ELSEVIER

Surgery for Obesity and Related Diseases ▮ (2016) 00–00

SURGERY FOR OBESITY AND RELATED DISEASES

Original article

Laparoscopic conversion of sleeve gastrectomy to Roux-en-Y gastric bypass: indications and preliminary results

Antonio Iannelli, M.D., Ph.D.[a,b,c], Tarek Debs, M.D.[a,*], Francesco Martini, M.D.[a], Benjamin Benichou, M.D.[a,b], Imed Ben Amor, M.D.[a], Jean Gugenheim, M.D., Ph.D.[a,b,c]

[a]*Digestive Center, Centre Hospitalier Universitaire of Nice, Nice, France*
[b]*Institut National de la Santé et de la Recherche Médicale (INSERM), U1065, Team 8, Hepatic Complications in Obesity, Nice, France*
[c]*Faculty of Medecine, University of Nice-Sophia-Antipolis, Nice, France*

Received December 1, 2015; accepted April 6, 2016

Abstract

Background: Laparoscopic sleeve gastrectomy (SG) has gained popularity as a standalone procedure. However, long-term complications are reported, mainly weight loss failure and gastroesophageal reflux disease (GERD). Therefore, demand for revisional surgery is rising.
Objectives: The aim of this study was to report preliminary results within the 2 main indications for laparoscopic conversion of SG to Roux-en-Y gastric bypass (RYGB).
Setting: University Hospital, France.
Methods: Data from all patients who underwent laparoscopic conversion from SG to RYGB were retrospectively analyzed as to indications for revisional surgery, weight loss, and complications.
Results: Forty patients underwent conversion, 29 cases (72.5%) for weight loss failure and 11 cases for refractory GERD (27.5%). The mean interval from SG to RYGB was 32.6 months (range 8–113). Revisional surgery was attempted by laparoscopy in all cases, and conversion to laparotomy was necessary in 3 patients (7.5%). Mean length of follow-up was 18.6 months (range 9–60) after conversion. Follow-up rate was 100%. Mean percent total weight loss and percent excess weight loss were 34.7% and 64%, respectively, when calculated from weight before SG. Remission rate for GERD was 100%. Improvement was observed for all co-morbidities after conversion. There was no immediate postoperative mortality. The postoperative complication rate was 16.7%. According to the Clavien-Dindo classification, there were 5 grade II and 2 grade IIIa complications.
Conclusion: Laparoscopic conversion of SG to RYGB is safe and feasible. In the short term, it appears to be effective in treating GERD and inducing significant additional weight loss and improvement of co-morbidities. (Surg Obes Relat Dis 2016;▮:00–00.)

Keywords: Sleeve gastrectomy; Roux-en-Y gastric bypass; Revisional surgery; Weight loss failure; Gastrooesophageal reflux

Laparoscopic sleeve gastrectomy (LSG) was originally described as the restrictive part of biliopancreatic diversion with duodenal switch (BPD/DS) [1] and was subsequently used as a first step procedure in difficult cases for either DS [2] or laparoscopic Roux-en-Y gastric bypass (RYGB) [3]. During recent years, LSG has progressively gained popularity among the surgical community as a standalone bariatric procedure. It was reported to be the most commonly performed bariatric operation in France in 2011 and in the United States in 2013 [4,5]. In France 480 LSG procedures were performed in 2005, versus 28,563 in 2014 [5]. The

*Correspondence: Tarek Debs, M.D., Service de Chirurgie Digestive et Transplantation Hépatique, Hôpital Archet, 151 Route Saint-Antoine de Ginestière BP 3079, Nice, Cedex 3, France.
E-mail: dr.debs@hotmail.com

http://dx.doi.org/10.1016/j.soard.2016.04.008

increasing numbers of surgeries performed will likely be followed by increasing reports of patients experiencing weight loss failure (WLF), defined as insufficient weight loss (WL) or weight regain (WR). Failure may be related to technical mistakes, such as the fashioning of too large a gastric tube or incomplete removal of the gastric fundus, thus leaving a pouch that is prone to dilation over time. As with any other bariatric procedure, failure may also occur in the absence of anatomic causes in patients with persistent nutritional or behavioral disorders that were underestimated at preoperative workup. These patients are not suitable candidates for revisional surgery and should be managed with diet and psychiatric counseling. WLF can also occur in the absence of a technical or behavioral/eating problem and likely represents underlying metabolic disease and an altered "set point" that is resistant to a restrictive-only procedure.

