Laparoscopic sleeve gastrectomy with or without minimal fixation: a new technique

Amr H. Afifi, Mostafa Nagy, Ramy Helmy

Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Amr H. Afifi, MD, Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo 11566, Egypt
Tel: 01007872550;
e-mail: dr_amrhamed1984@yahoo.com

Received: 08 June 2022
Revised: 25 June 2022
Accepted: 05 July 2022
Published: 05 April 2023

The Egyptian Journal of Surgery 2023, 41:990–994

Introduction
Obesity is a major health burden, with significant morbidity and mortality. Gastric tube twisting is an early uncommon serious complication. We aimed to compare laparoscopic sleeve gastrectomy (LSG) with or without minimal fixation to overcome such a complication.
Patients and methods
In our prospective cohort study, we reviewed medical records of patients undergoing LSG alone or LSG with minimal fixation. Patients with preoperative gastroesophageal reflux disease (GERD) were excluded. Patients were then followed postoperatively for gastric twist, leakage, or hemorrhage and then later for GERD, using upper gastrointestinal tract endoscopy and esophageal manometry. Missing patients were phone called and asked to attend the next day for follow-up.
Results
A total of 190 patients were included: 90 patients had LSG only, and 100 patients had LSG with minimal fixation. A significant difference was detected regarding operative time, with LSG with minimal fixation having a longer duration (P=0.0001). Patients who had LSG with minimal fixation had less postoperative twist, leak, and de novo GERD compared with LSG only, yet no statistically significant difference was detected. Both surgeries had comparable BMI loss at 36 months of follow-up.
Conclusion
Our study showed that patients who had LSG with minimal fixation had less postoperative complications than patients with LS only, yet no statistically significant difference was detected. Several techniques, including distal fixation and minimal fixation, have been proposed to overcome such complications. Studies comparing these techniques are needed.

Keywords:
leakage, minimal fixation, omentopexy, sleeve gastrectomy, twist

Egyptian J Surgery 2023, 41:990–994

1110-1121

Introduction

Obesity is a major health burden, with significant morbidity and mortality. Obesity is associated with devastating cardiovascular, endocrinological, and psychiatric outcomes. In 2017, the global burden of disease group reported that the prevalence of obesity has doubled in more than 70 countries since the 1980 [1,2]. Bariatric surgeries, including laparoscopic sleeve gastrectomy (LSG), are effective in treating obesity and its associated comorbidities.

Sleeve gastrectomy emerged as a part of duodenal switch procedure by Doug Hess in 1988. Lawrence L. Tretbar described weight loss after extended fundoplication (creation of tubular structure) for gastroesophageal reflux disease (GERD). Ever since, the popularity of LSG is increasing. Nguyen *et al.* [3] examined the popularity of bariatric procedures done in USA between 2008 and 2012, where the rate of gastric banding decreased from 23.8 to only 4.8%, whereas LSG increased from 0.9 to 36.3%. Currently, LSG is the most popular procedure performed [4].

LSG is not only a restrictive procedure but also affects satiety by reducing ghrelin hormone produced by the stomach. LSG is known for its safety and effectiveness, short operative time, feasibility, and easiness of revision and conversion to a malabsorptive surgery. Ongoing modifications for LSG are assessed to avoid its complications. Early complications include staple line leakage, hemorrhage, splenic injury, and portovenous thrombosis. Late complications include weight regain, GERD, hiatal hernia, gall stones, and gastric stricture or stenosis [5,6].

Leakage is a serious postoperative complication, ranging from 0.5 to 7%. Several techniques have been proposed for it after LSG. In a systematic review by Gagner and Kemmeter, the authors compared oversewing, fibrin

glue, nonabsorbable bovine pericardial strips, and absorbable polymer membrane for staple line leaks. They concluded that absorbable polymer membrane resulted in lower rates of postoperative leaks. In another study, triple reinforcement of staple line using Sydney patch showed promising results. Intragastric stenting is increasingly being used to manage such complications [7–9].

Gastric tube twisting is an early uncommon complication. In a study by Abd Ellatif *et al.* [10], 3634 patients had LSG and 45 patients had gastric twist. Gastric twist involves rotation of the gastric sleeve around the anatomical axes either longitudinal or transverse. In our study, we aimed to overcome these dreadful complications by fixing the gastric sleeve by a novel technique called minimal fixation through comparing LSG with minimal fixation to LSG regarding postoperative gastric twist, leak or hemorrhage, and de novo GERD.

