ORIGINAL ARTICLE

Revisional Bariatric Surgery

13-Year Experience From a Tertiary Institution

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Objective: To evaluate the safety and effectiveness of revisional bariatric surgery at a tertiary institution. Revisional bariatric operations for unsuccessful weight loss or intolerable complications following the primary intervention are increasing.

Design: Case series from a prospective database.

Setting: Tertiary bariatric referral center.

Patients: From 1995 to 2008, 56 patients who had been formerly operated on for clinically severe obesity underwent a revisional procedure at our institution. Their mean (SD) age and body mass index were 39.6 (9.6) years and 46.9 (16.4), respectively. They were divided into 3 groups according to the indications for reoperation: (1) unsatisfactory weight loss (n=39), (2) severe nutritional complications (n=15), and (3) intolerable adverse effects (n=2).

Main Outcome Measures: Effectiveness of the procedures according to the indication of revision and overall morbidity and mortality rates.

Results: Mean (SD) follow-up was 102 (8) months. There was no mortality but there was an early morbidity rate of 33.9% due to postoperative complications, including 2 cases of acute renal failure (3.6%), 5 anastomotic leaks (13.1%), 8 cases of pneumonia (14.3%), and 1 case each of wound infection, incisional dehiscence, bile leak, and small-bowel obstruction (1.8%). Late complications included stenosis of the gastrojejunal anastomosis in 2 patients (3.6%), hypoalbuminemia in 2 patients (3.6%), and incisional herniation in 9 patients (16.1%). Late morbidity was 23.2%.

Conclusion: Although revisional bariatric surgery is associated with higher risk of perioperative complications compared with the primary procedures, it appears to be safe and effective when performed in experienced centers.

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CLINICALLY SEVERE OBESITY IS a severe epidemic for which surgical treatment is the only current effective approach for long-term success in terms of weight loss and resolution of severe comorbidities.[1,2] During the last decade, there has been a marked increase in the number of bariatric operations performed annually,[3] which coincides with the increased acceptance and demand of these procedures worldwide.

The evolution of bariatric surgery has also led to a rapidly increasing demand for revisional bariatric procedures following the discontinuation of surgical techniques favored in the past that had unsuccessful weight loss results or other complications in the long-term.[4,5] Nowadays, revisional bariatric surgery has emerged as a distinct entity, performed mainly in experienced centers to resolve mechanical complications and metabolic problems caused by the primary operation or to provide satisfactory weight loss.

In this study, the experience with revisional bariatric surgery in a tertiary institution is reported with an attempt to define the major indications for revision and the perioperative and long-term morbidity and mortality as well as the surgical outcome.

METHODS

From June 1994, when the Nutrition Support and Morbid Obesity Unit of the Department of Surgery was established at the University Hospital of Patras, through November 2008, 1161 bariatric procedures were performed at our institution. Among them, 56 patients underwent a revisional operation. In 21 of these 56 patients (37.5%), the primary surgical procedure had been performed at our institution. All patients were operated on by a single surgeon (F.K.).

All patients underwent a standard preoperative workup, including laboratory examinations, chest radiography, respiratory function tests, sleep apnea study, complete cardiologic and nutritional evaluation, upper gastrointestinal tract series, and, if needed, esophagogastroduodenoscopy. In cases of se-

Table 1. Preoperative Data

	Mean (SD)		
	Group 1	Group 2	Group 3
No. of patients	39	15	2
Age, y	39.4 (9.1)	39.5 (10.1)	37.3 (10.1)
BMI			
Before the primary operation	59.2 (10.1)	55.1 (7.3)	54.1 (1.7)
Before the secondary operation	55.4 (12.5)	29.5 (7.2)	45.2 (2.1)

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared).

vere metabolic complications or malnutrition, artificial nutritional support was administered preoperatively.

According to the indications for reoperation, the patients were divided into 3 groups: group 1, unsatisfactory weight loss; group 2, major metabolic complications; and group 3, intolerable adverse effects. Preoperative patient characteristics are presented in **Table 1**.

