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ORIGINAL CONTRIBUTIONS

Conversion of Sleeve Gastrectomy to One Anastomosis Gastric Bypass for Weight Loss Failure

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Abstract

Introduction One anastomosis gastric bypass (OAGB) was suggested as an option in the management of weight loss failure after sleeve gastrectomy (SG). In parallel, the length of the biliopancreatic limb (BPL) is currently debated.

Objectives To evaluate morbidity and efficiency of the conversion of SG to OAGB using two lengths of BPL (150 cm versus 200 cm).

Methods Retrospective analysis of a prospectively collected database on 72 patients operated on between 2007 and 2017: (200-cm BPL before 2014 versus 150-cm BPL since 2014).

Results At revision, the mean body mass index (BMI) was 43.6 ± 7 kg/m^2. Sixteen patients (20%) had type 2 diabetes (T2D) and 23 (29%) had obstructive sleep apnea (OSA). Early morbidity rate was 4.2% (n = 3). Mean BMI were 33.7 ± 6 and 34.8 ± 9 at 2 and 5 years, respectively. At 5 years, the rate of lost of follow-up was 34%. T2D and OSA improved in 80% (n = 12) and 70% (n = 16) of the patients, respectively. At revision, the mean BMI were 46 ± 8 kg/m^2 and 41 ± 6 kg/m^2 for patients with 200-cm BPL (n = 38) and 150-cm BPL (n = 34), respectively. Two years after conversion, the mean BMI were 34 ± 1 kg/m^2 for 200-cm BPL and 32 ± 7 kg/m^2 for 150-cm BPL. The rate of gastroesophageal reflux disease (GERD) and diarrhea was 13% and 5% in patients with 200-cm BPL versus 3% and 0% in patients with 150-cm BPL.

Conclusion This study shows that the conversion of SG to OAGB is feasible and safe allowing significant weight loss and improvement in comorbidities. Weight loss seems comparable between the 150-cm and 200-cm BPL.

Keywords Sleeve gastrectomy · Weight loss failure · Revisional surgery · One anastomosis gastric bypass

Introduction

Sleeve gastrectomy (SG) has shown very good results in weight loss and improvement of comorbidities. Due to the technical simplicity and the low complication rate, SG gastrectomy has become extremely popular and is considered a full-fledged bariatric procedure [1]. However, recent studies show that up to 30% of patients may experience long-term weight loss failure [2].

In case of insufficient weight loss or regain after SG, several options were reported such as the resizing of the residual stomach (re-sleeve) [3, 4], the conversion to Roux-en-Y gastric bypass (RYGB) [5, 6], the completion to duodenal switch (DS) [7], or single anastomosis duodeno-ileal bypass (SADI) [8, 9].

One anastomosis gastric bypass (OAGB) has entered into the arsenal of bariatric surgeons [10, 11] and is currently a new therapeutic option that can be offered in certain situations to patients with weight loss failure after SG [12]. The revision of SG to OAGB seems an attractive alternative, even if poorly described.

Currently, the length of the biliopancreatic limb (BPL) in the OAGB is debated. Some have assumed that a 200-cm length of the BPL in the classic OAGB described by Rutledge could be responsible for functional complications as well as undernutrition observed in few patients [13–15]. We hypothesized that a length of 150 cm of the BPL could give satisfactory weight results and potentially reduce some functional complications such as chronic diarrhea [16].

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The aim of this study was to evaluate the efficiency and morbidity of SG conversion to OAGB performed for weight loss failure. In parallel, we evaluated the outcomes regarding two different lengths of the BPL: 200 cm versus 150 cm.

Material and Methods

Patients

A retrospective review of the prospective database of all consecutive patients with a history of SG conversion to OAGB between January 2007 and December 2017 for failure in terms of weight loss or regain was undertaken. All patients followed the guidelines for bariatric surgery according to the French High Authority for Health (Haute Autorité de Santé). Before surgery, all patients were evaluated by a multidisciplinary team and followed for at least 6 months.

Insufficient weight loss was defined as an insufficient percentage of excess weight loss (%EWL) 2 years after surgery (< 50%). Progressive weight regain was defined as > 25% EWL regain compared with minimal weight after SG or when a patient met the criteria for bariatric surgery again.

Before revision, a systematic endoscopic exploration was performed. Upper gastrointestinal series were routinely performed to evaluate gastric dilation.