Patients and methods

Study design and setting

This is a prospective cohort analysis of patients with morbid obesity who received LSG with or without minimal fixation from January 2017 to January 2018. Data of participants were collected and then patients were followed for 3 years. Patients had LSG alone or LSG with minimal fixation in the bariatric surgery department at Ain Shams University Hospital. The decision of which surgery to be performed was a shared decision between the multidisciplinary team and the patients. This research was performed at the Department of General Surgery, Ain Shams University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

Patient selection

We recruited 100 patients who had LSG with minimal fixation. A matched cohort of 90 patients who had LSG alone were also recruited. We included patients above 18 years old with BMI more than 40 or more than 35 with one or two of obesity-related comorbidities such as diabetes mellitus, hypertension, dyslipidemia, osteoarthritis, infertility, and severe sleep apnea. Patients who had previous bariatric or gastrointestinal surgery, preoperative GERD psychiatric contraindications, pregnancy, and other medical reasons denying laparoscopy were excluded.

Preoperatively, a multidisciplinary team evaluated the candidates based on medical, nutritional, endocrinological, and psychiatric workup. Preoperative assessment included blood examinations, cardiology evaluation, and chest radiography. Psychiatric counselling was conducted to evaluate mental health contraindications to surgery.

Follow-up

Patients who had LSG with minimal fixation were followed for 3 years at 3-, 6-, 12-, 24-, and 36-month intervals. Data of matched cohort who had LSG alone were also followed for at least 3 years postoperatively for gastric twist, staple line leakage or hemorrhage, excess weight loss (EWL %), and then later for GERD, using upper gastrointestinal tract endoscopy and esophageal manometry. Missing patients were phone called and asked to attend the next day for follow-up.

EWL (%) was calculated as follows: (preoperative weight–postoperative weight at each interval)×100/(preoperative weight–ideal weight), where the ideal body weight was defined at weight corresponding to BMI of 25 kg/m^2.

Surgical procedures

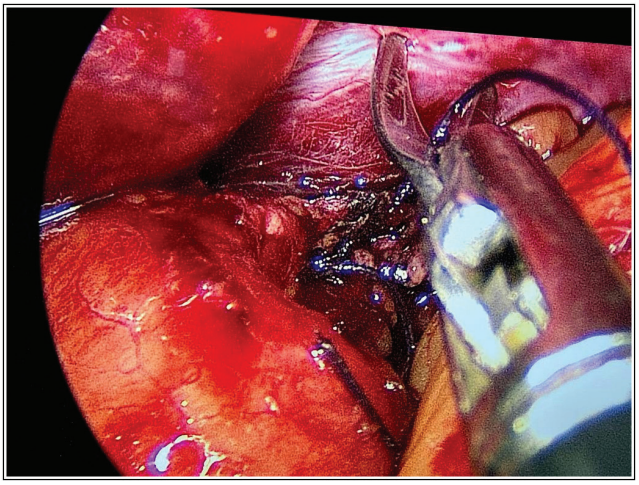
Sleeve gastrectomy

Under general anesthesia, the ports were placed in an anti-Trendelenberg position. We dissected the greater omentum and the short gastric vessels in close proximity to the gastric serosa up to the angle of His using a Ligasure. After dissection, the anesthesiologist passed a 32-Fr orogastric Bougie adjacent to the pylorus. We started by using a 60-mm green cartridge stapler (Ethicon Echelon Endopath) firing 4 cm proximal to the pylorus, followed by 60-mm gold reload (Ethicon Echelon Endopath), and finally, 60-mm blue reloads (Ethicon Echelon Endopath) were fired till the angle of His.

Minimal fixation (Figs 1–3).

After hemostasis, the gastric sleeve was brought into the anatomic posture of a normal stomach, and the

Figure 1

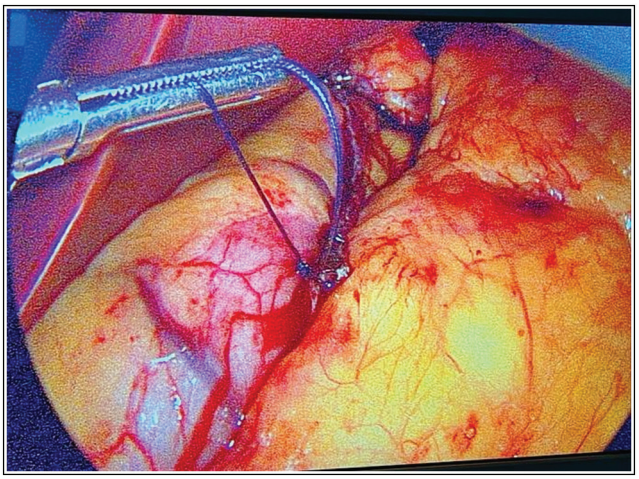


Suturing left crus of diaphragm to the proximal staple line.

gastric sleeve fixation was performed at three points. The first suture connected the proximal staple line to the left crus of the diaphragm, the second suture connected the midpoint of staple line to pancreatic fascia, and the third suture connected the distal staple line to the pancreatic fascia using vicryl 2/0 sutures.

