



Efficiency of Laparoscopic One-Step Revision of Failed Adjusted Gastric Banding to Gastric Sleeve: a Retrospective Review of 101 Consecutive Patients

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Published online: 4 July 2019
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Abstract

Background Until recently, laparoscopic adjustable gastric banding (LAGB) was one of the most commonly performed bariatric surgeries worldwide. Today, its high rate of complications and failure rates up to 70% requires revisional surgery. The one-stage conversion from LAGB to laparoscopic sleeve gastrectomy (LSG) has been shown to be safe, although there are some concerns on efficacy and long-term weight loss.

Objectives To demonstrate that one-step revision of LAGB to another restrictive procedure, such as LSG, might have efficient long-term outcomes.

Methods The charts from 133 revisional LSGs for failed or complicated LAGB were retrospectively reviewed for the period between January 2010 and August 2017. Thirty-two patients were excluded for loss to follow-up. Demographics, complications, and percentage of excess weight loss (%EWL) were determined.

Results One hundred one patients were included (85 women and 16 men), with a mean age of 48.5 years, and a mean body mass index of 47.1 kg/m². During the follow-up, 15 patients (15%) underwent a second revisional surgery for weight loss failure (8 Roux-en-Y gastric bypass (RYGBP), 3 biliopancreatic diversion, 3 single anastomosis duodenal-ileal bypass, 1 revisional LSG). Ten patients (10%) had long-term complications (8 severe reflux and 2 stenosis) during this period and underwent a second revisional surgery (10 RYGBP). The remaining 76 had a mean follow-up of 4.3 years and a mean %EWL of 53.2%.

Conclusion Single-stage conversion to LSG is a safe and appropriate solution for failed or complicated LAGB with good long-term weight loss.

Keywords Gastric band · Revisional surgery · Gastric sleeve · Weight loss

Introduction

In the past, laparoscopic adjustable gastric banding (LAGB) was one of the most commonly performed bariatric

procedures worldwide. However, there has been a significant decline in recent years as a result of two major concerns. First, while its short-term results were promising, the long-term failure and complication rates can reach up to 70%. Second, high

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revision rates have also been reported, as much as 60% in some series [1, 2]. Today, the most popular stand-alone bariatric procedure, either as a primary or a revisional option, has become the laparoscopic sleeve gastrectomy (LSG). This procedure has been shown to be efficient, safe, and technically simpler than the laparoscopic Roux-en-Y gastric bypass (LRYGBP) or the biliopancreatic diversion with duodenal switch (BPD-DS) [3, 4].

The debate now centers on whether a single-stage or two-stage approach is best, when performing LSG following failed LAGB [5]. Detractors of single-stage revision LSG argue that the perioperative complication rates reported are higher [6]. Furthermore, there could be an increased risk of anastomotic leaks, due to fibrosis and scarring, present immediately after band removal [7]. Nonetheless, the single-stage conversion from LAGB to LSG has been shown to be feasible and safe, although with a slightly higher leak rate of 5.5% [8].

Studies comparing LSG and other malabsorptive revision procedures following LAGB found no statistical difference between revisional LSG and LRYGBP, in terms of weight loss, reduction in comorbidities, readmission, or reoperation rates [9]. More severe complications have been reported with the LRYGBP in some cases [10].

However, recent concerns on the efficacy of one-stage conversion of failed gastric banding to LSG on long-term weight loss have led to the present retrospective study. This paper is aimed at presenting the long-term outcomes of patients who underwent a revisional LSG for failed or complicated LAGB.

Materials and Methods

A retrospective review of a prospectively collected database was conducted for the patients treated between January 2010 and August 2017. During this time period, the four operating surgeons from a university bariatric center in Montreal, Canada, performed more than 1500 LSGs. Among these, 133 had a revisional LSG for failed or complicated LAGB. Single-stage laparoscopic conversion was the preferred approach. A complicated LAGB was defined as slippage, erosion, port failure/infection, and blockage. A failed procedure consisted of insufficient weight loss or weight regain, defined as a percentage of excess weight loss (%EWL) of less than 50% or body mass index (BMI) > 35 at 2 years, based on Reinhold's criteria [11]. LAGB-related complications were evaluated via a Gastrografin upper gastrointestinal contrast study, upper endoscopy, or CT-Scan. Ethics committee approval was granted for this study, the patients' information was limited to the research authors, and the statistical analysis was carried out anonymously.

