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ORIGINAL ARTICLE

Laparoscopic omega-loop gastric bypass for the conversion of failed sleeve gastrectomy: Early experience

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KEYWORDS
Gastric bypass;
Mini gastric bypass;
Obesity;
Bariatric surgery;
Longitudinal gastrectomy;
Sleeve gastrectomy

Summary
Objectives: Despite the initial effectiveness of sleeve gastrectomy (SG), some patients who undergo this purely restrictive technique have inadequate weight loss or renewed weight gain and persistent obesity-related co-morbidities with their potentially lethal complications. In such patients, the conversion of SG by the addition of a malabsorptive technique may then be necessary.
Patients and methods: Conversion of SG to a mini gastric bypass (MGBP) was evaluated for failure of weight loss. An ante-colic end-to-side stapled gastro-jejunal anastomosis was performed laparoscopically, connecting the long narrow gastric tube to the jejunum at a point 200 cm downstream from the ligament of Treitz.
Results: Between October 2006 and February 2012, 651 laparoscopic MGBP were performed for morbid obesity. Twenty-three of these patients (3.5%) had previously undergone SG. The conversion from SG to MGPB was performed laparoscopically in 19 of the 23 patients (81%) at a mean interval of 26.3 months (8.2—63.7). The 30-day postoperative mortality rate was zero and the morbidity rate was 9.5%. The mean BMI before MGBP was 44 ± 7.7 kg (35.8—55.4). Conversion of SG to MGBP resulted in additional weight loss, achieving a mean BMI of 39.9 with a 26.8% loss of excess BMI (EBL) at 3 months, mean BMI of 36.5 with 37.2% EBL at 12 months, mean BMI of 36.2 with 48.6% EBL at 18 months, and mean BMI of 35.7 with EBL of 51.6% at 24 months. The overall mean EBL was 57.3 ± 19.5% (range: 25—82%) at 42.3 months (range 16.7—60.8 months).
Conclusion: Conversion of SG to MGBP is feasible, safe and effective, and results in significant additional weight loss. Definitive results at 2 and 5 years are awaited for the long-term procedure validation.

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Introduction

Surgical treatment of morbid obesity results in significant sustained weight loss, which reduces obesity-related morbidity and increases survival compared with patients receiving optimal medical therapy [1,2]. Laparoscopic sleeve gastrectomy (SG) has demonstrated its effectiveness in achieving weight loss and resolution of co-morbidities in patients with severe obesity and super-obesity [3,4]. However, this purely restrictive technique may sometimes be associated with long-term failure, due either to inadequate weight loss or to renewed weight gain; this requires effective low-morbidity alternative procedures [5,6]. Himpens et al. [5] reported that more than 30% of the SG patients ($n = 13/41$) had inadequate weight loss or renewed weight gain, requiring an additional procedure. Laparoscopic mini gastric bypass (LMGBP), described by Rutledge [7], has a lower operative morbidity with equivalent efficacy compared to laparoscopic Roux-en-Y gastric bypass (RY-GBP), in terms of resolution of the metabolic syndrome, loss of excess weight (EWL) and improvement of the quality of life [8]. The effectiveness of LMGBP has also been proven for failures of vertical banded gastroplasty or adjustable gastric banding (AGB) [9—12]. Recently, LMGBP has been used as a complementary procedure after failed SG, but its efficacy has not yet been validated [6]. The aim of this work was to study the feasibility, morbidity and mortality, and short-term weight loss results of LMGBP, when used as a supplementary malabsorptive procedure in patients who had undergone SG with unsatisfactory weight loss or renewed weight gain.

Materials and methods

Surgical indications

The initial decision to perform SG was made, in our service or at another institution, when performance of a tension-free omega-configured gastro-jejunal anastomosis of LMGBP was impossible due to short mesentery. The decision to convert SG to LMGBP was made in SG patients who had persistent obesity (BMI >40 kg/m^2 or >35 kg/m^2) with persistent co-morbidity (HAS recommendations) and when the initial weight loss was considered inadequate by Reinhold criteria: failure of SG was defined as loss of excess BMI (EBL) < 25% or gradual weight regain; lack of success was defined as EBL < 50% [13].

