



Indications and Mid-Term Results of Conversion from Sleeve Gastrectomy to Roux-en-Y Gastric Bypass

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Abstract Sleeve gastrectomy (SG) is currently considered as a primary bariatric surgery. This is because of its relative simplicity and satisfactory results. As observed with other bariatric procedures, surgeons are confronted with insufficient weight loss or weight regain, insufficient resolution of metabolic disorders, and intractable severe reflux. A retrospective analysis of conversion from SG to Roux-en-Y gastric bypass (RYGBP) was performed to assess weight loss, diabetes resolution, and relief of reflux symptoms. The mean interval between the two procedures was almost 24 months. Eighteen patients underwent conversion from SG to RYGBP for insufficient weight loss ($n=9$), severe reflux ($n=6$), and persistence of type 2 diabetes mellitus (T2DM) ($n=3$). The median follow-up was 15.5 months. Weight loss was significantly improved with a mean percentage of excess of body mass index loss at 64.6 % after conversion versus 47.1 % before conversion. All reflux symptoms were immediately relieved without any medication at the end of the follow-up. The three patients who had an operation for persistence of T2DM are now free of medication. Only one postoperative complication was observed as a small bowel injury, which was treated surgically. Conversion from SG to RYGBP is safe. Severe reflux is definitely treated and is an incontestable indication with this procedure. Additionally, weight loss and diabetes are clinically improved. Our results appear to be similar to those with a primary RYGBP.

Keywords Sleeve gastrectomy · Gastric bypass · Conversion · Weight loss · Reflux · Type 2 diabetes

Introduction

Sleeve gastrectomy (SG) was introduced less than 10 years ago as the first step of a two-step approach in high-risk [1] or super-obese patients [2]. The aim of this strategy was to complete duodenal switch after decreasing the operative risk. The results obtained in terms of weight loss and resolution of comorbidities encouraged and stimulated the diffusion of SG, leading bariatric surgeons to propose this procedure as a primary bariatric procedure. The indications were then expanded to all morbid obese patients as a definitive weight loss intervention [3, 4].

Long-term results on restrictive procedures [laparoscopic adjustable gastric banding (LAGB) and vertical banded gastroplasty (VGB)] show weight regain or insufficient weight loss (IWL) and lead to a revisional surgery [5, 6]. Secondary weight regain is also observed with Roux-en-Y gastric bypass (RYGBP), but it is less than that in pure restrictive procedures [7]. Few studies show long-term results of SG, but weight regain or IWL is expected. Proposed revisions include “re-sleeve” [8], the placement of an adjustable gastric band [9], conversion to RYGBP [10], or conversion to duodenal switch [11] as a second step procedure to re-induce weight loss.

Himpens et al. [12] described the appearance or a worsening of symptoms of gastroesophageal reflux disease (GERD) in almost 20 % of patients. Proton pump inhibitors (PPIs) at a high dosage are sometimes not efficient enough to treat these symptoms. RYGBP could be the last choice to relieve these patients and avoid peptic stenosis or Barrett’s esophagus.

Results obtained on the resolution of type 2 diabetes mellitus (T2DM) after SG are disappointing compared with those for RYGBP, as reported in a recent randomized controlled trial [13]. The purpose of this study was to report mid-term results within the different indications for conversion from SG to RYGBP.

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Materials and Methods

From June 2005 to December 2010, 114 consecutive patients underwent laparoscopic SG at the Department of Digestive Surgery of Caen Regional University Hospital. All patients are reviewed into a local prospective database dedicated to bariatric surgery. From October 2006 to July 2011, a total of 18 patients underwent conversion to RYGBP. Fourteen patients were operated on SG in our department (12 % of the total SGs), and four went to other hospitals.

The indications for SG for these patients were the patient's choice (16.67 %), high-risk patients (61.1 %), or intraoperative choice because of difficulties to perform RYGBP (22.2 %). A high-risk patient was defined by a body mass index (BMI) higher than 50 kg/m² with one or more major comorbidities, such as T2DM, high blood pressure, and obstructive sleep apnea syndrome. The main difficulty encountered during RYGBP is when the mesentery is considerably fatty and short, and the ileum is stretched when it reaches the gastric pouch. We believe that it is risky to perform the gastrojejunostomy in tension. In these cases, we would rather perform SG to convert into RYGBP further, if necessary, in terms of results. The patients are always informed of this possibility. The surgical technique was heterogeneous because four patients (22.2 %) were operated on in other hospitals, but all had a 36-Fr calibration of the sleeve.

