

Original article

Laparoscopic sleeve gastrectomy: long-term weight loss outcomes

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Abstract

Background: Laparoscopic sleeve gastrectomy (LSG) has become an increasingly popular stand-alone weight loss surgery, but there is a paucity of long-term efficacy data.

Objective: To determine long-term outcomes for patients undergoing LSG.

Setting: Tertiary care university hospital in the United States.

Methods: This study presents a case series of the first 16 patients undergoing LSG at our institution. Inclusion criteria were accepted indications for bariatric surgery, and exclusion criteria were any prior bariatric surgery, gastrectomy, substance abuse, uncontrolled psychiatric illness, end-stage organ disease, or advanced-stage cancer. Patients were followed for 7 years. Outcomes included percent excess weight loss (%EWL), percent weight loss (%WL), resolution of co-morbidities, and major and minor complications.

Results: Patients enrolled in this study had a mean body mass index (BMI) of 43.5 kg/m² and a mean age of 49, and 14 of 16 patients were women. Fourteen of 16 patients had 7-year follow-ups with a mean %WL of 29.6% ± 8.95 and a mean %EWL of 59.6% ± 89.9%. At 7 years, 11 of 14 patients achieved >50% EWL. One-year follow-up data revealed a mean EWL of 72% ± 20%, which was significantly greater than the %EWL at 7 years ($P = .005$). Complications included 1 partial obstruction at the gastric incisura angularis and 1 subacute leak; both were managed endoscopically. There were no reoperations and no deaths. Five of 14 patients experienced new-onset gastroesophageal reflux disease.

Conclusions: At 7 years postoperative, the LSG remained a durable and successful operation. (Surg Obes Relat Dis 2015;11:1004–1007.) © 2015 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords:

Sleeve gastrectomy; Laparoscopic sleeve gastrectomy; Bariatric surgery; Long term outcomes; Outcomes; Laparoscopic bariatric surgery; Minimally invasive bariatric surgery

Laparoscopic sleeve gastrectomy (LSG) began as a part of the laparoscopic duodenal switch (LDS) procedure. It was subsequently used as a preliminary procedure in super-obese patients before Roux-en-Y gastric bypass (LRYGB). Now LSG has evolved into an effective and increasingly popular stand-alone weight loss surgery. The reduced operative time, morbidity, and mortality of LSG that initially favored it as a first-stage procedure before

definitive LRYGB [1,2] or LDS [3] have led to its increased popularity as a definitive surgery. The morbidity and mortality of the procedure are well characterized, but there is a paucity of long-term data to confirm the efficacy of LSG. We present our initial case series demonstrating the long-term outcomes of LSG.

Methods

Study design

This study presents a retrospective review of a prospectively collected database at a single academic center and is a

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case series of 16 patients receiving LSG for morbid obesity. This case series was performed before the adoption and acceptance of laparoscopic sleeve gastrectomy as a stand-alone procedure, so all patients consented for participation and the study was approved by our Institutional Review Board. The CO-MIRB number is 06-0371. Inclusion criteria were in line with National Institutes of Health criteria of body mass index (BMI) $>40 \text{ kg/m}^2$ or 35 kg/m^2 with comorbidities. The exclusion criteria were any prior bariatric surgery, gastrectomy, substance abuse, uncontrolled psychiatric illness, end-stage organ disease, or advanced-stage cancer. Outcomes included percent weight loss (%WL), percent excess weight loss (%EWL), major and minor complications, death, and resolution of co-morbidities. Resolution of co-morbidities was determined by cessation of medications and resolution of signs and symptoms. This included resolution of symptoms for gastroesophageal reflux disease (GERD), normal blood pressure for hypertension, normal fasting blood sugar for diabetes, and normal lipid panel for dyslipidemia. Patients were followed for 7 years at the time of this study.

Surgical procedure

All patients received laparoscopic sleeve gastrectomy over a 32F bougie. A 5 trocar technique was used. The initial entry port was a 12 mm optical view trocar placed into the peritoneal cavity under direct vision and with concomitant insufflation approximately 15 cm caudal to the xiphoid and left of midline. Fifteen mm Hg insufflation pressures were obtained and a left subcostal 15 mm trocar, a distal right epigastric 12 mm trocar, a more superior 5 mm right epigastric trocar, and a right upper lateral 5 mm trocar were all placed under vision. A liver retractor was placed through the last 5 mm trocar. The greater omentum was divided from the greater curvature of the stomach using a harmonic scalpel, beginning approximately midway along the greater curvature and first heading toward the angle of His, completely mobilizing the fundus and angle of His, and then heading distally to a point approximately 6 cm proximal to the pylorus. Only obvious hiatal hernias were repaired. Once the greater curvature, body of the stomach, and fundus were all fully mobilized, a 32F bougie was placed down the stomach, and a 60 mm stapler was used to divide across the antrum using a 60 mm green cartridge stapler. Care was taken to avoid narrowing the incisura by staying on the stomach outside of the crow's feet vessels at the incisura itself. A second green cartridge fire completed the antrum and first portion of body staple lines. Two gold cartridge 60 mm staple fires were then utilized, staying close to the bougie but not too tight against it. The final 2 fires utilized a blue cartridge stapler dividing across the angle of His, and taking care to leave a few millimeters of stomach at the angle of His while not getting too close to the esophagus. The excised stomach was placed in a 15 mm

