Management of weight regain after laparoscopic Roux-en-Y gastric bypass: A retrospective study

Original Article

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ABSTRACT

Background/Objective: Laparoscopic Roux-en-Y gastric bypass (RYGB) is an efficient bariatric procedure. However, weight regain (WR) endangers its outcomes in ~10–20% of patients. In this study, we aim to unravel the weight loss outcomes of combined Limb distalization (LD) and laparoscopic pouch resizing (LPR) versus LD only.

Patients and Methods: We retrospectively followed patients who had either type I LD or combined LPR and type I LD for WR post-RYGB over a 2-year follow-up period. Patients who had more than one bariatric procedure were excluded. WR is defined as a regain of greater than or equal to 5 kg/m^2 of the BMI, and/or a regain of 25% of percentage excess weight loss (%EWL).

Results: During the study period from December 2019 to July 2023, 24 patients with WR after previous RYGB were enrolled. Eleven patients had type I LD (group A) while 13 patients had combined LPR and LD (group B). Both procedures had significantly higher %EWL and lower BMI than the preintervention values at one year of follow-up. Combined LPR and LD patients continued to lose weight significantly over the second year with a statistically significant drop in the mean BMI (from 31.9±6.8 to 28.7±7.1) and a similar rise in the mean %EWL (from 66.1±8.2 to 70.3±6.7), whereas LD patients had no additional significant weight loss at the 2-year follow-up. Combined LPR and LD led to more weight loss which is statistically significant at both 1- and 2-year follow-up (*P=0.046*, *P=0.021*, respectively). Additionally, 20.8% of our patients developed complications with no mortality recorded. Only one patient had a relapse of obesity-related comorbidity.

Conclusion: Patients with combined LPR and type I LD achieved more superior and durable weight loss at a 2-year follow-up compared to type I LD only.

Key Words: Limb distalization, pouch resizing, revisional bariatric surgery, Roux-en-Y gastric bypass, weight regain.

Received: 18 February 2024, **Accepted:** 6 March 2024, **Publish:** 7 July 2024

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ISSN: 1110-1121, July 2024, Vol. 43, No. 3: 867-875, © The Egyptian Journal of Surgery

INTRODUCTION

Current lifestyle and eating behavior have increased the prevalence of obesity globally affecting 42.4% of U.S. adults[1]. Roux-en-Y gastric bypass (RYGB) achieves satisfactory weight loss and remission of obesity-related comorbidities for morbidly obese patients. It had a higher percentage excess weight loss (%EWL) at 5 years follow-up than LSG[2]. However, long-term data suggest weight regain (WR) and recurrence of comorbidities in some cases[3,4].

Weight loss failure and/or WR after RYGB occur in ~9 to 40% of patients[5–7]. In a study by Toolabi *et al*.[8], 120 patients who underwent either LSG or RYGB were followed for 5 years. Both procedures achieved satisfactory weight loss in the early follow-up period; however, after 5 years, 9.3% in the RYGB group and 32% in the LSG group had regained weight.

With these caveats in mind, Reinhold's criteria[9] were primarily set to define insufficient weight loss (not WR) as loss of less than 50% of the excess weight one and half years after the index operation. Others[10,11] consider achieving a BMI over 35 kg/m^2 after bariatric surgery also as insufficient weight loss. Consensus on the definition of WR remains controversial[12]. Inspired by the work of previous studies, an Italian team headed by Dr. Silvia Ferro[13] defined WR as the regain of 25% or more of the nadir weight. They found it more related to the recurrence of comorbidities and the QOL worsening. or the regain of more than 25% of the nadir weight.

Surgical salvage options include laparoscopic pouch resizing (LPR) with or without banding, gastro-jejunal sleeve reduction, Limb distalization (LD), and conversion to duodenal switch[14]. In this study, we aim to unveil the outcomes of combined type I LD and LPR versus type I LD only in the management of WR after failed RYGB.

DOI: 10.21608/EJSUR.2024.357138

PATIENTS AND METHODS:

Upon approval of the institutional review board, a retrospective study of prospectively collected data was done at Ain Shams University Hospitals, Cairo, Egypt including all patients who had either LD or combined LPR and LD for the treatment of WR after a previous failed RYGB between December 2019 and July 2023. Patients who had a history of more than one bariatric procedure were excluded.

WR was defined as a regain of 5 kg/m^2(BMI) or more, or a regain of greater than 25% of %EWL[10,11]. The weight change (loss or regain) was expressed as BMI change and %EWL. The %EWL is calculated as follows: (preoperative weight – postoperative weight at each interval) *100/ (preoperative weight – ideal weight) where ideal body weight is defined at weight corresponding to BMI of 25 kg/m^2.