The data collected through routine follow-up included demographics, complications, and %EWL. Operative notes were also reviewed for every patient by two independents,

blinded, physicians for more accuracy. Unfortunately, 32 patients were excluded for loss to follow-up (less than 6 months).

Surgical Technique and Postoperative Management

All patients followed a two- to four-week Optifast® diet before the surgery. The surgery was performed laparoscopically, using six laparoscopic ports. The band was transected and removed before the vertical gastrectomy. The fibrous tissue caused by the band was carefully removed anteriorly, leaving a posterior segment to avoid further damage to the stomach. Any dimpling of the hiatus was explored and any hiatal hernia was repaired. The bougie size, 36 or 40 Fr, was chosen according to surgeon preference.

Diet started with clear liquids on postoperative day (POD) 1 and the patient was discharged the following day. Multivitamins, vitamin B12, calcium, iron, vitamin D, and thiamine were given depending on blood tests taken every 6 months.

The following outcomes were repeatedly assessed: weight loss, reduction of comorbidities, complications, and re-operations. Operative morbidity and mortality were defined as any significant complication or death within 30 days following surgery. Follow-up appointments with complete laboratory assessments were done routinely at 3, 6, 12, and 24 months post-operation. Patients were then seen annually or more frequently if necessary.

Statistical Analysis

All the analyses were performed in R (v3.5.3) using the default, standard libraries. Binary (0/1) labels were created for all 101 individuals in the study, depending on whether they had a secondary surgery (1) or not (0). Probability density was used to determine BMI distribution between the two groups with the “sm” library. A BMI cutoff value of 45 was determined empirically, dividing the two groups according to the probability of having a second surgery. Subsequently, a binary predictor with that cutoff value for BMI was defined. Then, a logistic model, using sex, age, weight at baseline, and BMI as predictors, was created. A set of additional predictors, based on the comorbidity information available for each patient at baseline, were also used. More specifically, each patient was tagged for the presence of diabetes. The control patients, who did not undergo a secondary surgery, were compared with the patients that underwent a secondary surgery, due to low weight loss, as defined by the %EWL. The logistic model was as follows:

$$\text{Secondary surgery (EWS)} \sim \text{sex} + \text{age} + \text{weight} \\ + \text{BMI} (> 45) + \text{diabetes}$$

Lastly, all the continuous variables (weight) were standardized by subtracting the mean and dividing it by the standard deviation to strengthen the logistic model.

Results

One hundred one patients, 85 women and 16 men, were included in the study. They had a mean/median age of 48.5/48 years (range 27–76, interquartile range 13), a mean/median preoperative weight of 126/121.5 kg (range 77 to 200, interquartile range 28.5), and a mean/median BMI of 47.1/45 kg/m² (range 32 to 71, interquartile range 10.6). The indication for band removal was failure to achieve sufficient weight loss results with the band in 59 cases (58.4%), complications with the band (slippage/erosion/port failure or infection) in 18 cases (17.8%), and blockage in 24 cases (23.8%) (Fig. 1 and Table 1). The mean/median time between LAGB and LSG with band removal was 42/40.5 months (range 9–72, interquartile range 4.5) and all procedures were performed laparoscopically. There were no conversions to an open procedure. Hiatal hernia was discovered and repaired during revision surgery in 7 patients (6.9%). The mean/median operating time was 110/108.5 min (range 58–220, interquartile range 26), and the mean/median hospital stay was 2.8 days (range 1 to 95). Approximately one third of the cohort was referred from other medical centers.