EndoCatch bag and taken out through the left subcostal trocar port site at the end of the case. The staple lines were then carefully reinspected, with hemostasis being noted and then maintained with endoclips as needed. Staple lines were not oversewn, and staple line reinforcement was not used. The bougie was removed, a nasogastric tube was placed down into the gastric sleeve, and the staple line was tested with a 200 mL solution of methylene blue dye. A Blake drain was then placed medial to the gastric sleeve away from any of the staple lines, with the tip being placed in the left subphrenic location. The abdomen was desufflated, and incisions were closed.

Results

Patients enrolled in this study had a mean BMI of 43.5 kg/m^2 and a mean age of 49, and 14 of 16 patients were female. At 7-year follow-up, 14 of these 16 patients had a mean %WL of $29.6\% \pm 8.95$ and a mean %EWL of $59.6\% \pm 19.9\%$ based on self-report. Eleven of 14 patients achieved $>50\%$ EWL. Three patients did not meet the treatment goal of $<50\%$ EWL, and 2 of these patients had $<30\%$ EWL. One-year follow-up data revealed a mean EWL of $72\% \pm 20\%$, which was significantly greater than EWL at 7 years (paired Student's *t* test = .005) (Figure 1). Each patient who met the goal of 50% EWL at 1 year still met that goal by 7 years. Complications included 1 patient with a partial obstruction and leak at the gastric incisura angularis presenting with vomiting 4 months postoperative and diagnosed on upper gastrointestinal (GI) series. She was managed with endoscopic stent placement. There were no reoperations and no deaths.

Of the patients who completed 7-year follow-ups, 7 of 14 (50%) had hypertension before surgery, 3 of 14 (21%) had diabetes, 5 of 14 had dyslipidemia (35%), and 5 of 14 (35%) had GERD (35%). At 7 years postoperative, hypertension resolved in 4 of 7 patients (28%), diabetes resolved in 1 of 3 patients (33%), dyslipidemia resolved in 2 out of 5 patients (40%), and GERD resolved in 3 out of 5 patients (60%). Of note, 5 patients experienced new onset of GERD postoperatively that persisted over the 7-year follow-up. Only 2 patients with new-onset GERD had upper GI series outside of the immediate postoperative period, but both were found to have hiatal hernias. Nutritional deficiencies, examined 1 year postoperative, were rare. One patient had low folate, and 2 patients had high total iron binding capacity but normal serum iron and ferritin levels.

Discussion

Patients had excellent 7-year long-term results and durability of weight loss, with %EWL of 59.6% and 11 of 14 (79%) treatment successes. There was a significant decrease in %EWL between years 1 and 7 and an overall treatment nonresponse rate of 21%. These results are

consistent with prior studies. A recent meta-analysis by Diamantis et al. found EWL of 62.3%, 53.8%, 43%, and 54.8% at 5, 6, 7, and 8 years, respectively [4]. With only 13 patients at 7 years and 34 patients at 8 years, this case series contributes a significant increase in the long-term data available. In addition, percent of patients lost to follow-up was 31.2% in the studies analyzed by Diamantis et al., compared with a rate of only 12.5% in this study. The critical question with LSG is whether the results are enduring. This concern was countered by Himpens et al., who found significant decreases in EWL and increases in the number of patients with <50% EWL between years 3 and 6 postoperatively [5]. We also found a significant decrease in EWL, though not of the same magnitude. In the Himpens study, treatment success fell to only one third of the cohort when patients lost to follow-up and revisions for weight regain were included as treatment failures. To be conservative and consistent with Himpens calculations, inclusion of our 2 patients lost to follow-up in our analysis only reduces our success rate to 69%.

