

Duodenal Switch is a Safe Operation for Patients who have Failed Other Bariatric Operations

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Background: The incidence of morbid obesity and its surgical treatment have been increasing over the last few years. With this increase, there has been a rise in the number of patients who have had less than desirable outcome after bariatric operations. We perform the duodenal switch (DS) in patients for whom other weight loss surgical procedures have failed, because of inadequate weight loss, weight regain or significant complications, such as solid intolerance or dumping syndrome.

Method: From November 1999 to March 2004, 46 revisional surgeries were performed at our institution. The data was prospectively collected and reviewed, based on a number of parameters. Operative details, perioperative morbidity, and results are reported.

Results: 46 patients had their original bariatric surgical operation revised to DS. This resulted in complete resolution of their presenting complaints. The %EWL was 69% at the time of publication, with a mean lapsed time of 30 months. We had no mortality. Anastomotic leak occurred in 4 patients, 2 in our first 8 patients. We also noted that the majority of the patients were not aware of all the surgical procedures available to them at the time of their original operation.

Conclusion: In patients in whom gastroplasty, gastric bypass or both have failed to provide adequate weight loss, or worse have resulted in complications, DS can be performed as a safe revisional operation. The revision of other failed bariatric operations to DS results in both weight loss and resolution of the complications.

Key words: Duodenal switch, biliopancreatic diversion, revisional bariatric surgery, gastric bypass, Roux-en-Y, gastroplasty

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Introduction

Since its inception in the 1960s, weight loss surgery has been the only option for morbidly obese patients who have been unable to lose and maintain adequate weight loss through conventional non-surgical methods. In 1991, the NIH released a consensus on gastrointestinal surgery for severe obesity,¹ which sparked further interest in the surgical treatment of morbid obesity, leading to an increase in the number of bariatric operations. This increase and the occasional failure and complications after these surgical procedures have resulted in an increased need for revisional surgery.

Bariatric procedures can be classified into three groups: those that restrict food intake, those that limit absorption, and those that utilize some degree of both components. Restrictive operations create a tiny neogastric pouch and a restrictive gastric outlet to decrease food intake.

Vertical banded gastroplasty (VBG) partitions the stomach along the lesser curvature, creating a channel restricted by an externally placed band. The upper pouch is approximately 5 cm long with a diameter of 1.5 cm and accommodates a volume of 20-40 ml. Gastric banding is another restrictive procedure, extensively performed in Europe and Australia, and recently in the United States. The published data varies significantly, with some reports showing <50% loss of excess body weight 9 years following the procedure.²

Roux-en-Y gastric bypass (RYGBP) is primarily restrictive, but also limits absorption of calories and nutrients to a varying degree. This procedure

involves division of the stomach to create a tiny proximal pouch with approximate volume 15 ml. This pouch is then anastomosed to a Roux-en-Y jejunal limb, bypassing the stomach, pylorus and duodenum, adding a limited malabsorptive component. Although the original descriptions of RYGBP defined the Roux-limb to be <100 cm, in almost all of the RYGBP revisions, we have measured the Roux-limbs to be >100 cm.

The biliopancreatic diversion with duodenal switch (DS) is a hybrid operation involving both components of weight loss surgery. In the DS, a lateral gastrectomy provides a restricted gastric volume of approximately 100 cc, while excess fat absorption is limited by shortening the functioning length of the intestine. This involves diversion of the biliopancreatic secretions by partitioning the bowel into two limbs – an alimentary channel, and the biliopancreatic (afferent) limb. These two limbs of small bowel are reconnected to form the common channel.^{3,4} DS appears to be the most effective bariatric operation to date. It produces the most sustained weight loss, without the unwanted side-effects present with other bariatric operations (i.e. dumping syndrome, marginal ulceration, and solid food intolerance).^{5,6} This is accomplished without any increase in the perioperative morbidity and mortality rate.

Restrictive operations have had varying results in long-term weight loss and complications.⁷ Van Gemert et al⁵ reported a 12% incidence of revision after RYGBP and a 56% incidence of revision after VBG.⁸ The need for revision after gastric banding has also been reported.^{2,9}

Revision of failed bariatric procedures has resulted in morbidity rates of 12-41%. The perioperative revision complication rate has been three times higher when compared to a primary procedure. Gagner reported a morbidity rate of 22%.¹⁰

Behrns et al¹¹ studied the choice of procedure for revisional surgery. They reported that when the primary operation had been a VBG, the most effective second operation was the RYGBP. The question arises as to what revisional surgery should be performed for failed RYGBP. The majority have been revised to a distal RYGBP.¹¹⁻¹⁴ However, Fobi et al¹⁴ showed that this was accompanied by only moderate weight loss and a protein malnutrition rate of 23%. Owens¹⁵ and Schwartz¹⁶ advised against revision

of an operation performed satisfactorily, to one of the same type, because it is unlikely to produce a significant benefit.

