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ORIGINAL ARTICLE

Laparoscopic revision of Roux-en-Y gastric bypass to sleeve gastrectomy: A ray of hope for failed Roux-en-Y gastric bypass

Muffazal Lakdawala,[1,2] Peter Limas,[1,3] Shilpa Dhar,[1] Carlyne Remedios,[1] Neha Dhulla,[1] Amit Sood[1,2] & Aparna Govil Bhasker[1,2]

1 Centre for Obesity and Digestive Surgery, Mumbai, India
2 Department of Bariatric and Metabolic Surgery, Institute of Minimally Invasive Surgical Sciences and Research Centre, Saifee Hospital, Mumbai, India
3 Gading Pluit Hospital, Kelapa Gading, Indonesia

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Correspondence
Aparna Govil Bhasker, Centre for Obesity and Digestive Surgery, Ground floor, Shiv Tapi Building, H. Goregaonkar Marg, Opp. Motor House, Opera House, Mumbai 400007, India.
Tel: +91 9819566618
Fax: +91 22 23649930
Email: aparna@codsindia.com

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Abstract

Introduction: Roux-en-Y gastric bypass (RYGB) is the most commonly performed bariatric operation across the world, but sometimes revision is necessary. Inadequate weight loss, weight regain, and complications such as dumping syndrome are common reasons for revision. We report the 1-year outcomes of five patients who underwent laparoscopic conversion of RYGB to sleeve gastrectomy during surgical revision.

Methods: Mean age was 38.8 ± 9.1 years. Mean BMI at primary surgery was 57.9 ± 8.1 kg/m^2. Two patients were diabetic and sleep apneic. One was hypertensive. All patients underwent a RYGB as the primary weight loss procedure. Mean weight loss was 36.8 ± 8.6 kg (excess weight loss = 39.8 ± 14.9%) at 2 years. At the end of 5 years, these patients regained 10.9 ± 4.1 kg (31.5 ± 13.6% of excess weight loss). Primary indications for revision surgery were failure to lose weight, weight regain, and intractable dumping syndrome. Mean duration between primary and revision surgery was 6.2 ± 1.1 years. RYGB was converted to sleeve gastrectomy as a first stage in all cases.

Results: Mean duration of revision surgery was 120.0 ± 15.5 min. Mean blood loss was 70 ± 50 mL. One year after revision surgery, a mean weight loss of 21.5 ± 10.5 kg was achieved (mean excess weight loss = 35.8 ± 8.8%). Two patients with type 2 diabetes mellitus and the one with hypertension achieved remission. Dumping was resolved. There were no complications.

Conclusion: Laparoscopic conversion of RYGB to sleeve gastrectomy as a first stage may be considered as an additional option in the armamentarium of revision procedures after RYGB.

Introduction

Over the years, laparoscopic Roux-en-Y gastric bypass (RYGB) has remained the most popular bariatric procedure across the world (1). It has shown durable weight loss and resolution of comorbidities along with a substantial reduction in all-cause mortality (2,3). However, weight regain and the reemergence of certain comorbidities, such as type 2 diabetes mellitus (T2DM), are known to occur in a significant number of patients in the long term (4,5).

Most patients reach the nadir of weight loss 2 years after surgery. After RYGB, 20.4% of morbidly obese patients and up to 34.9% of super-obese patients experience inadequate weight loss (6).

There is no consensus on the definition of successful outcomes after bariatric surgery. Although the Reinhold criteria defined excellent weight loss after surgery as

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achieving a BMI ≤ 30 kg/m^2, an excess weight loss (EWL) of more than 50% is considered an acceptable definition of success by centers across the world (7,8).

Causes of inadequate weight loss and weight regain after RYGB are multifactorial and can be divided into behavioral and anatomical factors. Lack of nutritional and psychological follow-up is a contributing factor in 60%–80% of patients who fail surgery (4). Pre-existing binge eating disorders and failure to attend regular support group meetings have also been implicated. In terms of technical or surgical failure, progressive gastrojejunal stomal dilatation can lead to significant weight regain over a period of years (9). Gastrogastric fistula, gastric pouch dilatation, and small bowel adaptation leading to a decrease in malabsorption are also contributing factors. These anatomical factors coupled with behavioral issues result in substantial weight regain in the long term.

Apart from weight regain, intractable dumping syndrome leading to hyperinsulinemic hypoglycemia due to changes in the hormonal milieu of the gut is another complication after RYGB that may warrant revision surgery.

