Comparison between antral resection in laparoscopic sleeve gastrectomy and classical laparoscopic sleeve gastrectomy

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Background
The objective of this study was to study the effect of the residual gastric antrum size on the outcome of laparoscopic sleeve gastrectomy (LSG) and to evaluate the effect of antral resection on weight reduction and complications after LSG.
Patients and methods
This retrospective study was carried out on the prospectively collected data of patients, who underwent LSG at Safwet Elgolf Private Hospital from February 2015 to July 2016. According to antral resection, the patients were divided into two groups: group A (n=54) underwent a 6-cm antral resection and group B (n=54) underwent a 2-cm antral resection. All patients who completed at least 24 months of follow-up postoperatively, the percentage of excess weight loss (%EWL) was calculated at 3, 6, 12, and 24 months as well as the postoperative complication rate.
Results
In our study, 110 patients were included. Patients in group B experienced statistically significant greater weight loss than patients in group A. Statistically significant greater weight regain was seen in group A. The mean BMI was 46.1 ±7.9 kg/m^2. In group A, the mean %EWL was 38.1±14.1, 54.9±19.9, 65.6±22.8, and 66.8±28.4% at 3, 6, 12, and 24 months, respectively. However, in group B, the mean %EWL was 42.1±13.4, 63.8±19.8, 80.0±22.1, and 81.5±22.9% at 3, 6, 12, and 24 months, respectively. Group B had a higher incidence of reflux symptoms and vomiting (six patients, 11%) than group B (four patients, 7.1%).
Conclusion
Radical antral resection in association with LSG safely potentiates the restrictive effect achieved and results in greater and better maintained weight loss, and in higher incidence of reflux symptoms and vomiting.

Keywords:
antral resection, bariatric surgery, excess weight loss, sleeve gastrectomy

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Introduction

Bariatric surgery has been considered as an efficient method to produce long-term weight loss, improve comorbidities, and improve the quality of life for the morbidly obese patient [1]. Currently, more interest in restrictive procedures is growing due to their lower operative and nutritional risks compared with mixed and malabsorptive procedures [2].

Laparoscopic sleeve gastrectomy (LSG) creates a narrow tube-like stomach, thus, the appetite is decreased by reducing the ability of the stomach to distend and producing the sensation of fullness with minimal food intake [3]. LSG was initially introduced as a potential first step prior to a more complex procedure (Roux-en-Y gastric bypass or biliopancreatic diversion–duodenal switch) to decrease the overall operative risk in superobese or high-risk patients [4]. Now, LSG is carried out more and more as a single and definitive bariatric procedure with promising short-term results [5]. However, LSG has its own disadvantages as the potential complications of the relatively long staple line and the irreversibility of the procedure [6].

LSG has been adopted by many surgeons. In the last years, the number of LSG performed has increased dramatically. However, many points of controversy still present regarding the operative technique including the size of bougie caliber, the necessity of reinforcing the staple line, the routine use of intraoperative seal testing, the section at the esophagogastric junction, and the distance from the pylorus to the beginning of antral resection [7,8]. All of these matters remain a controversy among the most experienced surgeons.

The most conservative surgeons prefer to begin the resection at 6 cm from the pylorus with the aim of improving gastric emptying and decreasing

intraluminal pressure. This also will allow early closure of gastric leak if occurred. Other surgeons performed the resection close to the pylorus and therefore achieve and maintain better results [9,10].

This prospective, randomized study was designed to compare between the beginning of sleeve gastrectomy 2 versus 6 cm from the pylorus with special regard to percentage of excess weight loss (%EWL) and complication rate in both groups.

Patients and methods

This was a retrospective study of the prospectively collected data of patients who underwent LSG at Safwet Elgolf Private Hospital from February 2015 to July 2016. The research is approved by the ethical committee of General Surgery department – Ain Shams University. Informed consent was obtained from all patients enrolled in the study. All the patients met the inclusion/exclusion criteria followed by the NIH Bariatric guidelines. The exclusion criteria included patients above 60 or below 18 years old, history of upper laparotomy, unfit for anesthesia or laparoscopy, major psychological instability, and drug abuse [11].

Informed consent was obtained from all patients to be included in the study, after describing the operative and postoperative details and complications.

During the first period of our study, we performed a 6-cm antral resection (the length of the antral remnant measured from the pylorus); subsequently, we adopted a 2-cm antral resection (second period of the study). This allowed us to compare the two sets of patients based on the length of the remaining antrum. Group A consisted of 54 patients who were left with a 6-cm antral pouch, and group B comprised 56 patients who were left with a 2-cm antral pouch.

Surgical technique

All operations were performed in the French position with the surgeon standing between the patient's legs. We used four ports: a 10-mm trocar was placed in the midline above the umbilicus; a 15-mm trocar was placed in the right subcostal area; a 12-mm trocar was placed in the left subcostal area; and a 5-mm trocar was placed in the subxiphoid for the liver retractor. On the left side, lateral to the rectus sheath, an additional 5-mm trocar was placed, thus, to aid in retraction of the omentum when necessary.