Between November 1999 and March 2004, we performed 614 primary DS operations with excellent weight loss and minimal (<2%) hypoalbuminemia. During the same period, we elected to perform the DS as our revision operation of choice on 47 referred patients, and the data on the latter are hereby presented.

Methods

From November 1999 to March 2004, 47 patients were referred to us for revision to a DS, a period when 614 primary DS operations were performed. The primary operation for the patients seeking revision had been VBG (16), RYGBP (26), and both (5). The five patients with both procedures had an initial VBG, later revised to a RYGBP and were now presenting for their second revision. All of our patients who underwent revisional surgery had either regained all (31) or some (>50% – 7) of their original weight loss, or had failed to lose sufficient weight (9). The other presenting complaints were: severe dumping syndrome (20); intolerance to solid foods (16); persistent nausea and vomiting (4); and severe gastroesophageal reflux disease (14) (Table 1).

In this series, all 19 patients who had severe dumping syndrome had also regained a significant amount of weight. This appears to contradict the notion that dumping syndrome is a beneficial side-effect of RYGBP as a behavior modification tool.

All patients were assessed by the surgeon, and had psychological, nutritional and medical evaluations. Extensive preoperative education was carried out to

Table 1. Reason for revision to duodenal switch

Reason for revision to DS	n=47	(%)
Weight regain/inadequate loss	22	46%
Significant dumping syndrome	13	28%
Solid food intolerance	10	2%
Persistent nausea and vomiting	18	5%
Severe gastroesophageal reflux	8	2%

ensure adequate informed consent, and to bolster postoperative compliance. The work-up before revisional surgery included: complete metabolic panel; mineral, vitamin and lipid profile; liver function tests; upper GI series, and upper endoscopy.

Surgical Technique

The revision of any previous bariatric operation to DS involves a thorough study of the patient's existing anatomy. The work-up includes review of prior medical records whenever available, as well as a detailed examination of the patient, followed by an upper GI series and an endoscopy performed at our institution by the operating surgeon. The peritoneal cavity is entered through a midline laparotomy incision.

Revision from VBG to DS entails exposure of the greater curvature of the stomach by ligation of the short gastric vessels. The stomach is then accessed through a gastrotomy at the greater curvature. A linear stapler is then used to divide the band through the gastrotomy and the distal end of the vertical partitioned stomach. Lateral vertical subtotal gastrectomy is accomplished over a 39-Fr bougie. The gastrectomy resection line includes the previous VBG staple-line, to prevent ruminant gastric tissue with compromised blood supply.

Revision of the RYGBP to DS involves a significantly greater degree of planning. The earlier open Roux-en-Y procedures were more likely to have left behind a larger stomach pouch with an intact left gastric artery than those performed laparoscopically. The reason for this is that most of the pouches were based on the greater curvature (horizontal), and little dissection was performed involving the lesser curvature. With the laparoscopic RYGBP procedures, the gastrojejunostomy anastomosis has been performed on the lesser curvature, and the left gastric artery has been frequently transected. Without the short gastric arteries, the pouch relies on the esophageal branches for its blood supply. The Lap-RYGBP patients have smaller pouch sizes and are exposed not only to an increased risk of leaks, but also have the potential for occurrence of stricture as a result of the tenuous blood supply. This may explain the high incidence of gastro-jejunostomy strictures needing balloon dilatation after lap-RYGBP.

Revision of RYGBP to DS involves taking down the gastro-jejunostomy anastomosis without compromising the blood supply of the proximal gastric pouch. The greater curvature of the bypassed stomach is then mobilized by ligation of the short gastric vessels to the level of the splenic hilum. The gastric continuity is then reconstructed by linear or circular staple firing between proximal stomach pouch and the gastric fundus of the mobilized bypassed stomach through a gastrotomy opening on the greater curvature. The staple-line is then over-sewn by a 3-0 Vicryl® in a running fashion. A lateral vertical subtotal gastrectomy is then performed over a 39-Fr bougie. This gastrectomy now includes both the previous gastric pouch and the bypassed stomach in continuity.