Once WLF has been established, the choice of a secondary procedure falls into 3 main areas: conversion to BPD/DS [2], conversion to RYGB [6], or revisional SG (ReSG) consisting of refashioning a dilated gastric tube [7]. Single anastomosis gastric bypass may also be considered [8]. Single anastomosis duodenoileal bypass with SG represents a new alternative to standard DS, but limited results have been reported in the literature [9] and must be validated over time. To date, results of only a few series of these revisional procedures have been reported in the literature, and only 2 of them proposed an algorithm to guide treatment choices after failed LSG [6,7,10–13].

Another frequent reason for conversion is gastroesophageal reflux disease (GERD) related to the disruption of anatomic anti-reflux mechanisms or persistent hiatal hernia that remained unrepaired at the time of LSG [14]. When proton pump inhibitors (PPIs) are not effective in relieving GERD symptoms, and in the absence of a correctable anatomic factor, RYGB is considered the optimal treatment approach.

The aim of the present study was to report preliminary results within the 2 main indications (WLF and GERD) for laparoscopic conversion of SG to RYGB, in a series of 40 patients. Safety, feasibility, and short-term effectiveness of this procedure were assessed.

Methods

Patient selection

The study was approved by the Institutional Review Board of our center. All patients who underwent conversion from SG to RYGB between October 2005 (date of introduction of SG at our center) and December 2013 were retrospectively selected from a prospective database including all patients who underwent bariatric surgery in our department.

Data collection

Before LSG, all patients had an extensive preoperative evaluation by a multidisciplinary team including a surgeon, endocrinologist, anesthesiologist, psychiatrist, and dietician. Preoperative workup included medical history and physical examination; standard blood tests; endocrine and biochemical evaluation to detect glucose intolerance, dysthyroidism, or hypo- or hypercortisolism; psychiatric and nutritional evaluation; blood pressure measurement; anthropometric investigations; chest radiography; electrocardiogram; abdominal ultrasound; and upper gastrointestinal endoscopy with biopsy for screening of *Helicobacter pylori*. All cases were discussed at a multidisciplinary meeting before surgery.

Before conversion, all patients underwent an additional nutritional and psychiatric evaluation. Anatomic assessment was performed again by gastroscopy, upper gastrointestinal series, and computed tomography scan with 3-dimensional reconstruction. All cases were discussed again at a multidisciplinary meeting.

The first indication for conversion was WLF, defined as percent excess weight loss (% EWL) $<50\%$ 18 months after surgery. One patient underwent a conversion, despite a % EWL of 52.9, to treat the recurrence of her comorbidities, type 2 diabetes and hypertension; she was also progressively regaining weight after reaching an adequate weight nadir.

The second indication for conversion was intractable GERD, defined as typical reflux symptoms refractory to PPI treatment in association with endoscopic findings of reflux esophagitis.

The presence and resolution of obesity-related co-morbid conditions were quantified according to the use and discontinuation of medication postoperatively in the instance of diabetes, hypertension, or dyslipidemia. Diabetes remission was defined as fasting glucose <5.6 mmol/L and a glycosylated hemoglobin value of $<6.5\%$ without the use of oral hypoglycemic medication or insulin. Improvement was defined as a decrease in the quantity or dosage of oral hypoglycemic medications or insulin. Remission of hypertension was defined as a systolic blood pressure <130 mm Hg or diastolic blood pressure <85 mm Hg without the use of antihypertensive drugs. Improvement was defined as a decrease in the quantity or dosage of antihypertensive drugs, with systolic blood pressure <130 mm Hg or diastolic blood pressure <85 mm Hg. The presence of preoperative sleep apnea syndrome was quantified by sleep studies and postoperative resolution by discontinued use of continuous positive airway pressure masks. Joint problems were quantified by recording history, medication use, or both.