Surgical Procedure

Conversion to One Anastomosis Gastric Bypass The gastric pouch was calibrated (32 French) and crafted using a linear stapler. Gastric transection was performed at the angulus of the lesser curvature. In case of gastric dilatation, the excision of the excess gastric tissue was performed because of the absence of vascularization on the large curvature. The measuring tape was used to measure BPL. The jejunal loop was ascended to the supracolic compartment in an antecolic position. Posterolateral gastrojejunostomy was performed using a linear stapler followed by hand sewing of the staple aperture. Anastomotic integrity was verified using a methylene blue test. Before 2014, the length of the BPL was 200 cm, as from January 2014, it was 150 cm. Patients were fed on the second day after surgery. All patients were reviewed at 1, 3, 6, 12, and 18 months and then yearly.

Outcomes

The Clavien-Dindo classification was used to grade postoperative complications [17].

Baseline weight (kg) and BMI kg/m^2 were defined as weight and BMI before any bariatric surgery. Maximal %EWL was defined as the sum of %EWL after SG and OAGB. Maximal percentage of total weight loss (%TWL) was defined as the sum of %TWL after SG and OAGB.

Functional complications were defined by the presence of chronic diarrhea, gastro-esophageal reflux disease (GERD), or chronic ulcer. Chronic diarrhea was defined by at least three liquid stools per day evolving for more than 1 month. GERD was defined as persistent symptomatic reflux after at least 3 months of treatment with 40 mg twice daily of PPI. Chronic marginal ulcer was defined as a persistent ulcer after at least 3 months of medical treatment with 40 mg proton-pump inhibiter twice daily.

Improvements in diabetes, hypertension, and obstructive sleep apnea (OSA) syndrome were defined as an improvement in the corresponding baseline characteristics with the same or lower doses of therapy.

Statistical Analysis

Categorical data are presented as percentages, whereas continuous variables are presented as means and standard deviations. Chi-squared test, Fischer test, and *t* Student test were used when appropriated. A value of $p \leq 0.05$ was considered significant.

Results

Patients and Procedure Characteristics

Of the 1585 patients who underwent OAGB between January 2007 and December 2017, 72 patients had a history of SG. There were 52 females (72%). The average age at the time of conversion to OAGB was 47 ± 10 years (25–63). Seventeen patients (24%) had a history of previous bariatric surgery: gastric banding $n = 14$ (19%) and Mason gastroplasty $n = 3$ (4%). Five patients underwent concomitant cholecystectomy. Sixty-eight procedures were achieved laparoscopically. There were four conversions to laparotomy due to adhesions as a consequence of previous surgery. The biliopancreatic limb length was 200 cm in 38 patients (52.7%), and 150 cm in 34 patients (47.3%). The average operative time was 80 min (50–200), and the average hospital stay was 3.1 days (3–8).

Postoperative Morbidity

There was no postoperative mortality (< 90 days). The overall early complication rate was 4.2% ($n = 3$): two patients (2.7%) developed major adverse events requiring reoperation (Table 1). The reasons were bleeding on the staple line ($n = 1$) and intestinal strangulation on the trocar port ($n = 1$). Another patient developed a postoperative bile leak consecutive to concomitant cholecystectomy that resolved spontaneously with drain removal on day 7.

There was no death during the follow-up. The overall late morbidity rate was 15.2% ($n = 11$) (Table 1). Six patients

Table 1 Early (< 90 days) and late major adverse outcomes after sleeve gastrectomy conversion to one anastomosis gastric bypass

Variable	*N* (%)	Clavien-Dindo classification
Bile leak	1 (1.4)	I
Bleeding	1 (1.4)	IIIB
Strangulated hernia at trocar port	1 (1.4)	IIIB
Total	3 (4.2)	
Late		
Surgical morbidities		
Incisional hernia	3 (4.1)	IIIB
Conversion to RYGB for GERD*	4 (5.5)	IIIB
Medical morbidities		
GERD*	6 (8.3)	II
Marginal ulcer*	2 (2.7)	II
Chronic diarrhea	2 (2.7)	II
Total	11 (15.2)	

*Same patients

RYGB, Roux-en-Y gastric bypass; *GERD*, gastroesophageal reflux disease

developed the symptoms of GERD. Four of them underwent conversion to RYGB 1 ($n = 2$), 4 ($n = 1$), and 5 years ($n = 1$) respectively after OAGB. Proton-pump inhibitor medication was sufficient in 2 others. Two patients presented chronic diarrhea requiring transit retarder treatment.