Small bowel continuity is restored by first taking down the Roux-limb, and reconnecting it in a side-to-side fashion at the previously placed biliopancreatic limb. The total length of the small bowel is measured on the anti-mesenteric side. The common channel and alimentary limbs are then based on the percentage of the total length of the bowel (8%-12% for common, and 35%-45% for the alimentary). All of the small bowel entero-enteric anastomoses, with the exception of the duodeno-ileostomy anastomosis, are done in a side-to-side fashion as previously described.¹⁷

The duodenal switch is then performed by first dividing the duodenum 5 cm distal to the pylorus. The alimentary tract is then pulled through a retrocolic plane to the right of the middle colic artery, and an end-to-side anastomosis is created between the end of the transected proximal duodenum and the anti-mesenteric side of the small bowel, with a linear stapler, reinforced with a 3-0 Vicryl® in a running fashion.

All patients also undergo liver biopsy, appendectomy and cholecystectomy at the time of the revision operation. A feeding jejunostomy tube is routinely inserted in the biliopancreatic limb distal to the ligament of Treitz, in all revisional operations.

Results

The mean age of the patients was 47.3 (33-64), 3.3 years older than the average age for primary DS.

Average pre-revision body mass index (BMI) was 47.3 kg/m² (range 24.5-73.7), and average pre-revision weight was 128.3 kg (range 76.0 to 214.3). This is comparable to averages of 50.6 kg/m² and 143.4 kg respectively, for primary DS. The average time elapsed between the primary operation and revision was 11.8 years (range 2.7 to 23). The female to male ratio was 9:1 compared with 6:1 in our primary DS patients.

A questionnaire administered to all revision patients at the time of the initial presentation, revealed that 96.2% of patients had been unaware of other surgical weight-loss options at the time of their primary operation, even though at the time the other bariatric operations were available.

The findings on preoperative radiological and endoscopic evaluation are shown in Tables 2 and 3.

The average operative time for revisional patients was 3.5 hours (2.3-5.7), and the average length of stay was 4.8 days. For primary DS, this has been 1.7 hours and 3.2 days, respectively.

Peri-operative complications included leaks in four patients (8.5%), one wound infection (2.1%), and one hernia (2.1%). All four of our patients who had leaks had undergone a previous RYGBP. Two of the four patients had undergone both a VBG and a RYGBP, and DS was their second revision. Two leaks occurred in the first 8 patients, and the remaining 2 in the following 38 patients. Two of the leaks were at the site of gastro-gastrostomy anastomosis, and the other two were located at the site of the lateral gastrectomy, just proximal to the gastro-gastrostomy anastomosis. Two of the four patients with leaks required further surgical interventions to com-

pletely resolve their complications. The other two were treated with enteral feeding and NPO, with drainage by means of the closed suction drains placed at the time of the operation. There has been no protein malnutrition and no deaths. The leak-rate for our primary DS patients has been 0.9%

Following a mean elapsed time of 30 months since revision to DS, the average BMI has dropped from 48.9 to 29.2 kg/m² and the %EWL has been 67%. Mean weight has fallen from 128 kg to 80 kg ($P < 0.0001$). The presenting complications of the original surgery have resolved in 100% of patients who underwent revision to DS. The BMI has remained stable after revision of failed VBG and RYGBP at 2.4 years after the DS. The data is summarized in Table 4.

Discussion

As more patients undergo bariatric surgery for treatment of morbid obesity, an increase in the number of patients with the need for revision are encountered. In our experience, the most common indication for re-operative surgery was inadequate weight loss (15 out of 35 patients, 43%). This has been confirmed by others. The reason could be due to a technical failure (eg. anastomotic dilatation, staple-line disruption). In the majority of the patients, however, we found no clear technical explanation for the failure of the operation. In restrictive operations such as VBG, patients recognize the smaller capacity of their postoperative stomach, and frequently modify their diet to comprise mainly high-calorie liquids or foods such as ice-cream and milkshakes.⁷ Intolerance to solid foods related to stricture or stenosis also makes patients resort to this type of diet. Gawdat¹⁸ found that 61% of revised patients had had no abnormality found at the time of the revisional operation.

The average BMI of our patients at the time of their primary operation had been 51.8 kg/m². Problematic weight loss in the super-obese has led to the proposition that some degree of malabsorption should be incorporated into bariatric operations in these patients.¹⁹ We agree with this, and we recommend that the DS be the primary operation of choice for patients with super-obesity.