Surgical technique

The surgical technique of laparoscopic conversion from LSG to RYGB adopted by all surgeons at our department

Table 1
Demographic characteristics

	Total (N = 40)	WLF (n = 29)	GERD (n = 11)
Age, yr	40.2 (20–61)	40.2 (20–61)	40.3 (23–57)
Gender (M/F)	9/31	5/24	4/7
Weight bsg, kg	130.9 (97–180)	130.2 (97–180)	132.8 (100–180)
BMI bsg, kg/m^2	47.5 (37.6–66)	47.7 (37.8–66)	47 (37.6–58.6)
Interval, mo	32.6 (8–113)	28.6 (8–113)	42.7 (16–91)
Weight bc, kg	109.5 (70–178)	107.5 (83–130)	114.7 (70–178)
BMI bc, kg/m^2	39.3 (26.3–52.7)	39.2 (34–50)	39.8 (26.3–52.7)
% TWL bc	16.1 (-4.5–33.1)	16.8 (-4.5–33.1)	14.2 (-3.3–30)
% EWL bc	28.7 (-10.3–66.8)	29.7 (-10.3–52.9)	26.3 (-8.1–66.8)

WLF = weight loss failure; GERD = gastroesophageal reflux disease; bsg = before sleeve gastrectomy; bc = before conversion; BMI = body mass index; TWL = total weight loss; EWL = excess weight loss.

All values shown as mean and range unless stated otherwise.

has been previously reported [15]. RYGB consisted of a 30 to 45 mL gastric pouch with an antecolic antegastric 150-cm Roux limb, 50 cm from the ligament of Treitz, and an 11-mm hand-sewn gastrojejunal anastomosis. In case of sleeve dilation or fundic pouch remnant after the sleeve gastrectomy, a vertical resizing of the gastric sleeve was done to create a small gastric pouch.

Results

During the study period, 430 patients underwent LSG at our department. A total of 77 patients (17.9%) had revisional surgery, including 40 RYGB, 31 DS, and 6 ReSG. Conversion to DS was performed as the second step of a staged strategy for super-obese patients, as reported in a previous paper [2]. The 40 patients who underwent conversion to RYGB (9.3%) represent the study population. Indications for conversion to RYGB were WLF in 29 patients (72.5%) and refractory GERD in 11 patients (27.5%). The mean interval from SG to RYGB was 32.6 months (range 8–113). Revisional surgery was attempted by laparoscopy in all cases, and conversion to laparotomy was necessary in 3 patients (7.5%). Mean length of follow-up was 18.6 months (range 9–60) after conversion. The follow-up rate was 100%. Demographic characteristics of the study population are listed in Table 1. The mean initial body mass index (BMI) in our series was 47.5 kg/m^2. Thirteen of 40 (32.5%) patients were super-obese, with a BMI >50. Ten of 29 (35%) patients were in the WLF group, and 3 of 11 (27%) patients were in the GERD group.

Among the 29 patients who underwent conversion for WLF, a mean percent total weight loss (% TWL) of 16.8% and a mean % EWL of 29.7 % were achieved after SG. BMI after conversion reached an average of 30.7 kg/m^2. The overall mean % TWL and % EWL were 35.2% and 64.5%, respectively. Bariatric results after conversion are shown in Table 2. Among the 11 patients for whom symptomatic GERD was the main indication for revisional surgery, 10 developed de novo GERD after LSG. All 11 of these patients complained of typical symptoms of reflux before the conversion in association with endoscopic findings of reflux esophagitis. None of them had a complication of GERD (Barrett's esophagus, peptic stricture) or an extraesophageal manifestation. After conversion to RYGB, all patients experienced profound and immediate relief of reflux symptoms and were able to stop PPI medication. No recurrence of reflux symptoms has been observed for a mean follow-up of 18.6 months so far. Concerning the weight curve in this group, a mean % TWL of 14.2% and a mean % EWL of 26.3% were achieved after SG. After conversion, BMI reached an average of 31 kg/m^2, compared with 39.2 kg/m^2 before conversion. The overall mean % TWL and % EWL were 33.4% and 62.8%, respectively. The weight curve of this group was similar to that of patients converted for WLF, with a higher WR before conversion (23.7 versus 11.6 kg), probably due to the longer interval before revisional surgery (42.7 versus 28.6 months). For super-obese patients, the mean overall % EWL was 59.7% in the WLF group and 51% in the GERD group, with an average of 57.6% EWL. For the non-super-obese, mean overall % EWL was 67% in the WLF group and 67.4% in the GERD group.

The exact etiology of WR is unknown and probably multifactorial. Even after conversion, 4 patients (10%) in the present series experienced WR and 6 patients (15 %) still had a % EWL $<50\%$ at a mean follow-up of 18 months. The evolution of co-morbidities is shown in Table 3. Improvement was observed for all co-morbidities after conversion; nevertheless, it was more important for hypertension and sleep apnea syndrome than for diabetes.