The postoperative complications were classified according to the Clavien–Dindo classification[15] and are subdivided into early (in the first month) and late (occurred after that). The remission of type II diabetes mellitus was defined as the discontinuation of medications with normal fasting blood glucose (<110 mg/dL) and normal glycated hemoglobin (<5.7%). The postoperative resolution of obstructive sleep apnea was defined by the discontinuation of the use of continuous positive airway pressure. Vitamin deficiency was considered severe if the patient developed symptoms of hypovitaminosis along with a serum level below the reference range while the patient opted for the regular daily dose[16].

The medical records of the included patients showed that they were preoperatively evaluated by a multidisciplinary team regarding their medical, endocrinological, and psychiatric status delving into their eating behavior. The three-dimensional gastric computed tomography (CT) volumetry can accurately calculate the gastric pouch volume and roughly identify the length of the AL, BPL, and CC. A gastric pouch was considered dilated when its calculated volume was more than 80 cm^3 (via the 3D CT gastric volumetry). LD was done for those with a normal-sized gastric pouch and were referred to as group (A) whereas combined LPR and LD were done for those with a dilated gastric pouch and were referred to as group (B).

Surgical technique

All surgical options were done laparoscopically under general anesthesia in a combined French position and anti-Trendelenburg position. After safe access to the peritoneal cavity, diagnostic laparoscopy was the first step. Adhesiolysis and identification of the anatomy are paramount.

Distalization

The AL was identified as the small intestinal loop going down from the GJ. Measurement of the length of the AL meticulously from the GJ down to the Jejunojejunostomy (JJ) was marked via a stitch just proximal to the JJ. Similarly, both the BPL and the CC were measured. Division of the AL just proximal to the JJ distalization was made by Endo GIA Tri-Staple purple cartridges (Medtronic, Minneapolis, MN, USA) making a new JJ at 350 cm proximal to the ileocecal valve. The prevention of JJ twist was achieved by keeping the AL facing the patient's right and the CC towards the left. Closure of the mesenteric defects by a continuous 2/0 polypropylene stitch (Prolene, Ethicon Inc., USA).

LPR

Meticulous careful dissection of the gastric pouch from the gastric remnant, liver, and diaphragm via Ligasure Vessel Sealing System (LVSS) (Valleylab, Longbow Colorado, USA). Another concern was related to the orientation of the pouch with its staple line facing laterally. Removal of any previous metallic clips on the pathway of planned stapling. Resection of the lateral gastric pouch was calibrated with a 36-Fr bougie using 60 mm Endo GIA black and purple cartridges with attention not to leave any posterior sagging. The candy cane was resected if present. A methylene blue test was routinely done and then the specimen was extruded from the left hypochondrial port.

Data collection

The demographic, anthropometric, and metabolic data were collected along with the postoperative complications and coded into a Microsoft Excel sheet (Microsoft Company, Redmond, Washington, USA).

Statistical analyses

Standard descriptive statistics were used to analyze the data. The categorical data were presented as frequency or percentages whereas the numerical data were represented as median and interquartile range (IQR). The χ^2 test was used to compare relapse of comorbidity after initial RYGB to intervention done for WR. Wilcoxon signed-rank test was used to compare BMI and %EWL during the prerevisional period, 1-year, and 2-year postoperatively. The analysis was done using the Statistical Package for the Social Sciences, software package for Windows version 29.0.1 (SPSS Inc., Chicago, Illinois, USA). *P value* is considered significant if it is less than 0.05, and highly significant if it is less than 0.01.

RESULTS:

During the defined period of the study, 29 patients presented with WR after failed RYGB, five patients were dropped out and didn't complete the routine follow-up. Hence, 24 patients were included. The median age was 39.6 years (IQR=25.3–56.9). Fifteen (62.5%) patients were females. The baseline demographic and anthropometric patients' data are illustrated in (Table 1).

Type I LD was proved to be efficient in the revision of RYGB with good outcomes at 1 and 2-year follow-up periods. LD had significantly reduced the %EWL at 1- and 2-year follow-up periods when compared to the preintervention level (*P=0.019*, and 0.012), respectively. However, in our study, there is no significant difference between the 1 and 2-year outcomes of the % EWL (*P=0.43*) and the BMI (*P=0.61*) (Table 2).

