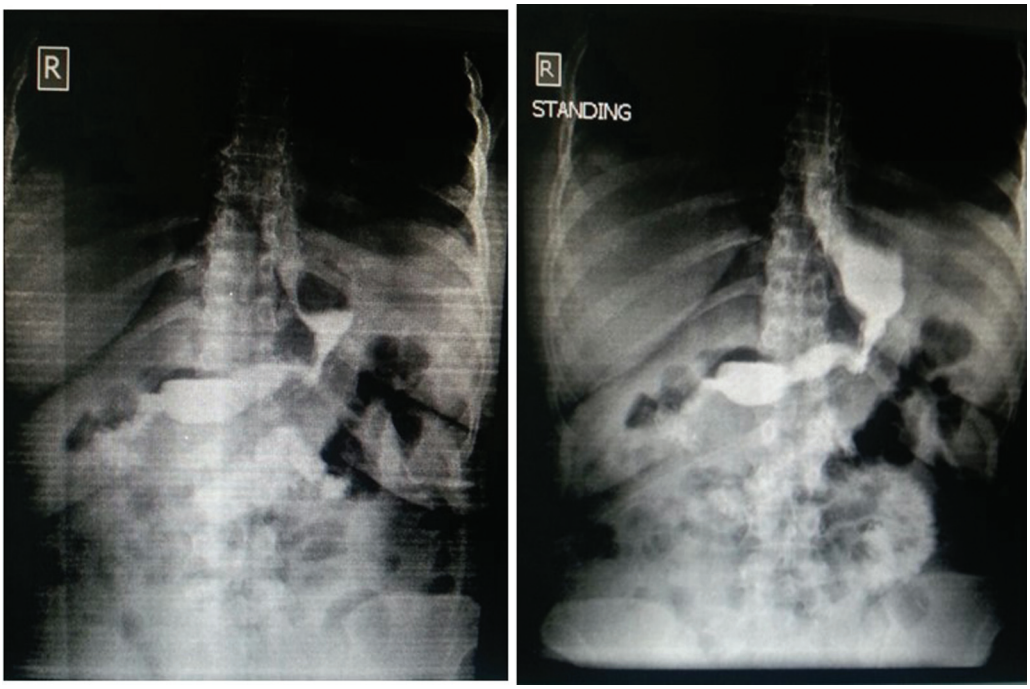
As regards hemorrhage there were two (1.3%) cases: one case was intraoperative hemorrhage due to injury of splenic capsule during dissection of short gastric vessels. Control of bleeding was difficult and need conversion to the open method. Bleeding was stopped by hemostasis and direct compression, while the second case was diagnosed postoperatively after 7 h by tachycardia, low blood pressure, and decreased hemoglobin level <9 g/dl. In the theater, there was 1.5 liter of clotted blood in the upper left quadrant due to minor bleeding in the dissected greater omentum. Hemostasis to the source of bleeding, intra-abdominal peritoneal wash, and drain was inserted. The patient

Figure 3



Post-LSG leakage stenting. LSG, laparoscopic sleeve gastrectomy.

Figure 4



Stenosis post-LSG. LSG, laparoscopic sleeve gastrectomy.

was stable and was discharged 4 days after the operation.

Wound infection was recorded in one case following exploration for internal hemorrhage. Incisional hernia after 3 month was also recorded in the same case. There were two cases lost to follow-up after 6 months. The result of the follow-up is reported in Table 2.

As regards comorbid disease after operation, diabetes revealed improvement and discontinuation of treatment in 81.25% (13 cases) and improved in 18.75% (three cases), hypertension achieved cure in 77% (seven cases), while the dose of treatment was reduced in 22% (two cases).

Discussion

LSG is currently gaining popularity due to its excellent efficacy in terms of combined restrictive and hormonal effects. The mid-term effectiveness of LSG on EWL and on major comorbidities contributed to its recent worldwide success [6]. The reason for this popularity is due to (a) less of difficulty in operation, (b) efficacy in weight loss with low rates of morbidity and mortality, (c) no nutrient malabsorption, (d) no blind stomach, (e) no dumping syndrome, (f) easy postoperative endoscopic cholangiography, (g) absence of foreign bodies, and (h) can be converted to gastric bypass or biliopancreatic duodenal switch in case of failure [7]. Complications of LSG may be fatal if not diagnosed early and managed well. Various complications are reported following LSG, including leaks, bleeding, strictures, and nutritional deficiencies. The reported postoperative complication rates vary between 1 and 29% [8,9]. The most frequently encountered major complications include leaks (0–10%), suture line hemorrhage (0–10%), and major organ injury (0–5%). Staple line leaks can result in severe peritonitis, sepsis, multiorgan failure, and rarely patient demise [10]. Hemorrhage is very serious with life-threatening complications in a patient's life.

Table 2 Complications within the first month

Complications	*n* (%)
Hemorrhage	2 (1.3)
Leakage	3 (2)
Vomiting	3 (2)
Deep venous thrombosis	0 (0)
Gastric stenosis	1 (0.7)
Gastric volvulus	0 (0)
Wound infection	1 (0.7)
Conversion to open	1 (0.7)
Intraoperative mortality	0 (0)
Pulmonary embolism mortality	1 (0.7)