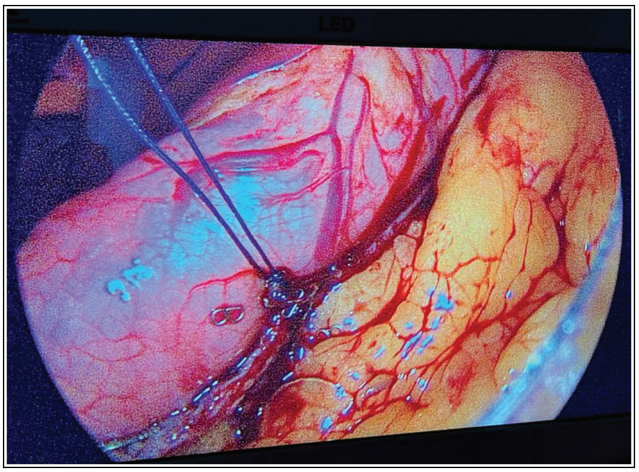
Statistical analysis was done using IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp.

Figure 2



Suturing pancreatic fascia to mid staple line.

Figure 3



Suturing of pancreatic fascia to distal staple line.

To ensure our data had normal distribution, we performed Kolmogorov–Smirnov test and Shapiro–Wilk test. Categorical variables were analyzed using χ^2 test or Fisher exact test when needed. We used analysis of variance test for comparison of means among three groups. A post-hoc analysis using Turkey was done to detect significance level among groups. *P* value less than 0.05 was considered statistically significant.

Results

We included 190 patients, with a mean age of 43.4 ± 6.07 years, in our analysis. The mean preoperative weight was 107.14 ± 17.3 kg, and the mean preoperative BMI was 42.4 ± 5.6 kg/m^2. Females accounted for 73.6% of the participants. A total of 100 patients had LSG with minimal fixation, and 90 patients had LSG alone. Table 1 shows the baseline characteristics of the included participants.

Patients who had LSG with minimal fixation had statistically significantly longer operative time compared with LSG alone. Patients who underwent LSG with minimal fixation had less postoperative leak, twist, and de novo GERD. However, no statistically significant difference was detected between both groups in postoperative complications. Regarding hospital stay, LSG alone group had longer yet not significant hospital stay compared with LSG with minimal fixation group (Table 2).

In EWL (%), there was no significant difference between both groups at 3, 6, 12, 24, and 36 months. Regarding weight loss, there was no significant difference between LSG and LSG with minimal fixation during 36 months of follow-up. SG and LSG with minimal fixation have comparable BMI loss during 36 months of follow-up except at 6 months (*P*=0.03) (Table 3).

Discussion

Obesity is a challenging pandemic, but with bariatric surgeries, we aim to overcome it. In this study, 100 patients who had LSG with minimal fixation were

Table 1 Baseline characteristics of laparoscopic sleeve gastrectomy with minimal fixation versus laparoscopic sleeve gastrectomy alone

	SG	SG with minimal fixation	*P* value
Age (mean±SD)	43.6 ± 5.9	43.3 ± 6.1	0.74
Sex			0.66
Male	25	25	
Female	65	75	
Weight (kg) (mean±SD)	106.6 ± 17.7	107.5 ± 16.9	0.72
Height (m) (mean±SD)	1.58 ± 0.07	1.58 ± 0.06	0.91
BMI (mean±SD)	42.2 ± 5.6	42.6 ± 5.6	0.68

SG, sleeve gastrectomy.

Table 2 Difference between laparoscopic sleeve gastrectomy with minimal fixation and laparoscopic sleeve gastrectomy in operative time, hospital stay, and postoperative complications

	SG	SG with minimal fixation	*P* value
Operative time (min) (mean±SD)	61.5±4	78.5±6.2	0.0001
Hospital stay (mean±SD)	1.5±0.8	1.4±0.5	0.29
Postoperative complications			0.51
No complication	81	99	
Bleeding	2	0	
De novo GERD	4	1	
Twist	2	0	
Leakage	1	0	

GERD, gastroesophageal reflux disease; SG, sleeve gastrectomy.