Various surgical options for weight regain after RYGB have been previously described, including endoscopic techniques for reducing pouch and stoma size, surgical revision of gastrojejunostomy and the pouch, band over pouch, conversion to distal RYGB, and conversion to duodenal switch (DS) (10–18). Conversion of RYGB to a sleeve gastrectomy (SG) as a first stage is a novel technique, and to date, very few reports have been published in the literature (19).

Here we report the 1-year outcomes of five patients who underwent laparoscopic conversion of RYGB to SG as a first stage.

Materials and Methods

Between May 2012 and June 2013, five patients underwent laparoscopic conversion of RYGB to SG as a first stage. The main reasons for a revision procedure were inadequate weight loss, weight regain, inadequate resolution of comorbidities, and intractable dumping. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee, the 1964 Declaration of Helsinki and its later amendments, or comparable ethical standards.

Preoperative preparation

Before revision surgery, all patients underwent extensive preoperative counseling on diet and lifestyle modification for 6 months with a multidisciplinary team consisting of a nutritionist, psychologist, endocrinologist, and surgeon. Emotional and behavioral causes for failure of primary surgery were ruled out. Patients were then evaluated to rule out causes for technical failure. An upper GI endoscopy along with a barium study was performed to assess the pouch and stoma size. The stoma size was adequate in all patients, and there was no dilatation of the gastric pouch. The pros and cons of the revision procedure were explained to all patients in detail, and all provided informed consent for the procedure.

Routine biochemical and radiological investigations were carried out in all patients. Nutritional parameters including serum vitamin B12 levels, serum vitamin D3 levels, serum iron studies, folic acid, homocysteine, and serum ionized calcium levels were also evaluated. A high-protein liquid diet was prescribed preoperatively. Compression stockings and low molecular weight heparin were administered 12 h before surgery.

All participants included in the study provided informed consent.

Surgical technique

Each patient was placed in a split-leg position with the surgeon standing between the patient's legs, the camera operator on the patient's right, and the first assistant on the patient's left. The abdomen was entered via an under-vision 12-mm trocar in the right midclavicular line. A 12-mm trocar was inserted above the umbilicus. Three 5-mm trocars were inserted in the epigastrium, left midclavicular line, and left anterior axillary line, respectively. The surgical steps are shown in Figure 1.

The liver was retracted with a liver probe from the epigastric port. Adhesions between the gastric pouch and the liver and between the pouch and remnant stomach were sharply dissected with scissors. The gastrojejunostomy was identified, and a tunnel was created posteriorly with sharp and blunt dissection. The gastric pouch was divided from the jejunum with a green cartridge just above the anastomosis. Subsequently, the gastrocolic and gastrosplenic omentum were divided from the greater curvature of the stomach, with the division commencing 4–5 cm proximal to the pylorus up to the left crus of the diaphragm. Crural dissection was performed, and the base of the right and left crus were identified. In case of a lax hiatus, crural repair was performed with a 2-0 nonabsorbable polypropylene suture. A gastrostomy was made in the greater curvature at the level of the incisura of the stomach, and a 25-mm circular stapler was inserted. Gastrogastric anastomosis was performed with a 25-mm circular OrVil stapler (Covidien^{TM}, Gurgaon, India). A 38-Fr bougie was passed into the stomach through the gastrogastric anastomosis. A sleeve of stomach was first created with green cartridges and then with blue cartridges. The entire fundus and part of