Statistical analysis was conducted using SPSS (version 13.0; SPSS Inc, Chicago, Illinois). The variables measured on a continuous scale were compared using 2-sample *t* tests while nongaussian data were assessed using Wilcoxon rank sum tests. Pearson χ^2 test or Fischer exact test was used for the investigation of difference in proportions in nominal data when necessary. Level of $P < .05$ was considered statistically significant. All values are expressed as mean (SD), unless otherwise defined.

RESULTS

During a 13-year period, a total of 1161 bariatric procedures have been performed at our institution, among which 56 were revisional operations. Indications for revision were unsatisfactory weight loss in 39 patients (69.6%) (group 1), severe metabolic or nutritional complications in 15 patients (26.8%) (group 2), and intolerable adverse effects or mechanical complications in 2 patients (3.6%) (group 3).

Revision or conversion to a variant of biliopancreatic diversion with Roux-en-Y reconstruction (BPD-RYGBP), which has been described in detail in a previous study[6] (**Figure**), was the most frequent procedure and was performed in 35 patients (62.5%). Three patients (5.4%) underwent revision to standard RYGBP (STD-RYGBP); in 3 patients (5.4%), a partial gastrectomy with BPD (Scopinaro procedure) was the secondary operation; and 15 patients (26.7%) underwent elongation of the common limb at the expense of the biliopancreatic limb after a previously performed BPD. All procedures were performed by a single surgeon using standard laparotomy. The characteristics of all procedures are summarized in **Table 2**. The operative time ranged from 90 to 420 minutes (median, 210 minutes) while the mean postoperative hospital stay for all patients was 16.5 days (range, 7-78 days).

There was no early or late mortality. However, serious complications developed in 19 patients resulting in an early morbidity rate of 33.9%. Leakage from the gastrojejunal anastomosis occurred in 5 of 38 patients in whom it was performed (13.1%), resulting in subphrenic collections in 3 cases, which were successfully drained under computed tomography observance. One patient developed clinical signs of septic shock and after hemodynamic stabilization

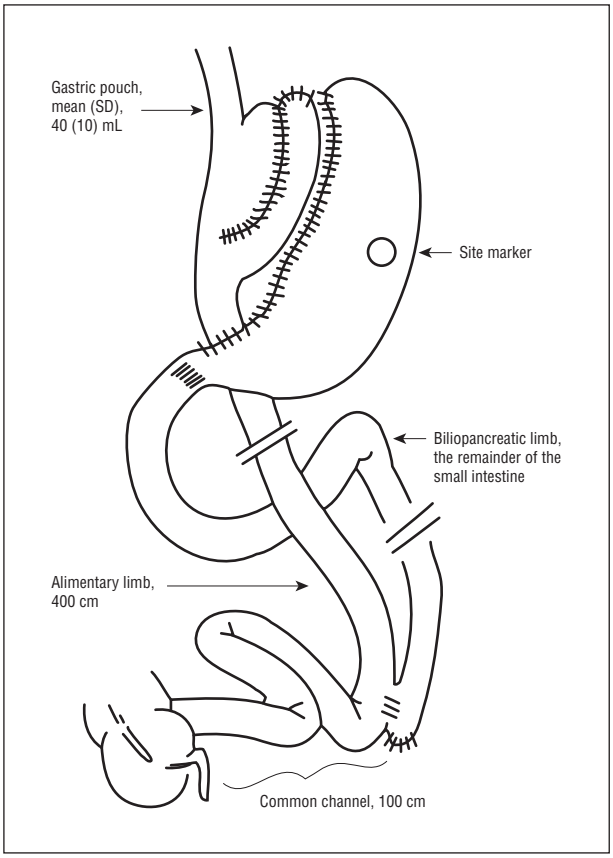

Figure. Variant of biliopancreatic diversion with Roux-en-Y reconstruction.

underwent exploratory laparotomy for surgical draining. Other serious early complications included 8 cases of pneumonia (14.3%), 1 of which was attributed to aspiration; 1 case of wound infection (1.8%); and 1 case each of trauma dehiscence, bile leak, and small-bowel obstruction documented during the first postoperative month. All these patients were treated conservatively. Late complications included 9 patients with incisional hernias (16.1%) and 2 patients with clinical and laboratory signs of hypoalbuminemia (3.6%) diagnosed during the first postoperative year who were treated successfully with oral nutritional supplements and dietary instructions with no need for artificial nutrition support. No recurrence has been documented since. Two patients experienced symptoms of gastric obstruction due to stenosis of the gastrojejunal anastomosis in the sixth and ninth postoperative months, respectively. Endoscopic balloon dilation of the stenotic anastomosis resolved the problem successfully in both cases. Late morbidity rate was 23.2%. The results are summarized in **Table 3**.