Table 2. Radiological and endoscopic findings for VBG patients (16/47) while preparing for revision

	Band erosion, Intact gastric partition	Stricture at the ring, Intact gastric partition	Staple-line failure, Gastro-gastric fistula	Staple-line failure, Gastro-gastric fistula, Stricture at band	Normal band and intact staple-line
VBG N-16	2	1	5	2	6
Presenting symptoms	Persistent nausea and vomiting, weight regain	Persistent nausea and vomiting, weight regain	Weight regain	Persistent nausea, ulceration proximal to band, weight regain	Weight regain

Table 3. Radiological and endoscopic findings for RYGBP (26/47), and those with VBG → RYGBP (5/47), while preparing for revision

	Gastrojejunostomy anastomosis narrowing (<0.9 cm)	Gastrojejunostomy anastomosis 1-2 cm	Gastrojejunostomy anastomosis >2 cm
RYGBP N=26	5	12	9
VBG → RYGBP N=5	0	4	1
Presenting symptoms	Persistent nausea and vomiting, solid intolerance, weight regain, dumping	Weight regain, lack of satiety, dumping	Weight regain, lack of satiety, dumping

Revision from a primary restrictive operation to DS involves complete conversion of the previous operation to essentially normal anatomy before the DS operation is completed. This necessitates working on a gastric pouch or remnant with tenuous blood supply. Paying heed to this danger during the operation has allowed us to limit our complication rates to those of previously published data. It is evident from our experience that the rate of complications such as leaks is increased in revisional operations. Complication rates are higher after RYGBP revision, and 100% of our leaks occurred in patients with prior RYGBP.

Gastric bypass has been shown to have better weight loss than VBG, justifying previous revision of failed VBG. However, DS has been shown to have better overall and long-term weight loss than the RYGBP. Therefore, our revision patients should have better results than if they had been revised to another to RYGBP.

With regards to patients with failed RYGBP, the

options promoted by others have been to revise to another RYGBP, or to add a malabsorptive component by lengthening the Roux-limb (i.e. distal gastric bypass). Neither option has been very successful. As reported by Fobi¹⁴ and by Sugerma,²⁰ problems with protein malnutrition occasionally follow distal RYGBP. Others have opted to manage these patients with strict diets and anorectic drugs. These modalities failed before weight-loss surgery in these patients, and are unlikely to be beneficial at this stage. Our decision to convert failed RYGBP patients to DS has led to good weight loss results. Additionally, we have encountered no issues of protein malnutrition, partly because a larger stomach is left with DS compared to RYGBP.^{21,22} The average size of the stomach remaining after primary DS or after DS for previously failed bariatric surgery is approximately 100 cc.

Conversion to DS resulted in weight loss in all patients, with an average weight loss per month of 5.4 kg (range 0.3-16.1). However, the increased risk of complications following the re-operation implores serious consideration of the primary reason for the revision. We believe that if the presenting complaint is exclusively that of weight gain or inappropriate weight loss, the increased risk does not warrant revision in patients whose preoperative BMI is lower than the guidelines set by the National Institutes of Health.¹ However, in patients presenting with primary surgical complications, such as dumping syndrome, intolerance to solids or persistent nausea and vomiting, where the patient's quality of life has deteriorated, DS is a highly successful procedure. Our data indicates that 100% of initial complaints were resolved following revision.

The other major consideration in revisional bariatric surgery is patient education. In this study, 96.2 % of the patients claimed that they were

Table 4. Variation of BMI and %EWL

	BMI kg/m ²	%EWL (combined)***	ANOVA
Pre-original Surgery (OS)	53.2		
Lowest post-OS	34.0	70% (19-130*)	<i>P</i> < 0.001
Pre-DS	49.2	8% (-126**-70)	<i>P</i> < 0.001
Lowest post-DS	29.2	75% (28.1-113*)	<i>P</i> < 0.001
Present	30.8	71% (30-113*)	<i>P</i> < 0.001

*Reflects excessive weight loss; **Weight higher than the pre-original surgery weight (N=8, 5=VBG, 3=RYGBP); *** There was no statistical difference when the patients who had the RYGBP, VBG or both were separately analyzed.

unaware of other weight-loss surgical options at the time of their primary operation. One could possibly question the validity of the informed consent at the time of the original operation. Our program incorporates an extensive preoperative education plan geared towards explaining the DS procedure in detail, clarifying the general risks of surgery, the resulting change in anatomy and the long-term follow-up requirements, including supplementation requisites to maintain vitamin, mineral and nutritional levels within normal limits. Patients undergoing DS as their primary operation are in addition required to attend group meetings for all other surgical procedures, in order to assure adequate informed consent. The surgeon has the duty to provide the patient with the information necessary for the patient to make an educated decision as to whether to consent to the recommended operation. For a patient to properly make that decision, all major surgical options, their advantages and disadvantages must be discussed. Patients who are fully aware of all their weight loss surgery options, will better select their primary operation, and will likely decrease their need for future revisional surgery. In our practice, we recommend that our patients not only attend group meetings but also seek a second opinion regarding other bariatric surgical procedures.

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