Regarding group (B), patients with a combined LPR and LD had a significantly higher %EWL after 1 year compared with the preintervention %EWL (*P=0.015*), along with a parallel significant drop in the BMI from 43.7±6.7 to 31.9±6.8 (*P=0.029*). More importantly, these outcomes continued to be improved at the 2-year follow-up with a statistically significant reduction of the BMI from 28.7±7.1 to 28.7±7.1 along with a similar increase in % EWL from 66.1±8.2 to 70.3±6.7 as shown in (Table 3). By comparing BMI and %EWL in both groups, combined LPR and LD achieve more weight loss which is statistically significant at both 1- and 2-year follow-up periods (*P=0.046, P=0.021*, respectively). There were no cases of weight regain in both groups.

Of the 24 patients, 17 patients had associated medical comorbidity (before the index RYGB) which was either single or multiple comorbidities. Fourteen out of the 17 cases had complete remission whereas three cases had only improvement (not complete remission). After WR, five cases had a relapse of their comorbidities which resolved in four (80%) patients upon the revisional procedure.

Postoperative complications occurred in 5/24 patients (20.8%). Leakage occurred in one patient from the JJ (group B) who was diagnosed with low-grade fever and severe abdominal pain and was confirmed by a contrast-enhanced CT scan. This patient was treated successfully with a pig-tail drain and full TPN. Nutritional deficiency occurred in one patient who developed moderate iron deficiency anemia (HGB=8.4 gm%) and vitamin D deficiency for which he was admitted for correction.

Two cases of bleeding occurred in this study, the first one (from group A) was hypertensive and had an effluent of 500 ml^3 blood from the drain with a significant drop in the hemoglobin. This case had a diagnostic laparoscopy that showed a large hematoma in the gastric bed (mostly from the staple line of the refashioned pouch), lavage, and suction done with an uneventful postoperative period. The second one (from group B) had pallor associated with a fainting attack on the 3rd day for which she was readmitted and improved with blood transfusion. Adhesive intestinal obstruction was diagnosed in a case of LD, a CT scan was done, and the case was managed conservatively. There was no mortality in this study.

Table 1: The baseline characteristics of the patients

Variable (median (IQR))	Outcome
Age	39.6 (IQR=25.3–56.9)
Sex	
Male	9 (37.5%)
Female	15 (62.5%)
Height	1.63 (IQR=1.56–1.79)
Weight pre-index RYGB	132 (IQR=117.3–158.7)
Nadir weight	79.2 (IQR=69.6–86.1)
Weight at revisional RYGB	116.8 (IQR=102.5–139.6)
BMI pre- index RYGB (median)	52.8 (IQR: 48.1–56.5)
Nadir BMI (median)	30.8 (IQR: 26.7–34.1)
Pre-intervention BMI (median)	43.5±5.1
Intervention:	
Type I LD	11 (45.8%)
Combined LPR and LD	13 (54.1%)

Table 2: The weight outcomes of limb distalization

	%EWL (from the original procedure)	%EWL (from LD)	BMI
Pre-Index RYGB	–	–	52.3±7.3
At revisional RYGB	33.5±14.7	–	42.9±5.1
1-year	51.8±21.1	63.9±18.1	33.7±5.9
2-year	52.3±17.8	64.2±17.3	33.2±2.9

*Via the Wilcoxon signed-rank test.

Table 3: The weight outcomes of Combined laparoscopic pouch resizing and limb distalization

	%EWL (from the original procedure)	%EWL (from Combined LPR and LD)	BMI
Pre-Index RYGB	–	–	53.1±10.6
At revisional RYGB	34.1±12.3	–	43.7±6.7
1-year	53.8±9.4	66.1±8.2	31.9±6.8
2-year	57.3±8.5	70.3±6.7	28.7±7.1

*Via the Wilcoxon signed-rank test.

DISCUSSION

RYGB is the gold standard bariatric procedure, but WR poses a threat to its effectiveness. Its results are prone to diminish with time, with the resultant weight recidivism and a recurrence of obesity-related comorbidities[14].

Up till now, the topic of WR post-RYGB has been vague. There is no consensus regarding its definition, causes, and management. Therefore, it has attracted greatly renewed interest in the past decade. From our point of view, the title of weight regain is not an accurate one to describe the failure of RYGB, with the resultant reaccumulation of body fat. This title includes both significant and nonsignificant increases in the total weight. In Addition, it does not discriminate between fat and other components of body weight such as body water and muscles. Therefore, we suggest changing it to significant fat mass regain.

Studies were tickling from overseas about the incidence of WR post-RYGB. Voorwinde *et al*.[12]. based on six definitions of WR reached an unacceptable wide range of (16%–87%), whereas King *et al*.[17] described a range of (43.6–67.3%) based on 13 different items in a large study involved more than 1400 cases. Other mid-term studies[6,7] observed similar trends, with 36.7–50% of their patients developing WR during the 5-year follow-up period.