Preoperative evaluation

The patient was informed of the benefits, alternatives, risks and long-term consequences of LMGBP during the preoperative consultation with the surgeon, endocrinologist and dietician. A psychologist confirmed the absence of psychiatric illness and severe eating disorder. An upper gastrointestinal series (UGIS) was performed with water-soluble contrast to evaluate the possibility of post-SG gastric dilatation as a cause of renewed weight gain. Upper endoscopy with biopsies to rule out *Helicobacter pylori* infection and abdominal ultrasonography were routinely performed. The patient's written consent was obtained before the surgical procedure.

Surgical technique

The laparoscopic procedure began with the lysis of adhesions along the left edge of the gastric tube related to the previous SG, taking care to dissect the entire stomach up to the left diaphragmatic pillar if gastric dilatation was suspected. A 45 mm Endo-GIA stapler was inserted at the corner of the lesser curvature to maximally preserve the arterial network of the lesser curvature. When gastric dilatation was present, a gastric pouch was revised by vertical application of a 60 mm Endo-GIA stapler parallel to the lesser curvature up to the angle of His, calibrated around a 34 French bougie. An ante-colic end-to-side gastro-jejunal anastomosis was then performed with the 45 mm Endo-GIA stapler to a jejunal loop 200 cm downstream from the ligament of Treitz. If elevation of the jejunum resulted in tension, the greater omentum was divided. The staple line was not reinforced with sutures. The bougie was replaced with a nasogastric tube advanced into the efferent jejunal loop, and blue dye was instilled to detect evidence of anastomotic leak. A suction drain was placed posterior to the anastomosis [14].

Postoperative management

If there were no signs of anastomotic complication by clinical or laboratory findings, the nasogastric tube was removed on the second postoperative day and oral feeding of liquids was started. An UGIS was not routinely performed. Patient ambulation was encouraged as soon as the patient returned from the operating room. If there were no signs of complications, the patient was discharged on the 5th day after dietary instruction by the dietician. At discharge, the patient received prescriptions for a daily multivitamin, a proton pump inhibitor (PPI), analgesics, and prophylactic anticoagulants. Follow-up visits were scheduled at 1, 3, 6 and 12 months, and every 6 months thereafter.

Statistical analysis

Data were recorded prospectively, including demographic information, patient history, co-morbidities prior to SG and at the time of LMGBP; data recorded at postoperative visits included weight, BMI, percentage of excess BMI, percentage of EBL, postoperative morbidity and mortality according to the Clavien-Dindo system [15].

Results are presented as mean ± standard deviation (SD) for continuous variables and as percentages for categorical variables. Univariate logistic regression with χ^2 test or *t*-test as appropriate was performed to define the relationship between the risk of complications, weight loss and the following variables: sex, age, BMI at the time of LMGBP, and bariatric surgery prior to SG. A *P*-value of < 0.05 was considered statistically significant.

Results

Population

Since October 2006, 651 patients underwent LMGBP for morbid obesity on our clinical service. Twenty-three of these patients had undergone previous SG. Of these patients, 21 were eligible for evaluation while two were lost to follow-up after hospital discharge. There were 13 women (M:F sex ratio = 0.6) with a mean age of 49.5 ± 11.2 years (range: 28—64). These patients were treated between October 2007

and September 2011. In eight patients, the initial decision to perform SG was made at another institution; these patients had an average weight of 137.4 ± 28 kg (range: 97—172 kg) and a mean BMI of 49.4 ± 9.2 kg/m^2 (range: 40.4—64.7). On our service, 13 patients initially programmed for LMGBP eventually, underwent SG when performance of a tension-free gastro-jejunal anastomosis proved technically impossible (12.8% of the 101 SG). For these 13 patients, the mean preoperative weight was 143.2 ± 29 kg (range: 100—193) and mean BMI was 51.4 ± 11 kg/m^2 (range: 36.5—75.4). Indications for converting SG to LMGBP were inadequate weight loss in 17 patients (81%) or subsequent weight gain despite initial good results in four patients (19%). Suspected gastric tube dilatation based on UGIS findings was confirmed in 11 patients (52.3%), including eight with dilatation of the entire gastric tube (38%), two with distal dilatation (9.5%), and one with proximal dilatation (4.7%). None of our patients developed gastroesophageal reflux (GERD) after SG.