GROUP 1 (UNSATISFACTORY WEIGHT LOSS)

Unsatisfactory weight loss was the indication for revisional bariatric surgery in 39 patients (69.6%). The initial failed procedure included vertical banded gastroplasty in 22 cases (56.4%), horizontal gastroplasty in 1 case (2.6%), gastric banding in 13 patients (33.3%), and STD-RYGBP in 3 patients (7.7%). Staple-line disruption was the cause of surgical failure in the cases of vertical banded and

Table 2. Type of Revisional Procedures[a]

Primary Procedure (No. of Patients)	Secondary Procedure			
	STD-RYGBP	BPD-RYGBP	Scopinaro Procedure	Common Limb Elongation
Group 1				
Vertical banded gastroplasty (22)	2	20		
Horizontal gastroplasty (1)			1	
Gastric banding (13)	1	12		
STD-RYGBP (3)		3		
Group 2				
BPD-RYGBP (15)				15
Group 3				
BPD-RYGBP (1)			1	
STD-RYGBP (1)			1	
Total (56)	**3**	**35**	**3**	**15**

Abbreviations: BPD-RYGBP, biliopancreatic diversion with Roux-en-Y gastric bypass; STD-RYGBP, standard Roux-en-Y gastric bypass.
[a]Group 1: revision for unsatisfactory weight loss. Group 2: revision for nutritional and metabolic complications. Group 3: revision for mechanical complications.

horizontal gastroplasties as well as in 3 patients who underwent STD-RYGBP in the beginning of our series, while band slippage was frequent in the group of patients who had previously undergone gastric banding.

Mean (SD) follow-up in this subgroup of patients was 98 (5) months. A statistically significant decrease in body mass index (calculated as weight in kilograms divided by height in meters squared) was observed (mean [SD], 35 [5.33] compared with preoperative value of 55.4 [12.5]; $P<.05$), while mean percentage of excess weight loss was 68.9% (range, 57.17%-111.89%) (**Table 4**). The overall success rate estimated by percentage of excess weight loss was not statistically different among the group of patients who underwent the 3 different types of malabsorptive secondary operations, but because of the small statistical sampling, these results might not be meaningful.

GROUP 2 (SEVERE NUTRITIONAL AND METABOLIC COMPLICATIONS)

Revisional surgery was necessary in 15 patients for protein malnutrition following BPD-RYGBP, which had been performed at our institution in all cases. This patient group represented 2.2% of all cases of hypoalbuminemia recorded after this type of operation in our series (35 patients among 682 BPDs performed; total, 5.13%). All patients experienced severe and persistent symptoms, with a mean albumin level of 2.28 g/dL (range, 1.8-2.7 g/dL) (to convert to grams per liter, multiply by 10), and despite repetitive attempts of artificial nutritional support, their nutritional status could not be corrected and a secondary operation was decided.

The surgical procedure included elongation of the common limb by 100 cm at the expense of the biliopancreatic limb by creating a new entero-enteric anastomosis to achieve better protein absorption in all 15 cases. There were no complications recorded. Mean (SD) follow-up in this group of patients was 65 (7) months, with total resolution of all clinical signs and symptoms of hypoalbuminemia (mean [SD] albumin level of 3.5 [0.9] g/dL; $P<.05$). On the other hand, there was some weight regain following the revisional procedure, which was not statistically significant ($P=.24$), and all patients were satisfied by the final outcome.