Following LSG revision surgery, 25 patients (25%) underwent a second revisional bariatric surgery (SRBS). Among these, 15 were revised for weight loss failure (8 LRYGBP, 3 BPD-DS, 3 single anastomosis duodenal-ileal bypass, 1 revisional LSG). They had a mean %EWL of

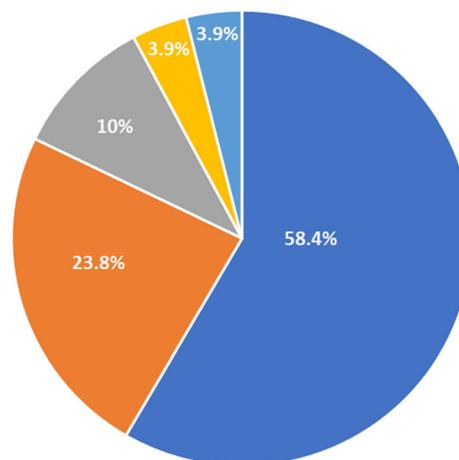
27.75% before the second revision, and a mean follow-up of 3.2 years (range 1–7 years). The remaining 10 patients (10%) underwent a second revision surgery (10 LRYGBP) because they suffered long-term complications after LSG (8 severe reflux and 2 antral stenosis). Their mean %EWL was 40.3% before SRBS, much better than the rest of the cohort needing a second revision, with a mean follow-up of 1.5 years (range 0.5–3 years) (Table 2).

There was no second revisional bariatric surgery for the remaining 76 patients in the cohort. Their mean follow-up was 4.3 years (range 1–8 years) and at least 5 years for 37 patients (49%), at least 4 years for 10 (13.2%), at least 3 years for 6 (7.9%), at least 2 years for 15 (19.8%), and at least 1 year for 8 (10.1%). The mean %EWL was 53.2% with 48.4%, 55.8%, 67.5%, 54.2%, and 59.8% at > 5, 4, 3, 2, and 1 years respectively (Table 2).

Among the group of 76 patients without a SRBS, the causes for LAGB removal were weight loss failure (44), complications (12), and blockage (20). Following analysis, the mean age (49, 49, 50 respectively) and mean preoperative BMIs (46.7, 46.9, and 47.1 respectively) were found to be very similar between the three subgroups. Finally, there was no statistical difference in their mean %EWL with 53.2%, 52.4%, and 52.2% respectively (Table 3).

Further analysis of this 76-patient cohort revealed that 42 patients (55.3%), before the one-stage procedure, had the following comorbidities: diabetes mellitus in 20 patients (26.3%), hypertension in 24 patients (31.6%), hyperlipidemia in 10 patients (13.2%), and obstructive sleep apnea in 19 patients (25%). Three patients (3.9%) had four obesity-related comorbidities, six (7.9%) had three comorbidities, 13 (17.1%) had two comorbidities, and the rest had zero or one

Percentage of patients



■ Weight loss failure ■ Blockage ■ Slippage ■ Erosion ■ Port failure/infection

Fig. 1 Indications for LAGB removal and LSG in our cohort of 101 patients. GERD: gastro-esophageal reflux disease

Table 1 Indications for LAGB removal in each subgroup of patients

Indications for LAGB removal	Patients without SRBS (<i>n</i> = 76)	Patients with SRBS for %EWL failure (<i>n</i> = 15)	Patients with SRBS for complications (<i>n</i> = 10)
Weight loss failure	44	10	5
Blockage	20	2	2
Slippage	7	1	2
Erosion	3	1	0
Port failure or infection	2	1	1

n number of patients, %EWL percentage excess weight loss, SRBS second revisional bariatric surgery, LSG laparoscopic sleeve gastrectomy, LAGB laparoscopic adjustable gastric banding

comorbidity. After the first postoperative year, 63.2% (12 out of 19) of patients with sleep apnea discontinued the use of a continuous positive airway pressure mask. Antidiabetic medication was reduced or discontinued for 70% (14/20) of diabetic patients, dyslipidemia disappeared in 90% (9/10) of patients, and preoperatively diagnosed hypertension returned to normal for 87.5% (21/24) of patients.

There were no perioperative (30-day) deaths in the cohort of 101 patients. In the group of 76 patients without SRBS, five postoperative complications were recorded. There was one gastric leak, requiring prolonged hospitalization with parenteral nutrition and stenting, two early gastric bleeding, stopped spontaneously which only needed a blood transfusion, and two small incisional port-site hernias without surgery. The group of 25 patients with SRBS presented minor complications, all of them occurring after SRBS and not after LSG. There were urinary infections (three patients), one bleeding (after LRYGB treated by endoscopy), and one port-site hernia without surgery.