Results of this strategy

The average interval before conversion of SG to LMGBP was 26.3 months (range: 8.2—63.7). Of all the patients studied, four (19%) required conversion to open laparotomy because of postoperative adhesions at the cardia, including one whose initial SG had been by laparotomy. Of these four patients, two had previous history of multiple bariatric surgeries (50%) and two had undergone SG alone (50%). For the 17 patients who underwent totally laparoscopic MGBP, five had undergone other bariatric surgery prior to SG (29.4%) and 12 had only undergone SG alone (70.6%, $P = 0.43$). No association was found between the rate of intra-operative conversion to laparotomy and patient age, sex or BMI > 50 kg/m^2.

Four patients (19%) with symptomatic cholelithiasis underwent cholecystectomy at the time of LMGBP. Of these, one developed a postoperative bile leak that resolved spontaneously with drain removal on day 7 (Dindo 1). Five patients (23.8%) required re-resection of the gastric pouch after intra-operative confirmation of gastric dilatation. One patient (4.7%) required reoperation to repair an incisional hernia after midline laparotomy (Dindo 3B). No patient developed deep vein thrombosis, rhabdomyolysis, intestinal obstruction, anastomotic leak, stricture or marginal ulcer during the period of follow-up. The 30-day postoperative mortality rate was zero.

The percentage EBL for this surgical strategy was 57.3 ± 19.5% (range: 25—82.8) after a mean interval of 42.3 months (range: 16.7—60.8). Table 1 and Figs. 1 and 2 provide details of the changes in weight, BMI and %EBL.

In this series, all the patients developed increased frequency of daily bowel movements (2—6 per day). We found no evidence of biliary reflux.

Follow-up after conversion of SG to LMGB was 95%, 90.5%, 71.4%, 42.9% and 23.8% at 3, 6, 12, 18 and 24 months, respectively.

Conversion results after adjustable gastric banding (AGB)

Seven patients (33%) had undergone AGB placement prior to SG (Table 2). There was no statistically significant difference in terms of outcome, weight loss, and surgical morbidity between patients who had SG de novo versus SG after takedown of AGB.

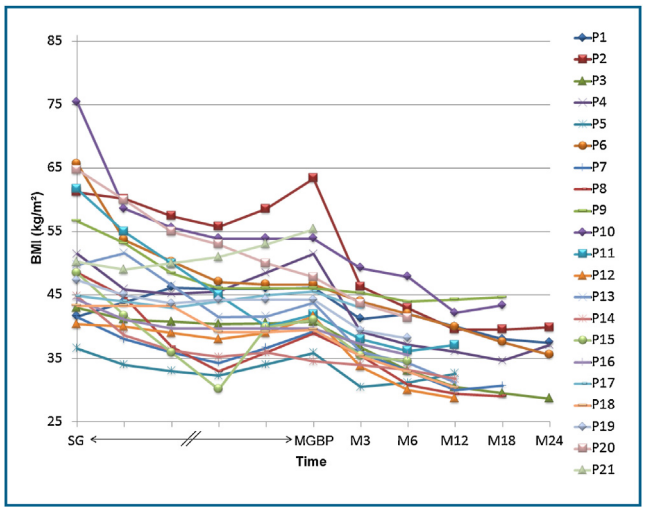

Figure 1. Individual changes in BMI after sleeve gastrectomy (SG) and conversion to mini gastric bypass (MGBP). The interval to conversion varied from 8.2 to 63.7 months. M = month; P = patient.

Discussion

This work has shown that laparoscopic conversion of failed SG to MGBP is feasible without major mortality or morbidity, and appears to be effective in the short-term with a significant EWL and a mean EBL of 51.6% at 24 months. We believe that this confirms the value of adding a malabsorptive procedure when a restrictive surgery like SG fails.

Laparoscopic SG was initially described as a first-stage procedure in the preparation for duodenal biliopancreatic diversion [4,16] or before RY-GBP [17] in super-obese patients for whom such complex procedures were considered too morbid [18]. When significant weight loss results with SG alone were reported, SG was incorporated into the bariatric surgical armamentarium as a stand-alone procedure [3,19]. LMGBP is technically simpler and less morbid than biliopancreatic diversion, whose major morbidity rate is as high as 38% with a 6% mortality rate — particularly in super-obese patients (BMI > 65 kg/m^2), as evidenced by the results of Ren et al. [4]. The major morbidity rate after SG is 12%, consisting mainly of staple line leaks, hemorrhage, or