Table 3. Overall Patient Morbidity

Complication	No./Total No. (%)		
	<30 d	30-90 d	>90 d
Anastomotic leak	5/38 (13.1)		
Wound infection	1/56 (1.8)		
Incisional dehiscence	1/56 (1.8)		
Bile leak	1/56 (1.8)		
Pneumonia/pleural effusion	7/56 (12.5)	1/56 (1.8)	
Acute renal failure	2/56 (3.6)		
Small-bowel obstruction		1/56 (1.8)	
Incisional hernia			9/56 (16.1)
Hypoalbuminemia			2/56 (3.6)
Anastomotic stenosis			2/56 (3.6)
Total	**17**/56 (30.3)	**2**/56 (3.6)	**13**/56 (23.2)

GROUP 3 (INTOLERABLE ADVERSE EFFECTS OR MECHANICAL COMPLICATIONS)

Two of the 56 patients underwent a revisional procedure for intolerable mechanical complications after the initial operation. Stomal obstruction diagnosed 6 months after a previously performed STD-RYGBP, most likely due to ischemia of the Roux limb, was the cause of severe malnutrition and dehydration in 1 patient. The second patient in this group presented with serious stomal stenosis due to recalcitrant stomal ulcer following BPD-RYGBP that had been performed 2 years before. Neither patient was eligible for endoscopic balloon dilatation and both underwent conversion to a Scopinaro procedure with favorable outcomes.

COMMENT

The incidence of reoperation in bariatric surgery has been reported to be 5% to 56%[5,7] while in our center these procedures accounted for 5% of all operations, reflecting some of our patients and others referred to our institution. Inadequate initial or sustained weight loss after the primary operation was the most common indication for revision in our series. Vertical banded gastroplasty and gastric band-

Table 4. Weight Loss Results After Revisional Procedures

	Revisional Operation				
	BPD-RYGBP	Scopinaro Procedure	STD-RYGBP	Overall	*P* Value
Prerevision BMI, mean (SD)	61.2 (10.4)	57.3 (8.7)	48.5 (8.3)	55.4 (12.5)	<.05
Current BMI, mean (SD)[a]	32 (3.2)	34 (4.1)	37 (4.8)	35 (5.33)	
Excess weight loss, %[a]	75.2	69.4	59.3	68.9	

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); BPD-RYGBP, biliopancreatic diversion with Roux-en-Y gastric bypass; STD-RYGBP, standard Roux-en-Y gastric bypass.
[a]Mean (SD) 98 (5) months of follow-up.

ing was the initial failed procedure in 90% of this patient group. Although the popularity of stomach-stapling operations dropped off 10 years ago and these operations are no longer performed, the volume of revisions after previously performed gastroplasties has not declined over our study period. Therefore, these procedures, along with the more recently applied gastric banding, still remain a challenging clinical problem when performing reoperation. Revision to a malabsorptive procedure was performed in all cases in our series, with a variant of BPD-RYGBP[6] reconstruction representing the most frequently performed secondary procedure. Although purely restrictive operations have been reported as options in revisional bariatric surgery,[8,9] disappointing data regarding these rescue procedures have already been reported.[10] Roux-en-Y gastric bypass or BPD seems to be the most effective revisional procedure for inadequate weight loss, as demonstrated in this study and others.[11-15] The efficiency of the operation is based on the feeling of early induced satiety and primarily on malabsorptive mechanisms along with alteration at the secretion of several gastrointestinal hormones, such as plasma ghrelin, glucagon-like peptide 1, peptide YY 33-36, and oxyntomodulin.[16,17] In our series, clinical and laboratory data after 7 years of follow-up confirm the success of BPD-RYGBP[6] in terms of excess weight loss (percentage of excess weight loss), which was 70% or more in 92% of patients who underwent this variant of BPD. This procedure is associated with better weight loss and less dietary restriction than seen following restrictive procedures, with corresponding improvement of major coexisting comorbidities. Therefore, it could be considered an excellent alternative after failed conventional malabsorptive operations, such as STD-RYGBP.