Himpens attributes a possible reason for decline in EWL after the first year to possible neo-fundus formation, which was found in several of the studies upper GI series [5]. Another possible explanation is provided by recent research on eating behaviors and psychiatric and psychological co-morbidities in bariatric surgery patients. Conceição et al. reveal the danger of maladaptive eating behaviors in a cross-sectional survey of postoperative gastric bariatric surgery patients, finding a higher prevalence after the first postoperative year and a positive correlation between grazing and weight regain [6]. There is also initial improvement in psychological and psychiatric co-morbidities, such as anxiety, depression, and substance abuse, that deteriorates after the first postoperative year [7,8]. This is especially relevant because Rutledge et al., in a study of 60 veterans undergoing bariatric surgery, found that there was no association between psychiatric co-morbidities at 1 year postoperative but did find a linear relationship between number of psychiatric disorders and weight regain between 1 and 2 years postoperative [9]. They also found that patients with ≥ 2 psychiatric disorders are significantly more likely to stop losing or regain weight than patients without psychiatric disorders.

In our study, all patients that were treatment successes at 1 year remained successes at 7 years. Yet weight regain was nonetheless significant and may be attributable to eating behavior. We encourage patients to continue long-term care with our multidisciplinary team to address these issues to reinforce healthy eating and to identify and address psychological or psychiatric co-morbidities. This continued intervention will hopefully further improve outcomes.

Like the current case series, other published data do not confirm decreases in average %EWL of large enough magnitude to jeopardize treatment success. Albeladi et al. report 57.1% EWL at 18 months [10], consistent with the

EWL of 53.0% reported by Mittermair et al. at this same point [11]. Guzman et al. report 73.7 % EWL at 3 years [12], which is consistent with 3-year results reported by Zachariah et al. at 73.0% EWL, who also report 63.7% EWL at 5 years [13]. Lim et al. report similar finding at 5 years, with 57.1% EWL [14]. All these numbers are consistent with the results of the meta-analysis by Demantis et al. The consistency of these results at increasing follow-up and our 7-year results suggest weight loss is enduring with LSG.

These comparisons unfortunately are limited by the fact that they were different patients treated at various centers with differing techniques. Although these studies do not indicate a long-term plateau of EWL over time, our study has found that results are still durable with the same success rate at 7 years as at 1 year, even though EWL decreased. In addition, long-term durability is also tied to patient follow-up, multidisciplinary care, and a full complement of bariatric resources to improve patient follow-up and prevent weight regain.

This study has a small number of patients but is notable for being one the larger long-term studies to date. Excellent resolution of co-morbidities was found. It is, however, notable for new-onset GERD in 5 of 14 patients. This was seen in Himpens' study as well. This has led to the adoption of aggressively closing all cural defects to reduce incidence of GERD. Another limitation was that 7-year data were predominately self-reported. Fortunately, Nicholas et al. confirmed that self-reported weights agree very closely with actual weights in bariatric patients [15].

In our experience, complication rates were low, with no reoperations and no deaths. The major complications of stricture and leak have led to subsequent modifications in our surgical procedure. Bougie size has been increased from 32F to 36F because of concerns over the potential for stricture. To prevent leaks, we now oversew and imbricate the staple line at the angle of His with running Lambert absorbable suture. Studies comparing oversewing to no reinforcement have been too small to demonstrate a statistical difference. However, a recent meta-analysis comparing any reinforcement of the staple line (which

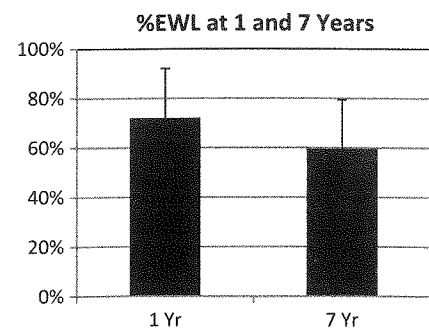


Figure 1. At 1 year %EWL was 72.0% \pm 20.0%, which declined to 59.6% at 7 years ($p=.005$).

includes oversewing) to no reinforcement found statistically lower leak rates for the patients with staple line reinforcement [16].

Conclusions

At 7 years postoperative, the LSG remained a durable and successful operation. The 79% long-term success rate will hopefully be further increased with aggressive follow-up and multidisciplinary care to prevent weight regain. New-onset postoperative GERD is an unfortunate side effect of LSG, and further studies reflecting aggressive closure of cural defects are required to determine if this provides a long-term solution to this problem. Additionally, although the decrease in EWL between 1 and 7 years was relatively small, it is unclear when EWL will stabilize. Nevertheless, like LRYGB and LDS, LSG provides enduring results. Further studies are required to more clearly define patient selection for LRYGB versus LSG. The efficacy of LSG has been found with increasing follow-up periods. It has clearly arrived as viable alternative to LRYGB.

Disclosure

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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