Indications for laparoscopic conversion to RYGBP were IWL in nine patients (50 %), intractable reflux in six patients (33.3 %), and persistence of T2DM requiring insulin therapy in three patients (16.7 %). One patient had both persistence of T2DM and a severe reflux, but the indication for conversion was reflux. Mean BMI before SG (BMI initial) was 55 kg/m² (range, 38–72 kg/m²). All data of the study population are presented in Table 1. We considered IWL as when the weight was stable for more than 6 months with a BMI remaining over 40 kg/m². The mean interval from SG to conversion for the overall series was 23.8 months (range,

4.3–51 months); it was after 24.3 months (range, 15.6–40.6 months) for IWL, after 28.1 months (range, 4.3–51.3 months) for reflux, and after 13.8 months for diabetes (range, 10–17.8 months). At the time of the conversion, the overall mean excess BMI loss was 47.1 % (range, 19–77 %) and was better in the reflux group (55.4 %) compared with the other groups. Mean BMI before conversion was 40.9 kg/m² (range, 28–48 kg/m²) and was slightly less in the reflux group (36.7 kg/m²) compared with the other groups.

Before conversion, we always performed gastroscopy with biopsies for the screening of *Helicobacter pylori* and a barium upper GI study. The patients also had a new nutritional and psychiatric evaluation. All the cases were discussed at a multidisciplinary meeting before conversion.

Surgical Technique

Conversion from SG to RYGBP is similar to a primary laparoscopic RYGBP with five ports; one port can be added if necessary. Adhesions between the gastric sleeve and the liver or the omentum were released with electrocoagulation. The lesser omentum was then dissected near the lesser curve to reach the lesser sac. The gastric sleeve was horizontally transected using a linear stapler Echelon® 60 mm (Ethicon Endo Surgery Inc., Cincinnati, OH, USA) with a green cartridge (4.1 mm). Sometimes, a resizing of the gastric pouch was necessary when the sleeve was slightly dilated; in these cases, another green cartridge was applied vertically. Further stomach resection was not useful. The biliopancreatic limb is approximately 70 cm in length. Gastrojejunostomy was performed manually with two running sutures of Prolene® 1 (Ethicon Inc., Cincinnati, OH, USA). The length of the alimentary limb depended on the patient; it was approximately 150 cm if the patient was diabetic and 120 cm if the patient was not diabetic. Jejunojejunostomy was performed using a linear stapler Echelon® (Ethicon Endo Surgery Inc.) 60 mm with a white cartridge (2.5 mm), and the enterotomy is closed with a running suture of Prolene® 2/0 (Ethicon Inc.). At the end of the procedure, a methylene blue dye test was routinely performed. A multitubular silastic drain was always left next to the gastrojejunostomy.

Table 1 Demographic data

| | Total, mean (range) | IWL (mean) | Reflux (mean) | Diabetes (mean) |
|----------------------------------|---------------------|------------|---------------|-----------------|
| N (%) | 18 | 9 (50) | 6 (33.3) | 3 (16.7) |
| Age (years) | 40.9 (24–55) | 36.8 | 44 | 47.3 |
| BMI initial (kg/m ²) | 55 (38–72) | 58.2 | 50.9 | 55.3 |
| Interval (months) | 23.8 (4.3–51) | 24.3 | 28.1 | 13.8 |
| %EBMILbc | 47.1 (19–77) | 42.2 | 55.4 | 44.9 |
| %EWLbc | 44.2 (23–73) | 41 | 49.4 | 43.6 |
| BMIbc (kg/m ²) | 40.9 (28–48) | 43.7 | 36.7 | 41 |

BMI initial BMI before SG, %EBMILbc percentage of excess BMI loss before conversion, %EWLbc percentage of excess weight loss before conversion, BMIbc BMI before conversion

Results

A total of 17 patients (94.5 %) underwent laparoscopic procedures without any conversion to an open technique. One patient (5.5 %) was operated on by laparotomy because of previous open operations, including peritonitis following SG. The mean operative time was 160±10.5 min (range, 95–260 min). The rate of complications was 5.5 %. This patient had peritonitis due to a small bowel injury and was reoperated on by laparotomy. The other patients (94.5 %)

had an uncomplicated postoperative course. The mean postoperative hospital stay was 6.4 ± 0.3 days (range, 5–12 days). The mean follow-up was 15.5 ± 1.9 months (range, 3.6–31.1 months). The follow-up rate was 100 %.

The percentage of excess BMI loss after conversion (%EBMILac) was calculated from the initial BMI, and the percentage of excess weight loss (EWL) after conversion was calculated from the initial weight. The mean %EBMILac was 64.6 ± 3.3 % (range, 36.9–104.6 %) (Table 2), which was significantly higher than that before conversion ($p < 0.001$). There were no significant differences between the different indications in mean %EBMILac: 60.6 ± 3.3 % for IWL, 69.9 ± 5.9 % for reflux, and 65.6 ± 14.4 % for diabetes ($p > 0.5$). According to the Reinhold criteria [14] with EWL, before conversion, there were six good results (>50 % EWL) and one failure (<25 % EWL). After conversion, 15 good results were obtained, and there were no failures. The patient who had 23 % EWL before conversion reached 69.1 % EWL [68.9 % excess BMI loss (EBMIL)] after 2 years of follow-up.

