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.

Arch Surg. 2010;145(2):173-177

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.
were 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 non-gaussian data were assessed using Wilcoxon rank sum tests. Pearson χ² 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.

Table 1. Preoperative Data

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>39</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Age, y</td>
<td>39.4 (9.1)</td>
<td>39.5 (10.1)</td>
<td>37.3 (10.1)</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
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<tr>
<td>Before the primary operation</td>
<td>59.2 (10.1)</td>
<td>55.1 (7.3)</td>
<td>54.1 (1.7)</td>
</tr>
<tr>
<td>Before the secondary operation</td>
<td>55.4 (12.5)</td>
<td>29.5 (7.2)</td>
<td>45.2 (2.1)</td>
</tr>
</tbody>
</table>

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

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 (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 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
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.

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 banding...
ing was the initial failed procedure in 90% of this patient
group. Although the popularity of stomach-stapling op-
erations dropped off 10 years ago and these operations are
no longer performed, the volume of revisions after previ-
ously performed gastroplasties has not declined over our
study period. Therefore, these procedures, along with the
more recently added gastric banding, still remain a chal-
lenging clinical problem when performing reoperation. Re-
vision to a malabsorptive procedure was performed in all
cases in our series, with a variant of BPD-RYGBP re-
construction representing the most frequently performed sec-
ondary procedure. Although purely restrictive oper-
a tions have been reported as options in revisional bariatric
surgery, disappointing data regarding these rescue pro-
cedures have already been reported. 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. The efficiency of the operation
is based on the feeling of early induced satiety and pri-
marily on malabsorptive mechanisms along with alter-
ation at the secretion of several gastrointestinal hor-
mones, such as plasma ghrelin, glucagon-like peptide 1,
peptide YY 33-36, and oxyntomodulin. In our series,
clinical and laboratory data after 7 years of follow-up con-
firm the success of BPD-RYGBP 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 co-
existing comorbidities. Therefore, it could be considered
an excellent alternative after failed conventional malab-
sorptive operations, such as STD-RYGBP.

Revisional bariatric surgery for severe metabolic and
nutritional complications is typically performed after pre-
vious malabsorptive procedures. In our series, 2.2% of
patients with hypoalbuninemia after the previously per-
formed bariatric operation experienced persistent pro-
tein 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 vari-
ant of BPD-RYGBP. Although no statistically signifi-
cant difference between this procedure and RYGBP has
been demonstrated in the incidence of nutritional defi-
ciencies, persisting hypoalbuninemia was evident in
these patients even after repetitive attempts of artificial
nutrition support. Thus, revision surgery with elon-
gation of the common limb at the expense of the biliopan-
creatic limb to achieve better protein absorption was de-
cided and performed in all cases, with favorable results.

Although mechanical complications are often referred
to as predominant indications for revision in bariatric sur-
gery, only 2 patients experienced irreversible complica-
tions, consisting of stomal obstruction or stenosis after previously performed STD-RYGBP and BPD-RYGBP, that
required reoperation in the current series. Stomal obstruc-
tion is a well-described complication mainly after verti-
cal banded gastroplasty, and if endoscopic dilatation is
unsuccessful because of complete obstruction or ulcer-
ation, operative revision is necessary. Dense adhesions in
the environs of the esophagogastroduodenal junction are present in most cases and dissection in this area is usually
extremely dangerous. 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.

The perioperative morbidity rate in revisional bariatric
surgery has been reported to be greater than that for pri-
mary procedures, ranging from 10% to 50%. 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 peri-
operative complication rates increase significantly follow-
ing revisional bariatric surgery compared with primary pro-
cedures, an observation also confirmed in our study,
these results are not prohibitive for this type of surgery. Re-
visional 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.

Laparoscopic approaches to revisional bariatric proce-
dures have been also reported as safe alternatives to the open
operations, with comparable morbidity rates when ap-
plied in selected patients. However, laparoscopic reop-
eration is considered technically challenging and requires
significantly longer operative time. In our series, no lapa-
roscopic 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 ex-
tremely hazardous and should only be reserved for se-
lected patients and, of course, for selected surgeons with
extensive experience in both bariatric surgery and ad-
vanced laparoscopy. Furthermore, most modern applica-
tions, such as endostapling techniques (natural orifice
transluminal endoscopic surgery [NOTES]), could be an-
other option either in primary or revisional bariatric sur-

<table>
<thead>
<tr>
<th>Revisional Operation</th>
<th>BPD-RYGBP</th>
<th>Scopinaro Procedure</th>
<th>STD-RYGBP</th>
<th>Overall</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerevision BMI, mean (SD)</td>
<td>61.2 (10.4)</td>
<td>57.3 (8.7)</td>
<td>48.5 (8.3)</td>
<td>55.4 (12.5)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Current BMI, mean (SD)</td>
<td>32 (3.2)</td>
<td>34 (4.1)</td>
<td>37 (4.8)</td>
<td>35 (5.33)</td>
<td>68.9</td>
</tr>
<tr>
<td>Excess weight loss, %</td>
<td>75.2</td>
<td>69.4</td>
<td>59.3</td>
<td>68.9</td>
<td></td>
</tr>
</tbody>
</table>
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 gastroplications. 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 decade31 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 re-operations.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 cautionous patient selection represent the cornerstone for achieving favorable results and for extending patients’ longevity.

Accepted for Publication: March 15, 2009.

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Financial Disclosure: None reported.

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