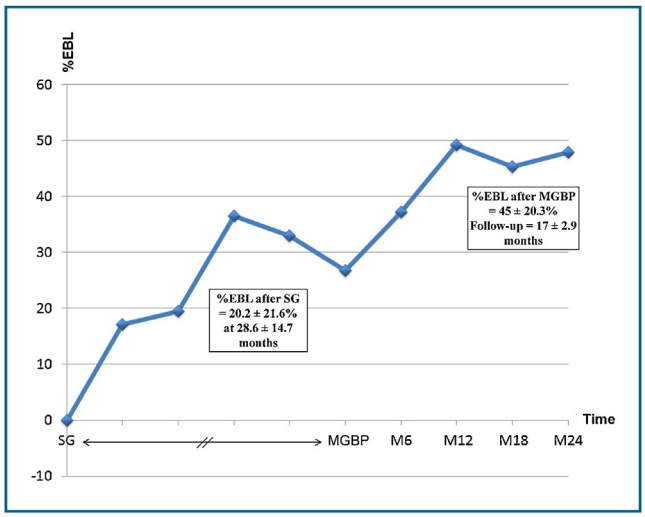

Figure 2. Efficacy of sleeve gastrectomy (SG) and of mini gastric bypass (MGBP) on the percentage loss of excess BMI (EBL) in the entire group. % EBL = percentage loss of excess BMI; M = month.

Table 1 Progression of weight, BMI, and percentage loss of BMI (% EBL) after sleeve gastrectomy (SG) and conversion to mini gastric bypass (MGBP).

	Before SG	After SG, before LMGBP	3 months after LMGBP	6 months after LMGBP	12 months after LMGBP	18 months after LMGBP	24 months after LMGBP
Patients (*n*)	21	21	20	19	15	9	5
Weight (kg)	141 ± 28.1 (97–187)	123 ± 17.9 (95–160)	110.3 ± 2.3 (81–152)	102.9 ± 15 (79–124)	94.6 ± 15.6 (69–125)	99.1 ± 16 (78–126)	96.4 ± 15.6 (78–118)
BMI (kg/m^2) (Range)	50.6 ± 12.3 (36–65.6)	44 ± 7.7 (35.8–55.4)	39.9 ± 6.6 (30.4–50.8)	36.5 ± 4.5 (30.8 ± 43.9)	34.6 ± 5.2 (28.7–44.3)	36.2 ± 5.9 (28.6–44.6)	35.7 ± 4.3 (28.6–39.9)
Weight loss (kg) (Range)	N/A	18 ± 22.7 (−55 to +15)	13.2 ± 5.4 (2–22)	18.2 ± 6.7 (6–31)	23.9 ± 10.2 (5–41)	26 ± 10.1 (4–41)	29.2 ± 7.5 (21–40)
% EBL (%)[a] (Range)	N/A	20.2 ± 2.6 (−27.5 to +53.9)	26.8 ± 12 (3.4–49.5)	37.2 ± 12.4 (10–58.3)	49.3 ± 19.8 (8.4–77.6)	48.6 ± 21 (6.7–78.8)	51.6 ± 14.8 (40.9–76.8)

[a]% EBL = percent of excess BMI loss.

stricture [5,20,21]. The incidence of gastric fistula is generally estimated at 2.5% [22], although it was as high as 7% in a European multicenter cohort [21]. Post-SG mortality of 0.4% is higher than that observed after RY-GBP (0.3%) and AGB (0%) [6]. In addition, mortality after reoperative bariatric surgery is significantly higher (2%) than that observed after primary bariatric surgery [23]. In the series of reoperative bariatric surgery reported by Patel et al. [23], a 13% anastomotic leak rate was noted ($n = 20/151$). In our series, which includes only secondary LMGBP after SG, we found no anastomotic complications and no surgical mortality. Unlike LMGBP, SG creates a high-pressure environment in the gastric tube due to pyloric preservation that predisposes to the development of anastomotic leaks. Given the small number of patients in this series, we were unable to demonstrate any statistically significant association between morbidity and the commonly recognized intra- and postoperative risk factors of age, sex, BMI or previous bariatric procedures before SG.