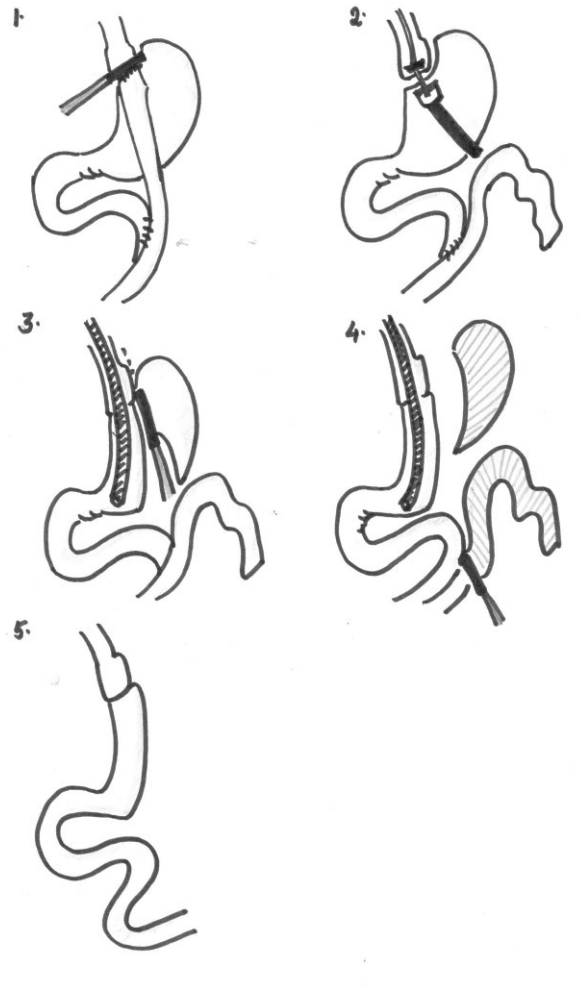

Figure 1 1. A linear stapler (green or purple cartridge) was used to divide the gastric pouch from the jejunum. 2. A gastrostomy was made on the anterior surface of the greater curvature, and a 25-mm circular stapler was inserted. Gastrogastric anastomosis was created with a 25-mm circular OrVil stapler (Covidien). 3. The greater omentum was divided, and a sleeve of stomach was created over a 38-Fr gastric bougie. 4. The Roux limb was measured and resected. 5. The entire staple line was overrun with a 2-0 absorbable suture, and omentoplasty was performed. (Illustration by Dr. Aparna G. Bhasker).

the stomach body were excised along the bougie. The entire staple line was reinforced with a continuous 2-0 absorbable suture, and an omentopexy was performed in all cases. The area of the gastrogastric anastomosis was also reinforced with a 2-0 absorbable suture. The total distal bowel length was measured, and the alimentary limb was resected.

An nasogastric tube was inserted in all patients and removed on postoperative day 3. A drain was inserted and kept *in situ* for 2 weeks. Under-water leak test was performed on the table with an endoscope to rule out a leak from the anastomosis or the staple line.

Postoperative care

Patients were kept nil by mouth for the first 3 days. An oral contrast study using a water-soluble dye was performed on postoperative day 4 to check for a leak. After this, the nasogastric tube was removed, and patients were started on liquids orally for 15 days followed by semi-solids for 15 days and subsequently solids. Deep vein thrombosis prophylaxis was continued for 7 days postoperatively.

Results

Demographics

The five patients included three men and two women. The mean age was 38.8 ± 9.1 years. At the time of primary surgery, all patients were super-obese (BMI > 50 kg/m^2) and the mean BMI was 57.9 ± 8.1 kg/m^2. Mean weight was 159.0 ± 29.6 kg. Two patients had T2DM and obstructive sleep apnea. One patient was hypertensive.

All patients underwent a standard RYGB as the primary weight loss procedure. A 20–30-mL gastric pouch, a 50-cm biliopancreatic limb, and 150-cm Roux limb were created in all cases at primary surgery. Mean weight loss at 2 years was 36.8 ± 8.6 kg (mean EWL = 39.8 ± 14.9%). Five years after RYGB, the mean weight regain in these patients was 10.9 ± 4.1 kg (31.5 ± 13.6% of the EWL). The two patients with T2DM and the one with hypertension failed to achieve remission and continued to require medications for the same. Two of these patients experienced persistent severe dumping syndrome inclusive of postprandial hypoglycemia, which was not relieved with dietary modification. The mean duration between primary and revision surgery was 6.2 ± 1.1 years.

All surgeries were performed laparoscopically. There were no conversions to open surgery. The mean duration of surgery was 120.0 ± 15.5 min. Mean blood loss was 70 ± 50 mL. Mean weight and BMI at the time of revision surgery were 128.9 ± 38.5 kg and 46.6 ± 11.5 kg/m^2, respectively. One year after conversion to SG, a mean weight loss of 21.5 ± 10.5 kg was achieved. Mean EWL at the end of 1 year was 35.8 ± 8.8%. Figure 2 shows each patient's change in weight profile from the primary surgery one year post-operatively. The two patients with T2DM and the one with hypertension achieved remission and no longer require any treatment. Dumping was resolved. Figure 3 depicts the mean blood sugar levels during a 5-h oral glucose tolerance test pre- and post-revision surgery in the two patients with dumping syndrome.