In a retrospective long-term study of 281 Portuguese patients, Guimaraes *et al*.[18] reported a 34–54% remission rate of comorbidities. WR was seen in eight (2.8%) patients requiring surgical intervention. Similar results were reported by Courcoulas *et al*.[19] in their Longitudinal Assessment of Bariatric Surgery (LABS) Study of 1738 RYGB patients. WR was evident in 3.9% of their patients between 3 and 7 years.

Given that obesity is a multifactorial disorder, WR after RYGB is also multifactorial. Hence, the management should include a multidisciplinary team to address this issue[13]. The suggested set of factors that puts at risk the anthropometric and metabolic outcomes of RYGB include but are not limited to eating hyperphagic behaviour (such as grazing, snacking, and well-tolerated fatty foods), sedentary lifestyle[20,21] loneliness, family issues[22], altered metabolic and gut hormones, and altered surgical anatomy (such as gastric pouch dilatation, gastro-gastric fistula, wide gastro-jejunal anastomosis (>1.5 cm)[3,23].

Indeed, pouch size is a pertinent factor in the sensation of satiety[13]. Despite being a well-established factor in the pathogenesis of WR, there is no consensus regarding the definition of pouch dilation[24,25]. It can be defined based on endoscopic and/or radiological, criteria. The endoscopic criteria include easy retroflection manoeuvre and/or a length of greater than 5 cm as stated by Hamdi *et al*.[25] in their trial of 25 RYGB cases published in 2014. The radiological criterion is a size greater than 80 ml by a three-dimensional gastric volumetric study[13].

LPR was first described by Parikh *et al*.[14] in 2011 to restore the restrictive element of the RYGB as well as to narrow the GJ if more than 1.5 cm by endoscopy. They had a 2.6 kg/m^2 BMI reduction. This could be attributed to the use of large bougie sizes (up to 60 French) in some cases. Others[26–28] reported better results (4.4–6) kg/m^2 BMI reduction with the use of smaller bougie size (32–34 French). It is worth pointing out as a parenthesis that better weight outcomes were

achieved in patients with primary pouch dilatation (dilated pouch immediately after the index RYGB) than those with secondary pouch dilatation. A study by Hamdi *et al*.[25] achieved 8 kg/m^2 BMI reduction (from 41 kg/m^2 to 33 kg/m^2) over at one-year period with the shortening of the pouch to less than 5 cm with a neo-GJ. However, these results were not durable with a rapid weight regain to 44.2 kg/m^2 two years postoperatively. Hehl *et al*.[29] reported unsatisfactory results of less than 4 Kg/m^2 BMI reduction after three years of follow-up. These results were the same at five years without any WR.

Boerboom *et al*.[30] were the first to highlight the importance of lengthening the Biliopancreatic limb (BPL) in patients undergoing RYGB post adjustable gastric banding. Two years later, Hamed *et al*.[31] classified LD into four types of which the first two types are the most common. Distalization could be done by lengthening the BPL (Type I, Sugerman-type distal bypass) [32,33] or by lengthening the AL (Type II, Brolin-type distal bypass)[34,35]. Type I LD was proved to be more effective in terms of more %EWL[36], whereas type II appeared to have no considerable weight loss even in the short-term as concluded by several randomized controlled trials[37–39].

The literature review showed extensive research and considerable debate regarding the optimum length of AL, BPL, and Common Channel (CC) which lead to the best % EWL without causing malnutrition. The term total alimentary limb length (TALL) was developed to describe the length of the small intestine able to absorb the nutrients (the sum of AL and CC).

A TALL of 250 cm carried a 13.6–30% incidence of severe malnutrition which needed a second revisional surgery as reported by Shin *et al*.[40], Felsenreich *et al*.[41], and Kraljevic *et al*.[42] Similar results were reported by Ghiassi *et al*.[43] and Shah *et al*.[16] who faced an unacceptably high incidence of severe malnutrition which led them to lengthen the TALL to 300 cm. However, this lengthening resulted in no statistically significant outcomes in terms of weight loss and malnutrition. By tailoring a TALL length of 295 cm (145 cm AL and 150 cm CC, they had a 32% incidence of severe malnutrition[44].

Understanding the consequences of severe malnutrition, coupled with the possibility of WR has led surgeons to try a TALL length of 400–450 cm. This shift was evident in a large well-designed cohort Study of 96 Patients published by Ghiassi *et al*.[43] in 2018 who were obliged to lengthen the TALL to 400 cm after the first 11 patients due to severe malnutrition.