Weight Loss

Before SG, the average baseline weight and BMI were 136 ± 6 kg (95–193) and 49.1 ± 8 kg/m2 (37–72), respectively. The mean delay between SG and RYGB was 28 ± 10 months (12–56) months. BMI, %EWL, and %TWL evolutions are shown in Table 2. At the time of revisional surgery, the average weight and BMI were 122 ± 24 kg (75–185) and 43.6 ± 7 kg/m2 (35–68). Two years after revision, the average weight and BMI were 91 ± 18 kg and 33.7 ± 6 kg/m^2 respectively, followed by weight loss stabilization, with a mean BMI of 34.7 ± 9 at 5 year (Fig. 1). The average %EWL and %TWL increased from 21 ± 18 and 11.6 ± 9 at the time of conversion to 66.2 ± 28 and 34 ± 16 5 years after conversion (Table 2).

Evolution of Comorbidities

There was a significant improvement observed at the last assessment in patients with type 2 diabetes with stopping or decreasing the treatment in 12 patients (80%) (Table 3). OSA was improved in 16 patients (70%) justifying the suppression of continuous positive airway pressure therapy. There was no significant difference in improvements of high blood pressure.

Subgroup Analysis

Comparative analysis between patients with 200-cm versus 150-cm BPL length is shown in Table 4. At the time of conversion, the mean weight and BMI were greater in patients with a 200-cm BPL (Fig. 1). At revision, there was no significant difference in %EWL and %TWL between two populations. There was no difference in terms of early or late morbidity. The GERD and chronic diarrhea were observed in 5 and 2 patients respectively in group with 200-cm BPL while only one patient developed GERD in group with 150-cm biliary limb. Two years after conversion, there was no significant difference in terms of BMI, %TWL, and %EWL changes.

Discussion

In this work, we present the largest series to date of revisional surgery from SG to OAGB. With an important rate of weight loss failure after SG, the number of these patients grows rapidly and their management becomes a real challenge due to the lack of the unanimously accepted algorithm. Weight loss failure or weight regain after SG can be conditioned by initial insufficient gastric resection or later modifications in eating behavior due to lack of nutritional or dietary follow-up. Other

Table 2 %TWL, BMI, and %EWL changes after revisional surgery over 60 months of follow-up

	At OAGB	6	12	18	24	36	48	60
Eligible/available (*n*)	72/72	72/63	72/51	60/42	60/39	54/39	49/34	41/27
Lost to follow-up (%)	0%	12.5%	29%	30%	35%	27.7%	30.6%	34.1%
%TWL (kg), mean ± SD, range	11.6 ± 9 (0–40)	27 ± 10 (3–56)	29 ± 1 (2–58)	31 ± 12 (2–63)	32 ± 13 (0–63)	32 ± 14 (4–63)	33 ± 14 (1–63)	34 ± 16 (1–63)
BMI (kg/m^2), mean ± SD, range	43.6 ± 7 (35–68)	33.6 ± 10 (28–53)	34.6 ± 5 (28–51)	34.1 ± 6 (25–49)	33.7 ± 6 (24–51)	33 ± 9 (25–53)	34.2 ± 8 (21–55)	34.7 ± 9 (21–57)
%EWL, mean ± SD, range	21 ± 18 (0–71)	55 ± 17 (8–89)	60 ± 20 (5–103)	63.2 ± 21 (6–105)	64.8 ± 23 (0–105)	64.9 ± 25 (9–104)	67.7 ± 26 (2–113)	66.2 ± 28 (2–105)

OAGB one anastomosis gastric bypass, *TWL* total weight loss, *BMI* body mass index, *EWL* excess weight loss