There was no immediate postoperative mortality. Seven postoperative complications were registered (16.7%). Four patients (10%) developed a stricture at the gastrojejunal anastomosis, which was managed in all cases with endoscopic dilation. One patient presented with fever and

Table 2
Bariatric results after conversion

	Total (N = 40)	WLF (n = 29)	GERD (n = 11)
Laparoscopy (%)	37 (92.5)	27 (93.1)	10 (90.9)
Follow-up, mo	18.6 (9–60)	18.6 (10–60)	18.4 (9–42)
Weight ac, kg	85.1 (54–138)	83.6 (60–106)	89.3 (54–138)
BMI ac, kg/m^2	30.8 (20.8–44.1)	30.7 (20.8–43.0)	31 (21.9–44.1)
% TWL ac*	21.9 (2.2–47.8)	21.8 (2.2–47.8)	22.2 (7.1–42.6)
% EWL ac*	48.8 (4.6–102.7)	48.6 (4.6–102.7)	49.4 (26.6–90.2)
Overall % TWL ac†	34.7 (11.2–53)	35.2 (11.2–52.2)	33.4 (19.2–53)
Overall % EWL ac†	64 (24.1–103)	64.5 (24.1–103.0)	62.8 (37.9–93.4)

WLF = weight loss failure; GERD = gastrooesophageal reflux disease; ac = after conversion; BMI = body mass index; TWL = total weight loss; EWL = excess weight loss.

All values shown as mean and range unless stated otherwise.

*Calculated from weight before conversion.

†Calculated from weight before sleeve gastrectomy.

Table 3
Evolution of co-morbidities

Co-morbidity	Before SG	Before conversion	After conversion
Diabetes	9 (22.5)		
Resolved		4	5
Improved		0	0
Unchanged		5	4
Hypertension	13 (32.5)		
Resolved		1	6
Improved		2	4
Unchanged		10	2
Sleep apnea syndrome	11 (27.5)		
Resolved		6	9
Not resolved		5	2

SG = sleeve gastrectomy.
Data presented as numbers of patients, with percentages in parentheses.

abdominal pain 1 month after conversion. The computed tomography scan showed a collection related to the residual stomach, but no leak at the gastrojejunal anastomosis; conservative treatment with antibiotics was effective. One patient developed an incisional hernia on a trocar site, and another presented with an internal hernia at the Petersen's defect. Both underwent surgical repair, without further complications. According to the Clavien-Dindo classification, there were 5 grade II and 2 grade IIIa complications.

Discussion

The present study demonstrates that laparoscopic conversion of SG to RYGB is safe, feasible and leads to good results in terms of WL and GERD resolution at a mean follow-up of 18 months.

Although technically straightforward, LSG can result in several postoperative complications, such as leaks, strictures, twists, or new-onset GERD. As with any other bariatric procedure, LSG can also be followed by a considerable rate of WLF, defined as primary inadequate WL or WR. Therefore, patients undergoing the procedure must be followed long-term for WR and reappearance of co-morbidities. The current revision rate ranges from 5.5% to 12% [6,12,16,17]. In our series of LSG, we observed a revision rate as high as 17.9%.

The true magnitude of the risk of failure after LSG is difficult to evaluate, as only a few series reporting the results of LSG beyond 5 years have been published so far [18,19], and none at 10 years. Although some papers report equivalent outcomes with SG and RYGB or BPD/DS in the short term [20], the overall trend is that WL is slightly inferior, and resolution of co-morbidities such as type 2 diabetes is lower with the SG [21,22]. Indeed, the longest follow-up for SG was reported by Himpens et al. [23] and Eid et al. [24] as 6 to 8 years, with a failure rate as high as 50% at the last follow-up. Other studies report a better outcome, but include very small groups of patients. It may be speculated that the rate of failure may vary as a function of the length of follow-up, the learning curve of the surgeon, the caliber of the bougie, and the alimentary habits of the patient. Behavioral issues must be carefully considered, since even with a revisional surgery that includes a malabsorptive component, some patients will still experience WLF.