All patients with reflux as an indication were relieved immediately during the first postoperative days. At the term of the follow-up, they all stopped PPIs, and no recurrence was observed.

Two patients with persistent diabetes did not require medication anymore, with a glycosylated hemoglobin of <6 %. One patient stopped insulin injections and is still being treated by oral hypoglycemic drugs. The other patient still needs insulin injections but stopped using an insulin pump.

Before SG, seven patients (39.9 %) suffered from obstructive sleep apnea syndrome. The weight loss following SG cured three of them, and after conversion, all of the remaining patients are free of the disease according to pulmonologists' reports.

Discussion

Weight regains or IWL is an important issue of bariatric surgery, regardless of the procedure. SG was initially described as the first step of a duodenal switch [15] or RYGBP

[16] and is currently considered as a primary and definitive procedure for weight loss [3]. The rationale for LAGB (or VGB) can be applied for failure of SG. Therefore, a second operation can be proposed [5, 6]. Resizing of the sleeve (or re-sleeve) [8] and the placement of an adjustable band [9] have been described. These procedures remain restrictive. It is possible that the introduction of a malabsorption could be worthwhile, as proposed by Langer et al. [10]. Although only 14 of the 114 patients (12 %) operated on SG in our institution underwent conversion to RYGBP, 13 other patients had IWL or mild reflux controlled by PPIs. Nevertheless, their quality of life and their comorbidities significantly improved, and therefore, they do not require a mandatory second step. When patients undergo SG in our institution, they are always informed that it could be a first-step procedure if mid-term or long-term results are insufficient. The second step is never scheduled. The weight results in our study, with a mean of 64.6 % EBMIL, are disappointing compared with those of our series of RYGBP (354 patients), approaching 75 % EBMIL at 18 months. The results of the patients who were reoperated on for IWL, whose mean %EBMILac was only 60.6 % at the term of the follow-up, are deceiving. All of these patients were super obese ($\text{BMI} > 50 \text{ kg/m}^2$) or even super super obese ($\text{BMI} > 60 \text{ kg/m}^2$) with a mean initial BMI at 57 kg/m^2 (range, 51–72 kg/m^2). As suggested by Christou [7] and more recently by a Brazilian team [17], %EBMIL and %EWL could be nonrepresentative in the case of super obesity. This highlights the fact that the objectives, in terms of weight loss, could be different between super obese patients and other patients.

The effect of SG on reflux remains unclear. Weight loss can improve GERD symptoms by decreasing intra-abdominal pressure, as shown in a dedicated review [18]. However, Himpens et al. [12] and Carter et al. [19] observed recurrence or “de novo” reflux in 23 and 43 % after SG, respectively. Modification of the gastric anatomy may impair the antireflux barrier. Therefore, the creation of a “neofundus,” as described by Himpens [12] and reinforced by a radiological study [20], could be correlated with GERD symptoms. Moreover, resection of the antrum decreases gastric mobility. Therefore, Nocca et al. [21] suggest its preservation to prevent this mechanism. Duodenal switch with SG also induces reflux [12]; therefore, RYGBP might be the only procedure to consider for the treatment of reflux after SG.

The superiority of surgery versus an intensive medical therapy is clearly established in the treatment of T2DM in obese patients [22]. Therefore, SG and RYGBP appear to have similar results for improvement or resolution of T2DM in most series [23]. A recent controlled study showed that RYGBP is slightly superior to SG [13] with an earlier and better control of T2DM. Lee et al. [13] suggested that the

Table 2 Results after conversion

| | Total, mean (range) | IWL (mean) | Reflux (mean) | Diabetes (mean) |
|----------------------------|------------------------|---------------|------------------|--------------------|
| BMI ac (kg/m^2) | 35.8 (24–42.6) | 38.1 | 32.7 | 34.9 |
| %EBMILac | 64.6 (36.9–104.6) | 60.6 | 69.9 | 65.6 |
| %EWLac | 61.7 (34.2–103.2) | 59 | 65.9 | 61.6 |

BMIac BMI after conversion, %EBMILac percentage of excess BMI loss after conversion, %EWLac percentage of excess weight loss after conversion

secretion of incretins and their effect on insulin secretion are mainly due to duodenal exclusion. According to these findings, the patients in our series with a persistence of T2DM after SG showed improvement after conversion to RYGBP. The only patient who still required insulin injection had a long past medical history of insulin therapy, which is a negative prognostic factor for resolution of T2DM.

In conclusion, the conversion of SG to RYGBP is a safe and simple procedure for surgeons who routinely perform RYGBP. The increasing number of patients undergoing SG associated with the appearance of severe reflux in the long-term follow-up will lead to an increasing amount of conversion to RYGBP. However, the results of conversion for weight loss and resolution of comorbidities appear to be similar to a primary RYGBP.

Conflict of Interest None.

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