Mean hospital stay was 4.5 days (range, 4–6 days). There were no complications in any of the patients. None

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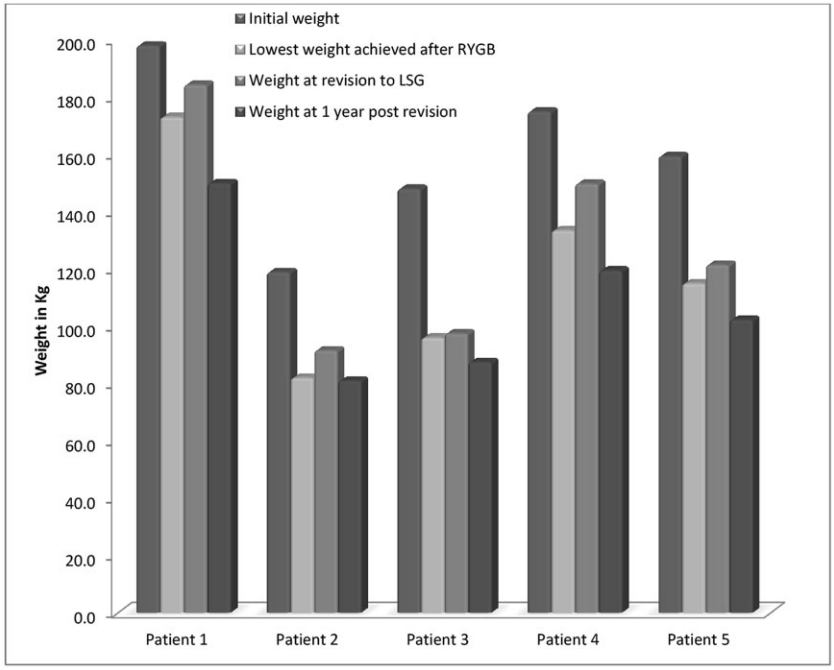

Figure 2 Change in weight profile of individual patients. LSG, laparoscopic sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass.

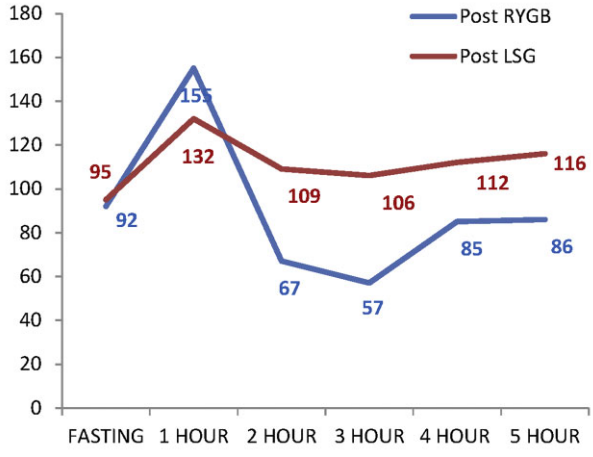

Figure 3 Mean blood sugar levels during a 5-h oral glucose tolerance test pre- and post-revision surgery. LSG, laparoscopic sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass.

of the patients complained of gastroesophageal reflux for at least 1 year after surgery. However, given the refluxogenic potential of SG, it remains to be seen if they will develop de novo reflux in the future. At our center, yearly upper GI endoscopy is a part of routine follow-up after all bariatric surgeries.

Discussion

Failure of RYGB is a known entity, and revision surgery after RYGB is a complex issue. Once considered a combination of restriction and malabsorption, RYGB currently remains a primarily restrictive procedure. EWL results after banded RYGB have been reported to be considerably better than conventional RYGB and have resulted in sustained weight loss of up to 70% after 10 years (14).

Various options for revision after RYGB have been reported in the past. The revision choices are based on intensifying either the restrictive or the malabsorptive component of the RYGB. Restriction can be augmented by either surgical or endoscopic approaches. Endoscopic reduction of the gastrojejunostomy or the pouch size has been attempted by various authors with poor long-term results. Endoscopic sclerotherapy has shown only 7%–9% EWL at 2 months (15), and 25% of these patients regained weight. Endoscopic anastomotic reduction led to 25% EWL at 5 months, but most plications were lost within 1 year and led to weight regain (16). Surgical revision of the gastrojejunostomy and reduction in pouch size have also had poor long-term weight loss results (13).

EWL of up to 69% has been reported in the literature after the malabsorptive component of RYGB was increased through conversion to a distal RYGB or a DS (12,17,18). However, the shorter the common channel, the higher the morbidity and mortality (17,18). Almost 50% of patients with common channel lengths of 50–150 cm experience unacceptable levels of morbidity in terms of protein energy malnutrition and need reversal. Sugerman *et al.* performed distal RYGB in five

patients with a common channel length of 50 cm. Two of these patients died due to hepatic failure and the remaining needed a reversal (17). Laparoscopic conversion of RYGB to DS is technically more complex than distal gastric bypass, but it is tolerated better by patients (12). DS also has the added advantage of restoring the gastric anatomy with a larger stomach pouch and an intact antrum and pylorus. However, performing a DS in one stage as a conversion from RYGB increases the operative time, complexity, and morbidity of the procedure.