Additionally, in a comprehensive review addressing the same issue, Shah *et al*.[16] using a TALL length of 300 cm posited controversial results with 64.5% EWL and 6.4 points drop in the BMI 1 year postoperatively. Three out of the 42 patients enrolled in the study had a second operation for malnutrition. They concluded that a TALL length of 350 cm could be the best option which balances between weight loss results and malnutrition. These results were durable after 8 years with a TWL% of (17.2%) in comparison to 21.9% in one year. The length of the CC should not be less than 150 cm as confirmed by Sugerman *et al*.[32] to avoid any further vitamin deficiency.

Another pertinent factor that is not well understood is the small intestinal adaptive changes such as cellular hyperplasia and increased permeability[45]. These changes increased with time. Therefore, the more time passed after the failed RYGB, the more adaptive intestinal changes occur. It seems plausible to hypothesize that these adaptive changes could be the most important factor leading to variable and even controversial outcomes regarding both weight loss and malnutrition. Given that these changes could not be measured, the length of the TALL could not be accurately standardized with any mathematical or statistical equation.

The present study verifies that patients who had LD can maintain their %EWL and BMI reduction over 2 years without any WR. However, we noticed that there was no significant added weight loss in the 2nd year (Table 2). Our findings were consistent with Himpens *et al*. on 58 patients with WR or insufficient weight loss. Nineteen patients underwent LD. Re-intervention has significantly lowered the initial mean BMI from 42.7±19.7 kg/m^2 to 39.1±11.3 kg/m^2 with an overall complication rate of 20.7%.10.

It was proved that type I LD is effective in restoring the malabsorptive element of a failed RYGB. Additionally, LPR can restore the lost restrictive component and regain early satiety. Nevertheless, there is scarce data regarding the combination of both techniques in patients with WR after RYGB. Therefore, we tried to unveil the weight loss outcomes after combining LPR and type I LD comparing it to type I LD only. This study confirmed that patients with combined LPR and type I LD achieved and maintained significant weight loss after a previous RYGB and appeared to be superior to type I LD only. In this study, there are no definite cases of failure (or weight regain) after both procedures (according to the definition of failure mentioned in the study). This could be attributed to the relatively short period of the study (2 years) which could not allow for this possible sequelae to appear.

Kermansaravi *et al*.[46] in a recent well-designed meta-analysis of 4 l studies, regarding the best surgical technique for failed RYGB. LD was done in eight studies whereas LPR (with or without banding) with or without narrowing of the GJA was done in 22 studies. Only four studies[10,14,47,48] included combined LD and LPR. They documented that LPR and GJA narrowing is the least effective procedure in terms of weight loss. whereas LD is the most effective procedure in the long run and concluded that severe malnutrition is the most feared complication.

Parikh *et al*.[14] confirmed poor outcomes of 12.8%EWL 1 year after combined type II LD and gastrojejunal anastomosis sleeve reduction. Another short-term study[47] on 29 patients reported that type II LD and silicone band placement resulted in 23% absolute weight loss (average follow-up time of 11.2 months).

Debs *et al*.[49] presented a 54-year-old male who had a previously failed sleeve gastrectomy, RYGB, and LPR. Type I LD (with a TALL of 250 cm) and LPR were done with a significant weight loss at 1 year postoperative (68.8% % EWL). The weight decreased from 115 kg to 85 kg, and the BMI dropped from 41.2 kg/m^2 to 30.5 kg/m^2 without malnutritional or diarrhea.

More strikingly, 80% of the enrolled patients had a complete remission of their obesity-related comorbidities which is in range with that concluded by other trials (65.2–88.9%)[16,40] whereas a study from Portugal[18] described a 54.2% remission rate of type II DM. Hamdi *et al*.[25] reported a significant amelioration of GERD and dumping syndrome after LPR. Unfortunately, some other studies[6] did not comment on this issue. In our series, we had a relatively high incidence of complications (20.8%), however. this is in range with other various studies (8–30%)[10,13,28,50].

The study is limited due to its relatively small sample size and the short duration of follow-up which could not allow us to unveil the mid-term and long-term effects of these procedures. Further large sample-sized studies are needed to consolidate the outcomes of this study.

CONCLUSION

WR after RYGB is a challenging vague issue. Combined LPR and type I LD can effectively correct the disturbance in both the restrictive and the malabsorptive components of a failed RYGB with the resultant statistically significant weight loss at 1- and 2-year follow-up and is astonishingly more superior and durable than type I LD only.

CONFLICT OF INTEREST

There are no conflicts of interest.

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