Table 3 BMI and weight loss in laparoscopic sleeve gastrectomy alone versus laparoscopic sleeve gastrectomy with minimal fixation

	SG	SG with minimal fixation	*P* value
Weight			
3 months	98.1±16.3	95.7±15.1	0.29
6 months	88.5±14.7	84.9±13.4	0.08
12 months	75.7±12.6	74.2±11.7	0.38
24 months	72.5±12.1	70.9±11.2	0.36
36 months	70.4±11.7	68.8±10.8	0.34
BMI			
3 months	38.8±5.1	37.9±5	0.19
6 months	35±4.6	33.6±4.4	0.03
12 months	30±4	29.3±3.9	0.28
24 months	28.7±3.8	28.1±3.7	0.25
36 months	27.8±3.7	27.3±3.5	0.28
EWL (%)			
3 months	23.9±5.03	25.4±7.2	0.10
6 months	47.9±10.2	51±14.4	0.09
12 months	76.6±18.4	81±19.9	0.11
24 months	84.5±20.4	88.8±21.8	0.16
36 months	89.8±21.6	94.1±23.1	0.19

EWL, excess weight loss; SG, sleeve gastrectomy.

compared with 90 patients with LSG without fixation to study postoperative complications including postoperative twist and GERD. LSG with minimal fixation had a lower incidence of postoperative gastric twist, staple line leakage or hemorrhage, and GERD, yet there was no statistically significant difference between both groups. Seven patients had postoperative twist, leak, and de novo GERD in LSG only compared with one patient in LSG with minimal fixation. On the contrary, LSG with minimal fixation had a longer operative time.

Gastric twist is a serious but rare postoperative complication of LSG with an incidence ranging from 0.2 to 5%. The concept of gastric fixation is to hold gastric sleeve in its anatomical position [11]. Several techniques have been proposed for gastric fixation. A study of 1385 patients who had LSG with omentopexy reported no postoperative gastric twist [12]. In another study of 717 patients who had either LSG or LSG with gastric sleeve fixation at two points only of the gastric sleeve, LSG with fixation significantly reduced gastric twist (functional stenosis) and postoperative nausea and vomiting. Gastric sleeve fixation had a lower incidence of staple line leak or bleeding [13]. In a study by Kizilkaya and Bozkurt, 200 patients were classified into either LSG or LSG with posterior fixation using fibrin tissue glue to prevent gastric twist. The authors reported a significantly lower complication rate (staple line leak, hemorrhage, or stenosis) and lower 6-month BMI at LSG with posterior fixation group [14]. In another study by Abdallah and colleagues, 252 patients had either LSG or LSG with distal sleeve fixation. The LSG group had significantly higher gastric twist, hospital readmission, and postoperative bleeding compared with LSG with distal sleeve fixation [15,16]. In our study, gastric sleeve is fixed in its anatomical position along the staple line at three points with left crus of the diaphragm and pancreatic fascia. All techniques proposed for gastric fixation had reduced the incidence of gastric twist, leak, or hemorrhage,

yet, to our knowledge, no study had compared these techniques in terms of efficacy, learning curve, and cost-effectiveness.

Roux-en-Y gastric bypass is still the preferred procedure for obese patients having GERD. De novo GERD after LSG could be explained by either high intragastric pressure or migration of gastric sleeve through hiatal defect. Gastric fixation could decrease postoperative GERD after LSG by preventing herniation of gastric sleeve. In a RCT, 200 patients have been randomized to either LSG or LSG with omentopexy. The author reported significant improvement in postoperative nausea, vomiting, GERD symptoms, and gastric twist [17]. On the contrary, several studies showed no significant improvement in LSG with omentopexy [18–21]. According to these studies, variation in improvement of GERD after LSG with omentopexy is due to different questionnaires used to assess postoperative GERD. GERD-Health-related quality-of-life questionnaire, GERD-Q, and Rhodes index were used unlike this study, where our patients were assessed using upper gastrointestinal tract endoscopy and esophageal manometry. These studies showed gastric fixation had a lower incidence of GERD. Our study is limited by its observational design, which lacked randomization to minimize bias. Our study also did not account for cost-effectiveness of gastric fixation.

Conclusion

LSG with minimal fixation lowers the incidence of postoperative complications including staple line leakage and hemorrhage, gastric twist, and GERD.

Financial support and sponsorship

Nil.

Conflicts of interest

No conflict of interest.

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