The most common bleeding site is the staple line after transection of the stomach, but it may also occur from the gastroepiploic or short gastric vessels during dissection of the greater curvature. The gastrosplenic ligament may be short, or missing, with virtual fusion of the fundus to the upper pole of the spleen. Splenic capsule might also be torn in cases of vigorously retracted omental adhesions, while attempting to better visualize the proximal greater curvature [11]. Mittermair *et al*. [12] reported that the postoperative bleeding rate in their study was 3.3% and Sakran *et al*. [11] reported it to be 2.1%. De Angelis *et al*. [13] reported a bleeding rate of 1.9% from splenic injury and suture line. In our study bleeding occurs in two (1.3%) cases; one case is due to splenic capsule injury; the bleeding was controlled after conversion to the open method without need for splenectomy. Other case of bleeding from the omentum during dissection of greater curvature was diagnosed early postoperatively by close observation to vital data, good hemostasis, and peritoneal wash was done. Leakage is another serious complication which may lead to sepsis, hemodynamic instability, multiorgan failure, and even mortality in 0–1.4% of cases [14]. Although in LSG no anastomosis is created, the long divided staple line carries a marked risk of leak that varies between 0 and 7% in primary procedures, and up to 20% in revisional surgery. The vast majority of leaks in LSG (85.7%) occur in the proximal sleeve over the last staple firing, near the angle of His [15]. Some factors may share in leakage at that site as (a) insufficient staple height, as the gastric wall thickness varies from the antral to the cardial region; (b) tearing at the top of the staple line; (c) staple gun failure, increasing the risk of leakage at any point in the gastric division; and (d) ischemia from gastric tube weakness due to the stapling of branches arising from the left gastric artery [16]. Stricture at the incisura angularis also reported as a factor resulting in leakage [10]. Leakage can be classified according to the time of onset, early appear within 1–4 postoperative days, intermediate 4–9 postoperative days, or late more than 10 days. According to their severity, from simple, contained leaks without sepsis, to life-threatening septic leaks that require emergency surgical re-exploration [17]. According to both clinical and radiological findings, type A leaks are microperforations without clinical or radiographic evidence of leak, while type B are leaks detected by radiological studies but without any clinical finding, and type C are leaks presenting with both radiological and clinical evidence [14]. Bougie size may play a role in leak in some studies. The Rosenthal [19] study show that 87% of the panelists agreed that the optimal size of the bougie should be between 32 and 36 Fr. Using a

bougie of 36 Fr may bring about limited weight loss effects due to possible dilatation of the sleeve. Another meta-analysis of Parikh *et al*. [20] including 198 leaks in 8922 patients revealed that the risk of leak decreased with a bougie more than or equal to 40 Fr with no effect on %EWL. Tachycardia is the earliest and the most common finding present in 72–95% of cases fever and left shoulder pain are also common presenting symptoms. Nausea and vomiting may be present up to 80% of patients with post-LSG fistula. External drainage or increased drain output may also be a manifesting sign in 25% [17]. An increased C-reactive protein level raises suspicion of post-LSG leak. UGI radiography with contrast media and gastroscopy are comparable and superior to standard CT in patients with a BMI of 50 kg/m^2 to detect leakage after SG [21]. Otherwise, CT scans had the highest rate of leak detection [22]. According to a German multicentric observational study male sex and BMI between 50 and 59.9 kg/m^2 increase the risk for leakage by 2.5 and 1.6%, respectively [23] In our study, we had three (2%) cases of gastric leak classified as intermediate fistula diagnosed on 4, 9, and 10 POD. Two of them need esophageal stents, one was the first line for treatment and second was the second line after failed primary repair and the last one had conservative management. Our result is near close to other studies as Boeker *et al*. [24]; their study showed a step line leakage of 2.1%, Sakran *et al.* [24] 1.5% and Tan *et al.* [25] 2.5%, but it was best than ours in the study of Rondelli, *et al*. [4] which was 0.7% and the study of Noe *et al.* [26] which was 1%. In this study, there was one case of incisional hernia (0.7%). Incisional hernia as a complication here is not related to the LSG, but it is related to obesity surgery as the obese patient has a higher risk factor for incisional hernia with incidence ranging from 25 to 50% [27].

Sleeve strictures have been reported in 0.26 to 4% of LSG [28], less than 1% may require endoscopic or surgical intervention. Strictures post-LSG are common at the level of incisura angularis also can occur anywhere along the staple line. They are either mechanical or functional. Mechanical due to (a) the use of small bougies, (b) stapling close to bougies, (c) twisting of the staple line (spiral sleeve), (d) aggressive oversewing of the staple line. Functional stricture is usually due to edema or hematomas at the staple line [29]. In the early postoperative period, the treatment of stricture is conservative by resuscitation of the patient with hydration and antiemetic drugs for 24–48 h. Nasogastric tube guided by fluoroscope may be used. Surgical intervention was indicated for (a) failed conservative management, (b) short segment stricture with failed balloon dilatation, and (c) long segment stricture. Surgical treatment is remove oversewn suture or seromyotomy along the greater curvature and conversion to an reux-en-y-gastric by pass (RYGB) is the last option for failed previous treatment [30]. In our study post-LSG stricture was 0.7% due to twisting of the staple line and was treated by RYGB. In our study, the operative time range from 60 to 120 min (mean, 105±25 min); in the study of Mittermair *et al*. [12] the median length was 86 min (range, 48–140 min), in De Angelis *et al*. [13] it was 110 min and in the study of Sofianosa and Sofianos [31] it was 104.3 min.

The mean hospital stay in our study was 4 days (3–10 days) in comparison to the study of Mittermair *et al*. [12], the mean hospital stay was 3.5 and in the study of Sofianosa and Sofianos [31] it was 2.5 days.

In our study, the mortality rate was 0.7%, one case due to pulmonary embolism after 2 weeks from LSG. In modern series, the overall mortality rate of LSG is ~0–1.2% [32].

In summary, LSG is one of the most effective surgical procedures in weight loss and is considered safe if its complications are diagnosed and managed early. Gastric leakage and stricture are most frequent complications which may occur during the learning curve, both of them may be fatal if not diagnosed early and managed well.

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Conflicts of interest
There are no conflicts of interest.

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