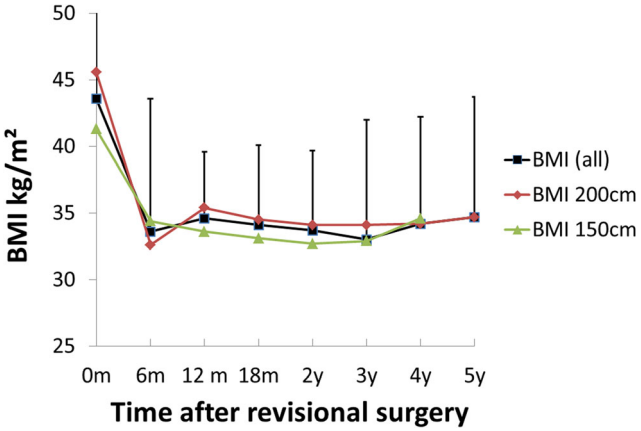

Fig. 1 BMI (all, 150-cm BPL, and 200-cm BPL patients) evolution after revisional surgery.

restrictive procedures, such as resizing of SG [3, 18] or addition of gastric banding [19] have shown its limitations because of the moderate efficiency. Completion by another malabsorptive procedure such as RYGB, SADI, DS, or OAGB seems to give better results [5–9, 12, 18].

In our previous work, short-term efficiency of SG revision to OAGB had been demonstrated in a small series [12]. In our current work, with 66.2% of EWL at 5 years, our results confirm by a larger sample the good long-term efficacy of SG revision to OAGB. These results are comparable with those observed after SG revision to RYGB6 and a little less so than after SADI [8] and DS [7]. However, the overall rate of early morbidity in our series was 4.2% and revisional surgery was required in 2.8%. These rates seem lower than those observed after conversion to RYGB [6], SADI [20], or DS [7] probably reflecting the absence of the cumulative morbidity linked to the entero-enteric anastomosis for RYGB and DS, potentially iatrogenic dissection between duodenum and pancreas, and duodenal suture in SADI and DS. Our results are also in agreement with the results shown by Chiappetta et al. [21] in a comparative study evaluating OAGB versus RYGB as second step procedure after SG. There was no early morbidity in 34 patients who underwent conversion to OAGB while 14.2% ($n = 3$) of patients who underwent revision to RYGB developed an adverse event [21].

Late morbidity was observed in 11 patients (15.2%). Functional complications were predominant. Six patients (8.3%) developed GERD and 2 patients (2.7%) had chronic diarrhea. Concerning GERD, our results are in accordance with those observed by Chiappetta et al. [21] with 11.8% (4 from 34 patients) of GERD developed after OAGB. This could be partially explained in our patients by the fact that OAGB was a second revisional procedure. Thus, among 6 patients who developed GERD after OAGB, 3 (50%) had a history of gastric banding. Because of prior gastric dissection for gastric banding and resection for SG, revisional surgery

Table 3 Improvement of comorbidities ($n = 72$)

Comorbidities	Before conversion	At last assessment	*p* value
Hypertension (*n*, %)	29 (40)	23 (32)	0.2
Type 2 diabetes (*n*, %)	16 (22)	4 (5.5)	0,003
Obstructive sleep apnea (*n*, %)	23 (32)	7 (9.7)	0.001

Table 4 Comparison between patients with 200-cm versus 150-cm length of biliopancreatic limb

	200 cm	150 cm	
Patients	$n = 38$	$n = 34$	*p*
At sleeve gastrectomy (mean ± SD, range)			
BMI (kg/m^2)	51.5 ± 9 (41–72)	46.4 ± 6 (37–66)	0.007
Weight	143.7 ± 26 (97–190)	128.6 ± 21 (95–180)	0.008
At OAGB (mean ± SD, range)			
Age (year)	49 ± 9	45 ± 10	NS
BMI (kg/m^2)	45.6 ± 8 (36–62)	41.3 ± 6 (35–60)	0.01
Weight (kg)	127 ± 24 (94–185)	115 ± 22 (75–160)	0.02
%EWL	20 ± 20 (0–63)	22 ± 22 (0–71)	NS
%TWL	10 ± 11 (0–40)	10 ± 10 (0–24)	NS
History of previous bariatric surgery (*n*, %)			
Gastric banding	9 (23)	6 (17.6)	NS
Mason gastroplasty	3 (7.8)	0	NS
Morbidity			
Early surgical (*n*, %)	2 (5.2)	1 (2.9)	NS
Bleeding	1 (2.6)	0	
Bile leak	1 (2.6)	0	
Strangulated hernia	0	1 (2.9)	
Late surgical (*n*, %)	4 (10.5)	3 (8.8)	NS
Incisional hernia	1 (2.6)	2 (5.8)	
Conversion to RYGB*	3 (7.8)	1 (2.9)	
Late functional (*n*, %)	7 (18.4)	1 (2.9)	NS
GERD*	5 (13.1)	1 (2.9)	
Marginal ulcer*	2 (5.3)	0	
Chronic diarrhea	2 (5.3)	0	
Weight evolution at 2 years (mean ± SD, range)			
Eligible/available	38/25	22/14	
BMI (kg/m^2)	34.1 ± 7 (25–51)	32.7 ± 5 (24–44)	NS
%TWL	34 ± 11 (7–63)	28 ± 14 (0–55)	NS
%EWL	67.5 ± 20 (14–101)	58.7 ± 28 (0–105)	NS