The stomach was completely mobilized by dividing the greater omentum from the stomach using LigaSure (Covidien, MN, USA), starting 1–2 cm from the pylorus and extending up to the angle of His. A 38-Fr calibration bougie was inserted by the anesthesiologist along the lesser curvature of the stomach. The length of the antral remnant was measured from the pylorus (6 cm for group A and 2 cm for group B). From this point, resection began with the use of a 4.8-mm green Endo GIA stapler (Covidien), followed by several firings of a 60-mm blue stapler proximal to the angle of His; an ~5–10-mm cuff of stomach was preserved at the level of the angle of His to avoid including the esophagus in the staple line. The staple line was reinforced using seromuscular invaginating V-Loc sutures (Covidien).

Statistical analysis

SPSS, version 21.0 was used for the statistical analysis. The paired Student's *t* test was used for normally distributed variables. A *P* value of less than 0.05 was considered to be statistically significant. Results are shown as mean±SD (range) unless otherwise stated.

The %EWL was calculated as follows: % EWL=100%×(weight lost)÷(preoperative weight–ideal body weight). The ideal body weight was calculated as that equivalent to a BMI of 25 kg/m^2. Weight regain was defined as an increase in body weight of more than 10 kg from the nadir.

Results

One hundred and ten consecutive patients underwent the LSG procedure in the period between February 2015 and July 2016. All patients completed at least 24 months of follow-up, with a mean follow-up period of 33 months.

There were 27 male and 83 female patients' aged 33.8 ±10.8 years (16–58 years). The mean preoperative weight was 125.5±29.1 kg, and the mean preoperative BMI was 46.1±7.9 kg/m^2. The mean postoperative hospital stay was 3.1±2.2 days. The mean operative time was 83.2 ±34.6 min. The two groups were comparable in terms of preoperative weight, BMI, sex, and age. The mean operative time was shorter in group A, but the difference was not statistically significant (Table 1).

Overall, the %EWL was 39.9±13.9% at 3 months, 58.8 ±20.2% at 6 months, 72.9±23.5% at 12 months, and 73.2±27.3% at 24 months. In group A, the mean % EWL was 38.1±14.1, 54.9±19.9, 65.6±22.8, and 66.8 ±28.4% at 3, 6, 12, and 24 months, respectively. In group B, the mean %EWL was 42.1±13.4, 63.8±19.8, 80.0±22.1, and 81.5±22.9% at 3, 6, 12, and 24 months, respectively. Patients in group B had statistically

Table 1 Patient demographics and perioperative data in the two groups

	Total (*N*=110)	Group A (*N*=54)	Group B (*N*=56)	*P* value
Weight (kg)	125.5 ±29.1	125.6±4.0	125.3±3.8	0.95
BMI (kg/m^2)	46.1±7.9	46.3±8.1	45.8±7.9	0.76
Age (years)	33.8±10.8	34.7±11.3	32.8±10.3	0.37
Sex (female) (%)	75.5	75.9	75.0	0.91
Hospital stay (days)	3.1±2.2	3.3±2.8	2.9±1.2	0.33
Operative time	83.2±34.6	79.9±24.4	86.4±42.1	0.31

Data are presented as mean±SD.

Table 2 Percentage of excess weight loss among the two groups

	Total (*N*=110)	Group A (*N*=54)	Group B (*N*=56)	*P* value
%EWL at 3 months	39.9±13.9	38.1±14.1	42.1±13.4	0.17
Range	27–43	29–43	27–41	
%EWL at 6 months	58.8±20.2	54.9±19.9	63.8±19.8	0.05
Range	51–88	51–87	53–88	
%EWL at 12 months	72.9±23.5	65.6±22.8	80.0±22.1	0.04
Range	52–87	52–85	53–87	
%EWL at 24 months	73.2±27.3	66.8±28.4	81.5±22.9	0.03
Range	51–90	51–88	55–60	

%EWL, percentage of excess weight loss.

significantly greater weight loss than patients in group A (Table 2). Statistically significant greater weight regain was seen in group A compared with group B.

Early postoperative complications occurred in six (5.4%) patients (Table 3). One leak occurred which was in group B, presented on the seventh postoperative day by abdominal pain and fever. The patient is explored; the leak was found to be at the gastroesophageal junction. Abdominal toilet was done with insertion of intra-abdominal drains, followed by stenting 2 days later and the condition was controlled and the patient recovered safely. Postoperative bleeding that necessitates blood transfusion occurred in three cases, which were all managed laparoscopically; one (1.9%) occurred in group A and two (3.6%) occurred in group B, but this difference is statistically insignificant between the two groups (*P*=0.32). The most common early complication encountered was postoperative deep vein thrombosis presented by two (0.9%) patients; one for each group and was treated conservatively. No patient had pulmonary embolism and there were no mortalities.

Table 3 Complication rate between the two groups

	Total (*N*=110)	Group A (*N*=54)	Group B (*N*=56)	*P* value
Perioperative bleeding	3 (2.7)	1(1.9)	2 (3.6)	0.32
Leak	1 (0.9)	0	1 (1.9)	0.16
GERD	10 (9.1)	6 (11.1)	7 (12.5)	0.04
Vomiting	10 (9.1)	6 (11.1)	77 (12.5)	0.04
Weight regain	14 (12.7)	12 (22)	2 (3.5)	0.003
DVT	2 (0.18)	1 (1.9)	1 (1.9)	0.53

Data are presented as *n* (%). GERD, gastroesophageal reflux disease; DVT, deep vein thrombosis.