Revisional bariatric surgery for severe metabolic and nutritional complications is typically performed after previous malabsorptive procedures. In our series, 2.2% of patients with hypoalbuminemia after the previously performed bariatric operation experienced persistent protein malnutrition that required revisional surgery. These patients represented the second largest group in need of surgical reintervention. All of them had been formerly operated on at our institution and had undergone a variant of BPD-RYGBP.[6] Although no statistically significant difference between this procedure and RYGBP has been demonstrated in the incidence of nutritional deficiencies,[18,19] persisting hypoalbuminemia was evident in these patients even after repetitive attempts of artificial nutrition support. Thus, revision surgery with elongation of the common limb at the expense of the biliopancreatic limb to achieve better protein absorption was decided and performed in all cases, with favorable results.

Although mechanical complications are often referred to as predominant indications for revision in bariatric surgery,[11,20] only 2 patients experienced irreversible complications, consisting of stomal obstruction or stenosis after previously performed STD-RYGBP and BPD-RYGBP, that required reoperation in the current series. Stomal obstruction is a well-described complication mainly after vertical banded gastroplasty,[7,21] and if endoscopic dilatation is unsuccessful because of complete obstruction or ulceration, operative revision is necessary. Dense adhesions in the environs of the esophagogastric junction are present in most cases and dissection in this area is usually extremely dangerous.[22] Hence, a BPD such as the Scopinaro procedure would be a wise option in these cases and that was the surgical choice in our series.[23]

The perioperative morbidity rate in revisional bariatric surgery has been reported to be greater than that for primary procedures, ranging from 10% to 50%.[4,12,24] In our study, an early morbidity rate of 33.9% was documented, which is comparable with the data in the literature, while no mortality was recorded. The late morbidity rate, mostly due to incisional herniation, reached 23.2%. Although perioperative complication rates increase significantly following revisional bariatric surgery compared with primary procedures,[25,26] an observation also confirmed in our study, these results are not prohibitive for this type of surgery. Revisional surgery can be as effective as primary procedures in attaining successful long-term weight loss and today is essential more than ever to correct complications arising from failed bariatric interventions of the past.[27]

Laparoscopic approaches to revisional bariatric procedures have been also reported as safe alternatives to the open operations, with comparable morbidity rates when applied in selected patients.[22,28] However, laparoscopic reoperation is considered technically challenging and requires significantly longer operative time.[28] In our series, no laparoscopic revisional procedure has been performed so far. It is our opinion that since an open bariatric reoperation may be one of the most challenging procedures a surgeon can encounter, the laparoscopic approach could be extremely hazardous and should only be reserved for selected patients and, of course, for selected surgeons with extensive experience in both bariatric surgery and advanced laparoscopy.[29] Furthermore, most modern applications, such as endostapling techniques (natural orifice transluminal endoscopic surgery [NOTES]), could be another option either in primary or revisional bariatric sur-

gery in the near future, but more research is required for ensuring patients' safety and for evaluating the effectiveness when applying this advanced technology.[30]

Since its early onset nearly 50 years ago, bariatric surgery has demonstrated numerous surgical approaches for the treatment of clinically severe obesity. The past is rife with failed operations with serious postoperative complications or insufficient weight loss, such as the jejunoileal bypass or the more recent stapled gastroplasties. Roux-en-Y gastric bypass, adjustable gastric banding, and the recent sleeve gastrectomy represent the most modern modalities in bariatric surgery, the first of which has been acknowledged as the "gold standard" in the treatment of clinically severe obesity.

The accelerated growth of bariatric surgery during the last decade[31] has led to a proportional increase of bariatric revisions worldwide. As improvements in technique and instrumentation take place in this surgical field, along with the novel compelling application of bariatric surgery in the treatment of severe metabolic disorders,[32] it is very likely that revision rates of both failed operations of the past and currently popular procedures will increase considerably in the near future. Nonetheless, despite the higher demand for these procedures, not every surgeon should perform reoperations.[33] Revisional bariatric operations require experienced surgeons and well-organized "centers of excellence"[34] in order to use the technological innovations and the human experience for the patient's best interest.[35] New concepts and improved techniques by well-trained surgeons in properly organized institutions coupled with cautious patient selection represent the cornerstone for achieving favorable results and for extending patients' longevity.

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