*Same patients

BMI, body mass index; *OAGB*, one anastomosis gastric bypass; *EWL*, excess weight loss; *TWL*, total weight loss; *RYGB*, Roux-en-Y gastric bypass; *GERD*, gastroesophageal reflux disease

could be difficult due to adhesions compromising the preparation of an adequate small and narrow gastric pouch leaving a large part of cardia on the posterior side. Large gastric pouch could promote bile and food stagnation and secondary appearance of GERD. In case of medical treatment failure, the management of these patients becomes protocolized requiring conversion to RYGB. We have already reported our experience of OAGB conversion to RYGB for different disabling digestive disorders such as GERD, marginal ulcer, or chronic diarrhea [15, 22]. Four patients with refractory GERD underwent conversion to RYGB. All incidents of reflux were resolved.

There was a discrepancy concerning chronic diarrhea, 2.8% ($n = 2/72$) in a current study versus 35% ($n = 12/34$) for Chiappetta et al. [21] This fact could be explained by incomplete adherence to postoperative follow-up in our patients. Only 65.9% had 5 years of follow-up. On the other hand, it could be explained by the shorter length of the BPL for 34 patients. Thus, the rate of chronic diarrhea was 5.3% in the patients with 200-cm BPL versus 0% in the patients with 150-cm BPL. Chronic diarrhea and steatorrhea accentuate malabsorption and induce undernutrition by lack of absorption of nutriments and chronic loss of trace elements. The impact of the length of the BPL in OAGB on the occurrence of nutritional complications was shown [13, 14]. Highest rates were observed in patients with BPL length of > 250 cm while lowest rates of 0% in the patients with 150 cm or lower [14].

The measurement of small intestine is a major issue to avoid undernutrition or weight loss failure due to inappropriate length of the BPL. Thus, in a recent study concerning OAGB conversion to RYGB for undernutrition or disabling digestive disorders, the mean length of BPL ranged from 150 to 250 cm [15]. To make our measurement as safe as possible, we use a measuring tape.

To avoid undernutrition since 2014, we modified our procedure and realized a 150-cm length of BPL for all patients with BMI < 50 who underwent the primary OAGB or redo surgery after restrictive procedure failing. Interestingly, at 2 years, we observed a similar weight loss in both groups with a lower rate of diarrhea in the 150-cm BPL group. These results are encouraging and comfort us in our choice.

The positive effect of malabsorptive bariatric procedures on the improvement of the co morbidities has been clearly demonstrated in several studies [23, 24]. In a current study, 80% of diabetic patients, 70% of patients with OSA, and 20% of patients with high blood pressure had significant improvement, allowing treatment to be stopped or reduced. These results are in accordance with our previous work for patients who underwent primary OAGB [22, 25]. Thus, at 2 years, remission rate from type 2 diabetes was 85.7%, the resolution rate was 80.6% for dyslipidemia, 52.1% for high blood pressure, and 50% for sleep apnea [25].

Despite our findings that support the hypothesis that by decreasing the length of the BPL, it is possible to achieve a satisfactory weight loss and decrease long-term morbidity, the retrospective nature of our study, the small number of patients in each group, lack of biologic data, and incomplete adherence to follow-up constitute important limitations that do not allow clear conclusions to be drawn concerning the impact of 150-cm BPL on the undernutrition. Randomized studies comparing these two lengths are needed to confirm this hypothesis on a large scale.

Conclusion

Our results suggest that conversion of SG to OAGB seems feasible with early low morbidity rate, achieving satisfactory weight loss, and significant improvement of comorbidities. A length of 150 cm of BPL gives a similar weight loss when compared with 200-cm BPL.

Compliance with Ethical Standards

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

Ethical Approval Statement For this type of study, formal consent is not required.

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

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