Overall, 10 (9.1%) patients developed reflux symptoms and vomiting that were documented by upper endoscopy performed at the 1-year follow-up. These were divided between the two groups, with six (11.1%) patients for each symptom in group A and four (7.1%) patients in group B being affected. Group A had a significantly higher incidence of reflux symptoms and vomiting than group B.

Discussion

Weight loss mechanisms after LSG is multifactorial; a combination of gastric restriction, hormonal factors, and changes in gastric emptying and eating habits are involved. However, the most important factor is the degree of restriction performed [12].

Sleeve gastrectomy is primarily considered a restrictive type of bariatric surgery, where surgical technique plays a major role in the resulting and maintained weight loss. The ideal restriction creates a narrow gastric tube without a large antral pouch, leaving a gastric capacity of no more than 80 ml. The restrictive effect of sleeve gastrectomy depends on multiple technical factors. The size of the bougie used for calibration varies among surgeons, and there is controversy surrounding proximal gastric resection and the use of reinforcement materials [13].

Another controversial issue in the LSG technique is the degree of antral resection. Some authors start their resections 6 cm or more from the pylorus, thus, preferring antral preservation. They believe that doing so preserves contractile function, promoting gastric emptying, and thus reducing intraluminal pressure and potentially decreasing leakage [14].

In contrast, other surgeons began the division ~2 cm from the pylorus; they argue that since LSG is a purely restrictive procedure, restriction should be more aggressive than when it is a part of another procedure such as a duodenal switch [15].

The most frequent argument against radical pyloric antrum resection is that it may predispose patients to developing a gastric evacuation disorder. LSG affects both the proximal and distal stomach in a significant way, so it has an impact on gastric motility patterns. Theoretically, LSG may affect emptying via several mechanisms: removal of the fundus with its receptive and propulsive abilities, altered compliance and contractility of the resulting narrow and nondistensible sleeve, and removal of the gastric pacemaker area in the body of the stomach [16].

Studies that have looked at the effect of pyloric antral resection on weight loss have shown conflicting results. Jacobs *et al.* [17] showed no statistically significant difference in the %EWL following creation of a 4- versus 7-cm antral pouch.

In contrast, analysis of data from the Spanish national registry revealed that resection closer to the pylorus resulted in better weight loss during the first and second postoperative years [18]. Our study showed that a more radical antral resection resulted in significantly better weight loss in the first two postoperative years.

The effect of radical antral resection on reflux symptoms and gastroesophageal reflux disease (GERD) is controversial. LSG may lessen reflux by reducing intra-abdominal pressure (by way of decreasing intra-abdominal fat) and reducing acid production by decreasing the gastric tissue [19].

Postoperative reflux may be attributed to technical issues; for example, partial resection of the sling fibers of the lower esophageal sphincter, which can produce a hypotensive lower esophageal sphincter, has been suggested to result in GERD [20]. A lack of gastric compliance, severely restricted gastric capacity with an intact pylorus, and impaired gastric emptying have also been suggested to predispose patients to reflux during the first postoperative period [21].

Whether antral resection is associated with the development of GERD is still controversial. A study performed resection at 10 cm from the pylorus and suggested that preservation of the antrum reduces the symptoms of reflux [20].However, other studies reported a very low incidence of postoperative GERD despite the 3-cm antral resection [22]. Our study showed a significantly lower incidence of GERD symptoms in the 2-cm antral pouch group. This can be explained by the faster emptying mechanism previously suggested by some authors. However, further studies comparing gastric emptying are needed.

Weight regain or insufficient weight loss, which occurs in 1.3–15% of cases, limits the success of LSG when performed as a sole bariatric procedure. Multiple factors are responsible for failure, involving poor adherence to prescribed lifestyle modifications, procedural failure, and operator error [23].

Potential explanations for LSG failure include eventual dilation of the gastric tube with consequent increases in gastric capacity, incomplete removal of the gastric fundus, and creation of a large gastric tube calibrated over a large bougie. The hypothesis that the gastric tube may undergo dilation over time has been a constant source of debate [24].

A study found that gastric volume increased over a 2-year period, but it did not report any weight regain. Whether the creation of a narrower tube with a higher pressure and less dispensability may prevent gastric dilatation and weight regain requires further study [25].

Conclusion

LSG is a safe and effective bariatric procedure. The performance of radical antral resection safely potentiates the restrictive effect achieved by LSG and results in greater and better maintained weight loss without increasing the complication rate. Both LSG techniques are equally efficient regarding weight loss, reduction in comorbidities, and increasing quality of life at 1 year after surgery. Also, they represent valuable surgical alternatives for selected patients with morbid obesity. Long-term follow-up data and larger studies are needed to confirm these results, particularly in superobese patients.

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Conflicts of interest

There are no conflicts of interest.

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