Following statistical analysis, a BMI above the cut-off value of 45 was found to be predictive ($p = 0.028$) of a second surgery, due to failed weight loss (Fig. 2, Table 4). The remaining covariates, including age, sex, and the presence of diabetes, were not found to be significant (p values > 0.05) to predict a second surgery (Table 4).

Table 2 Characteristics of patients in both groups: 76 patients without SRBS and 25 patients with SRBS after LSG

	Patients without SRBS (<i>n</i> = 76)	Patients with SRBS for %EWL failure (<i>n</i> = 15)	Patients with SRBS for complications (<i>n</i> = 10)
Mean age (years)	49	45.4	47.2
Sex ratio (F:M)	62:14	14:1	9:1
Mean weight before LSG (kg)	124.7	137.7	116
Mean BMI before LSG (kg/m ²)	46.7	47	46
Mean follow-up (years)	4.3	3.2	1.5
Mean %EWL after LSG	53.2%	27.75%	40.3%
Diabetes mellitus	18	1	1
Obstructive sleep apnea	16	3	0
Hypertension	17	4	3
Hyperlipidemia	7	1	2

Values are mean (s.d.), %EWL percentage excess weight loss, BMI body mass index, LSG laparoscopic sleeve gastrectomy, SRBS second revisional bariatric surgery, *n* number of patients

Discussion

The main objective of this retrospective study was to present the long-term outcomes of a large cohort of single-stage conversion LSG following failed LAGB. The results show that a majority of patients (76) had successful %EWL and saw a major resolution of their comorbidities. Nevertheless, 25% of the cohort presented either a complication or a failure after LSG and needed a second revision.

The feasibility of LSG as a revisional surgery after failed LAGB has been the subject of many studies [12, 13]. Indeed, Aminian et al., using the database of the American College of Surgeons National Surgical Quality Improvement Program, compared close to 11,000 primary LSG to 323 one-stage revisions from LAGB to LSG and found that conversion from LAGB to LSG in a single stage was similar, in terms of safety, to primary LSG [14]. Moreover, two other studies found no difference in the complication rate between revision to LRYGB versus LSG, no difference between the readmission or reoperation rates at 30 days or absolute rate of complications within 12 months, and no statistically significant differences in %EWL at 6 and 12 months [15, 16]. Nonetheless, one study reported a 2.9% gastric leak rate, but they had a smaller sample size (34 patients). It should also be noted that all the

Table 3 The 3 subgroups according to the reason for LAGB removal among the 76 patients without a second revisional surgery after LSG

	Weight loss failure (<i>n</i> = 44)	Complication (<i>n</i> = 12)	Blockage (<i>n</i> = 20)
Mean age (years)	49	49	50
Mean weight before LSG (kg)	124.7	124.8	125.3
Mean BMI before LSG (kg/m ²)	46.7	47	47.1
Mean %EWL after LSG	53.2%	52.4%	52.2%

Values are mean (s.d.), %EWL percentage excess weight loss, BMI body mass index, LSG laparoscopic sleeve gastrectomy, LAGB laparoscopic adjustable gastric banding, *n* number of patients

revisions to LSG they reported on were performed as 2-stage conversions and some of the gastric bands were removed in a different center from where the patients underwent LSG [17].

The %EWL results in the 76-patient cohort without SRBS were very satisfactory, according to Reinhold's criteria [11], and there was a major reduction or discontinuation of comorbidities 1 year after LSG. These results add weight to other reports on the metabolic and hormonal efficient function of LSG [18]. Furthermore, the experience the surgeons gained over the years contributed to the reduction of gastric leaks from 5.5 to 1%, gastric bleeding from 4.4 to 2%, and conversion to open surgery from 6.6 to 0% [8].