In this study, we have presented a series of five patients who underwent laparoscopic conversion of RYGB to SG as a first stage. Here, we report the preliminary outcomes 1 year after conversion to SG.

All patients in this series were super-obese (BMI ≥ 50 kg/m^2) at the time of the primary surgery. The primary reason for revision surgery was inadequate weight loss along. Additionally, two patients experienced persistent comorbidities, three experienced weight regain, and two experienced persistent dumping.

In our series, we performed laparoscopic conversion of RYGB to SG as a first stage. We preferred a staged approach because it kept the operative time short and was potentially less technically complicated. In the second stage, an SG can be easily converted to other procedures such as a single anastomosis loop ileostomy, a loop duodeno-jejunal bypass, or a DS.

After conversion from RYGB to SG, the mean weight loss after 1 year was 21.5 ± 10.5 kg (mean EWL = 35.8 ± 8.8%). In a similar study, Dapri *et al*. reported an EWL of 59.3 ± 31.5% at 1 year in four patients who underwent a conversion from RYGB to SG (19). The 1-year weight loss results after conversion from RYGB to SG are thought-provoking. Possible mechanisms to explain this additional weight loss include restoration of the gastric anatomy with a functional pylorus that augments the restriction after SG and the resection of the entire ghrelin-producing fundus of the stomach. The role of ghrelin has previously been implicated in weight loss and the amelioration of T2DM (20–23).

The postoperative weight loss in our series was less than that of Dapri *et al.* (19), and this can be attributed to a higher preoperative BMI among our patients. Various investigators have studied preoperative BMI as a predictor of weight loss after bariatric surgery. In our series, the mean BMI at the time of primary surgery was 57.9 ± 8.1 kg/m^2; in the series published by Dapri *et al*., it was 43 ± 8 kg/m^2 (19). In 2007, Dixon *et al.* evaluated 440 patients 1 year after they underwent gastric banding and found that increasing BMI was significantly associated with lower EWL% (23). In a systematic review published in 2011, Livhits *et al.* found that 62 studies (n = 24 326) reported an association between preoperative BMI and subsequent weight loss after bariatric surgery. Of these, 37 studies reported a negative association, 16 showed a positive association, and 9 showed no association (24). Similarly, a few other studies have also shown that super-super-obese patients have a lower EWL% than non-super-obese patients (25,26).

Dumping syndrome symptoms in the two patients with postprandial hypoglycemia also improved dramatically after conversion to SG. Dumping syndrome is experienced by more than 50% of patients undergoing a RYGB. It typically occurs after ingestion of simple sugars and is characterized by symptoms like tachycardia, flushing, diarrhea, and abdominal pain (27). Most patients with post-RYGB dumping syndrome respond to dietary modification and medical management. However, it remains one of the main indications for reversal of RYGB along with marginal ulceration, excessive weight loss, and malnutrition (28). In a series of 20 patients reported by Vilallonga *et al*., 10 patients underwent a reversal and 10 underwent conversion to SG. Fifteen of these patients suffered from either hypoglycemia or severe dumping syndrome. Carter *et al.* have also reported a series of 12 patients who underwent a conversion of RYGB to SG, and one of the indications for conversion was dumping syndrome (29). It is more prudent to convert the RYGB to SG in such cases as the odds of weight regain are lower than after reversal of RYGB to normal anatomy.

In patients in whom the long-term RYGB results may not be satisfactory, these results at 1 year are encouraging and belie the theory that, as a combined malabsorptive and restrictive procedure, RYGB is better than SG, which is believed to be a solely restrictive procedure.

The limitations of this study are its small sample size of five patients and short follow-up period of 1 year. This is a novel surgical process, and to date, only one other study has reported this procedure. It will be interesting to see how these patients fare in the long term. We hope to present the long term results of this procedure in future.

Bariatrics is an ever-evolving science, and laparoscopic conversion of RYGB to SG as a first stage is a safe and quick option in the armamentarium of revision procedures after RYGB. It can serve as a stopgap procedure before proceeding to extensive malabsorptive procedures such as DS or single anastomosis loop ileostomy, which are poorly tolerated in terms of nutritional upkeep in the Indian setting. These results indicate hope for those who have few options after weight regain and persistent dumping uncontrolled with diet therapy after RYGB.

Acknowledgments

The authors have no potential conflicts of interest to declare. This study was reviewed by the appropriate

ethics committee – Saifee Hospital and has therefore been performed in accordance with the ethical standards laid down in the Declaration of Helsinki.

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