Analysis of long-term data after SG shows a high failure rate, especially if the volume of resected stomach is low (< 500 cm^3) [24]. In the series of Himpens et al. [6], 26% of the patients required an additional duodenal diversion procedure and 43% were dissatisfied with SG results at 4–6 years postoperatively. More than 20% of the patients who underwent SG reported severe GERD or vomiting at 6 years after SG. Weiner et al. [14] reported a 15% incidence of GERD, which was improved by conversion to RY-GBP. At our center, the incidence of GERD after LMGBP is estimated at 2% ($n = 2/100$) [14]. No patient in this series developed GERD after reoperation, however, none of these patients had GERD after their SG prior to conversion to LMGBP. In our technique of LMGBP, the jejunal limb is anastomosed to the posterior surface of the stomach; gravity helps to create an anti-reflux system and theoretically helps prevent bile reflux.

Hyperactivity of ghrelin-producing cells, scattered along the entire length of the intestinal tract, tends to inhibit the early effect of gastric fundal resection; this may partly explain the renewed weight gain after SG [25]. In addition, changes in eating behavior, particularly consumption of sweets, and lack of ongoing surveillance may also contribute to renewed weight gain [26]. Dilatation of the remaining stomach or persistence of the fundus due to inadequate resection may result in a decrease in the restrictive mechanism (formation of a neo-fundus). Failure of weight loss (due more to gastric pouch expansion than to inappropriate dietary habits) has led some teams to propose SG revision [6,27]. In our series of LMGBP performed because of inadequate weight loss or renewed weight gain, we suspected inadequate initial gastric resection in 52.3% of the cases, although preoperative UGIS did not objectively demonstrate gastric pouch dilatation in all the cases [27]. Among the

Table 2 Comparison of results of conversion to MGBP for patients after primary SG and for patients having SG after removal of AGB.

	Primary SG*n* (%)	SG after AGB*n* (%)	*P*
	14 (64)	7 (33)	
Sex F/M	7/7	6/1	0.11
Age at conversion (years)	48.5	51.5	0.54
BMI at conversion (kg/m^2)	41.8	45.2	0.13
% EBL after LMGBP (%)	43.1	48.6	0.63
% EB* cumulative (%)	59.0	49.6	0.45
Follow-up after conversion to LMGPB (months)	16.6	18.0	0.62
Follow-up after SG (months)	43.4	40.0	0.83
SG by open laparotomy	2 (14)	2 (28)	NA
Complications	0	2 (28.5)	NA

BMI: body mass index; % EBL: percentage loss of excess BMI.

patients studied, five (23.8%) required additional resection of the gastric pouch, which was accomplished without anastomotic leakage.

The analysis of the Swedish registry of obese patients showed a maximum weight loss of $32 \pm 8\%$ kg between 12 and 24 months; stable weight loss at 10 years remained at $25 \pm 11\%$ [1]. Laparoscopic RY-GBP is considered a safe procedure with estimated postoperative mortality between 0.16% and 0.54% [18,28]. The technique of LMGBP is now widely practiced [29]. A prospective randomized comparison of LMGBP vs RY-GBP showed a morbidity rate of 7.5% vs 20%, ($P < 0.05$) and a shorter operative time (148 vs 205 min, $P < 0.05$) [8]. These results were confirmed at 10-year follow-up [30]. In addition, when the LMGBP was used as a secondary procedure, the results for the resolution of the metabolic syndrome, EWL (64.4% vs 60% at 2 years), and improvement of the quality of life were at least equivalent to those of RY-GBP. In a previous publication, we noted a 7% incidence of major complications after LMGBP (including one peri-anastomotic abscess and one stricture) and EWL of 63% at one year [14].

At our institution, LMGBP is proposed for all patients whose obesity exceeds the indications for AGB [31]. Initial SG was proposed as a preparatory procedure for super-obese patients (BMI > 60 kg m^2) or when unfavorable anatomical conditions (short thick mesentery) prevented performance of a tension-free gastro-jejunal anastomosis. The addition of LMGBP after SG was discussed at two years if weight loss was inadequate or if the patient regained weight. In this series, the average interval for conversion was 26.3 months, including 2 patients re-operated at 12 months and 9 patients re-operated within 24 months, either due to the immediate ineffectiveness of restrictive surgery ($n = 8$, mean %EBL = 19% after 14.7 months) or in initially super-obese patients after the BMI fell below 50 kg/m^2 ($n = 3$).

Conclusion

Given the increasing frequency of bariatric surgery, failure of first-line restrictive procedures will require the development of safe and effective conversion procedures. The choice of LMGBP as a revision technique after failed SG appears to be a possible alternative to duodenal diversion, revisional SG, and RY-GBP. However, these data must be validated with evaluation of long-term results and controlled trials.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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