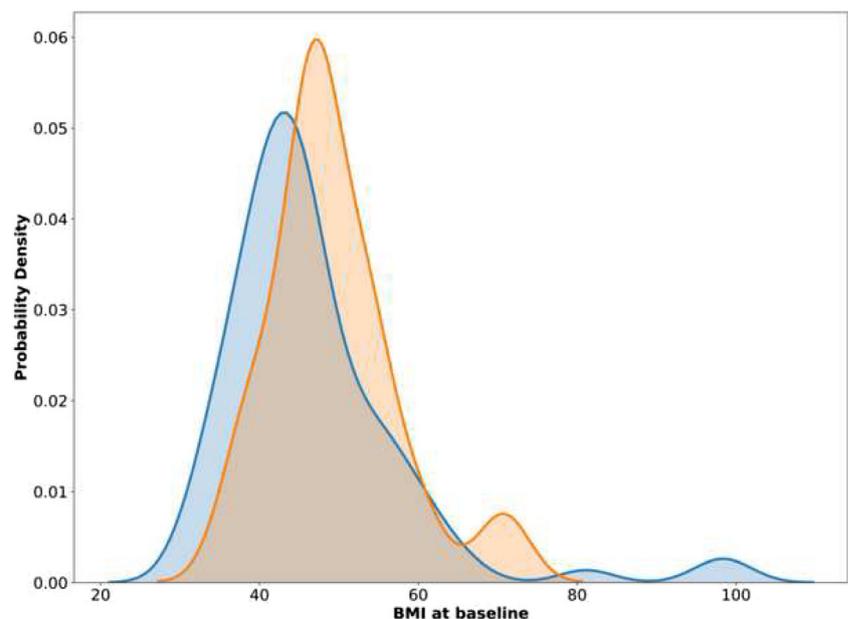
Conversely, one of the major concerns of the present study was the significant proportion (25%) of SRBS following LSG. The statistical analysis revealed that the only significant trend for a second revision after LSG was a BMI > 45 among the patients re-operated for weight loss failure. Those re-operated because of severe reflux or stenosis were more at risk because

Table 4 Statistical analysis of 76 patients versus 15 patients with second revision due to failure of %EWL, effect sizes, standard errors, and the corresponding *p* values are shown for all the tested factors.

Predictors	Effect size (BETA)	Standard error (RS)	<i>p</i> value
Intercept	−0.54091	1.64137	0.7417
Sex	−0.31056	0.89006	0.7272
Age	−0.04217	0.03478	0.2253
Weight	0.09953	0.37574	0.7911
BMI (< 45)	−.024245	0.2354	0.1345
BMI (> 45)	1.86420	2.194	0.0282

of the nature of the complication itself, which is a known predictive factor for revisional surgery. The rate of long-term complications (~ 10%) was similar to other series in the literature reporting only on primary LSG. This would suggest that the single-stage procedure is as safe as a primary LSG, having a similar number of adverse events [16, 19].

The limitations of this study include its retrospective nature, as well as a relatively important number of patients lost to follow-up [32]. This is an important concern in most bariatric surgery series. Many patients, because of low education levels and poor understanding or compliance, do not follow the surgeons' instructions, believing that there is no need to attend a medical follow-up unless there is a major problem [20]. Nonetheless, the remaining cohort was bigger and had a longer follow-up than other similar studies [21]. Another strength of the study was the detailed analysis of the different subgroups (patients with and without second revision after LSG) to identify determinant factors and achieve better patient selection for those who might benefit from this one-stage procedure. Indeed, the multivariate analysis confirmed a possible

Fig. 2 Comparison of BMI density distributions at baseline between the group without second revisional surgery (blue line) and the group with second revisional surgery (orange line) because of %EWL failure

cut-off at baseline BMI as a factor for %EWL failure. Patients with a BMI > 45 were more likely to require a second revision long-term.

These findings need to be studied further through randomized trials with larger samples and a longer follow-up, in order to determine the proper indications for one-stage LSG after LAGB removal.

Conclusion

Single-stage conversion of LAGB to LSG seems to be efficient and safe, with very good long-term results. Nevertheless, a BMI > 45 kg/m² is associated with insufficient weight loss or weight regain. Overall, we advocate this procedure as an additional treatment option after LAGB failure or complication.

Acknowledgments The authors wish to thank Abdou Mousas for statistical analysis and Kathleen Beaumont for writing assistance.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethics All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent Informed consent was obtained from all individual participants included in the study.

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