Although proper patient selection before proposing revisional surgery seems of paramount importance, behavioral screening tools are not yet available. As LSG is a relatively new procedure, it is still not clear which procedure should be proposed to patients who present with a failure. The 3 main options include: BPD/DS [2], RYGB [6], and ReSG [7]. Only a few studies have been published to date, all of them on small, single-center, retrospective series.

With regard to WL outcomes in the short- and midterm, BPD/DS appear to be superior to RYGB and ReSG, with % EWL of 73% to 80%, 65% to 66%, and 43% to 58%, respectively [10,12,13,23]. In our previous series of 30 patients, the mean % EWL after 2-stage DS was 72.7% [2]. As LSG has been introduced as the restrictive part of BPD, BPD/DS seems to be the most appropriate second procedure, although BPD/DS carries an increased risk of deficiencies, protein malnutrition, and intestinal bacterial overgrowth. Still, the fact that RYGB is technically less demanding compared with BPD/DS, has lower complication rates, and is less malabsorptive encourages many surgeons to opt to perform RYGB. In addition, compared with LSG, RYGB increases restriction because of the small capacity of the gastric pouch [12]. In some cases, the development of a dumping syndrome may further limit the sweet-eating habits of some patients.

Our data showed a mean % EWL of 64% at a mean follow-up of 18.6 months, close to the expected outcome for primary laparoscopic RYGB [25]. Our results are concordant with the main studies in the literature. In particular, Gautier et al. [12] reported a mean 64.6% EWL at a median follow-up of 15.5 months in a series of 18 patients, while Carmeli et al. [10] observed a mean 65.5% EWL at a mean follow-up of 15.6 months. Morbidly obese patients with a BMI <50 showed a better % EWL of 67%, compared with 57.6 % EWL in super-obese patients. Super-obese patients have a higher risk of WLF.

The pathogenesis of GERD is not fully understood and is influenced by several factors. The presence of a hiatal hernia and/or preoperative GERD is probably responsible for the occurrence of de novo GERD or aggravation of the pre-existing GERD after LSG [26]. Himpens et al. were the first to report postoperative development of de novo GERD symptoms after the LSG [27]. In 2009, Gagner et al. reported 6.5% of patients developing de novo GERD after LSG [28]. In morbidly obese patients, there is a high prevalence of GERD due to increased gastroesophageal pressure gradient [29]. The LSG may reduce GERD

through a decreased gastroesophageal pressure gradient induced by WL, but also through accelerated gastric emptying and reduced gastric acid secretion [30]. However, LSG may also be responsible for the occurrence of de novo GERD due to disruption of anatomic anti-reflux mechanisms (such as the removal of the angle of His) or because the presence of a hiatal hernia is often missed preoperatively. Indeed, Soricelli et al. showed that systematic exploration of the hiatal region for the presence of a hiatal hernia and hiatal hernia repair prevent the occurrence of de novo GERD, at least in the short term [14]. Our data confirm the efficacy of laparoscopic RYGB in treating GERD with a 100% remission rate, the same reported by Gautier et al. and by Langer et al [6,12].

As seen in 4 patients in our series, WR might be observed even after conversion, and 6 patients still had a % EWL <50%. Failure of conversion was seen in 15% of patients. It remains difficult to recognize the causes of such failure; however, careful nutritional, psychological, and anatomic evaluation can shed light on the causes of WLF. The most common factors leading to WR after WL surgery are decreased exercise and a return to preoperative eating habits, with an increased caloric intake or increased consumption of calorie-dense foods. In our study, no mortality was observed, but the complication rate was slightly higher than primary laparoscopic RYGB. In particular, in the present series, we found a 10% rate of stricture formation at the gastrojejunal anastomosis, which is significantly higher than the 3.4% rate seen with primary RYGB at our institution.

We acknowledge that the present study has several limitations. It involved only a small, single-center series and was retrospectively conducted. Moreover, the average duration of follow-up was limited to 18 months. However, data on revisional surgery after LSG are scarce, and to our knowledge this paper reports the largest series of conversions from SG to RYGB published to date.

Conclusion

This study shows that laparoscopic conversion of SG to RYGB is a safe and feasible procedure for surgeons who routinely perform RYGB. In the short term, it appears to induce significant additional WL and additional improvement of co-morbidities, with a mean % EWL of 64% at a mean follow-up of 18.6 months. Remission rate for GERD was as high as 100%. Further research is necessary to determine which factors contribute to the highly variable degree of WL seen after conversion of SG for WLF or WR.

Disclosures

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

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