Laparoscopic Roux-En-Y gastric bypass versus mini-gastric bypass for the treatment of morbid obesity and effect on glucagon-like peptide-1 level: a randomized comparative study

Mohamed M. Kandel[a], Mostafa R. Elkeleny[b], Doaa A. Header[c], Islam M. Korayem[b], Mohamed M. Hassan[b]

[a]Department of Surgery, Faculty of Medicine, Port Said University, Port Said, Egypt, [b]Department of Surgery, Faculty of Medicine, Alexandria University, Alexandria, [c]Department of Internal Medicine, Gastroenterology Unit, Faculty of Medicine, Alexandria University

Correspondence to Mohamed M. Kandel, MD, MSc, BSc, 46 Ibrahim Nosir St., Louran, Alexandria, Egypt. Mobile: +0100 200 6814; e-mail: dr.m.mosaad@gmail.com

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Background
The gold standard malabsorptive technique for patients who are morbidly obese that promotes sustained weight loss is laparoscopic Roux-en-Y gastric bypass (LRYGB). An alternative that has gained popularity is laparoscopic mini-gastric bypass (LMGB), which has the advantages of being more technically straightforward, needing less time during surgery, and having a higher food tolerance. This study compares the short-term effects of LMGB and LRYGB on weight reduction and postoperative levels of glucagon-like peptide-1 (GLP-1).

Methods
This prospective study included 50 morbidly obese patients who were randomly assigned to receive either LRYGB or LMGB, with 25 patients/group in the period from March 2020 to February 2021.

Results
Group B experienced a much shorter hospital stay and operation time than group A. There was no discernible difference between the two groups in terms of intraoperative errors or postoperative problems. Throughout the follow-up period, the patients' weights and BMI dramatically fell in both groups, with the LMGB group seeing a much larger mean excess BMI reduction percent. Preoperative comorbidities were significantly resolved in both operations, and there was no discernible difference between the two groups. GLP-1: Following surgery, both groups exhibit a noteworthy rise in postprandial GLP-1 levels.

Conclusions
Compared with LRYGBP, the LMGB technique produced a greater weight loss with a similar efficiency on metabolic control.

Keywords:
mini-gastric bypass, one-anastomosis gastric bypass, roux-En-Y gastric bypass, laparoscopy, hypertension, bariatric surgery, mini-gastric bypass, glucagon-like peptide-1

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Introduction

The World Health Organisation (WHO) identified obesity as the world's most evident yet most ignored public health issue in 2000 [1]. Over the past 10 years, obesity has become a global epidemic. Between 1980 and 2008, the number of deaths linked to obesity doubled worldwide, accounting for 2.8 million deaths [2,3].

A version of the Mason bypass [4] with a longer pouch based on less curvature is called laparoscopic mini-gastric bypass (MGB). Even though the first MGB was carried out more than fifteen years earlier in 1997 and published in 2001 [5], the bariatric societies had trouble and a slow acceptance of it [6,7] There were records of esophagitis and symptomatic biliary gastritis that required revision.8. Alkaline reflux has raised concerns among certain researchers over the potential for gastric and esophageal cancer. A randomized controlled comparison research with long-term follow-up has been recommended in response to concerns expressed over the reported levels of problems and the scope of follow-up [8].

For those who are extremely obese, bariatric surgery is currently the only way to achieve significant and lasting weight loss [9]. The number of bariatric surgeries performed has increased significantly thanks to laparoscopy, which is also now being suggested for a variety of different surgical techniques. The most popular bariatric treatment that achieves significant and long-lasting weight loss with long-term follow-up is Roux-en-Y laparoscopic gastric bypass (RYGB).

It is regarded as the gold standard in bariatric surgery, and other operations ought to be evaluated in light of RY [10].

MGB offers unique benefits of its own. There is an appeal to this single-anastomosis bariatric treatment, particularly when contrasted with the gold standard RYGB. Thousands of these procedures have now been carried out by a variety of surgeons who think that this procedure is superior to RYGB because it has fewer internal hernias and anastomotic leaks, a shorter learning curve, easier reversibility and revision, and comparable weight loss and comorbidity. Outcomes of resolution [11].

Following LRYGB, there are noticeable changes in gut hormones such as ghrelin, peptide YY (PYY), and peptide-like glucagon-1 (GLP-1). Raising GLP-1 levels appears to be essential for enhancing insulin sensitivity. GLP-1's primary actions include increasing the amount of insulin secreted in response to glucose, supporting beta-cell development and survival, blocking the release of glucagon, and reducing appetite. Both the postprandial and LRYGB increases were accompanied by significant increases in GLP-1 levels. Furthermore, a rise in fasting and postprandial GLP-1 was observed after sleeve gastrectomy [12]. Few studies examine the impact of MGB on postoperative GLP-1 [13].

Our research aimed to compare the LRYGB and LMGB short-term results based on: Operative duration, weight reduction rate throughout a 1-year follow-up period, postoperative complications, and postoperative morbidities and mortality will all be reported. Impact on the related comorbidities will be evaluated both prior to surgery and during the 12-month follow-up period. Enhancement of quality of life after surgery (QOL) and Impact on glucagon-like peptide 1 (GLP-1): GLP-1 is measured before to surgery and 6 weeks after surgery.

Methods

This prospective randomized study, which included 50 adult morbidly obese patients over the age of 18, with a BMI of more than 40 kg/m^2 or a BMI of more than 35 kg/m^2 and concomitant conditions, was carried out in the Gastrointestinal Surgery Unit of Alexandria University Main Hospital, Egypt, with approval from the Ethics Committee and Institutional Review Board of Alexandria Faculty of Medicine. A BMI of more than 60 kg/m^2, active peptic ulcer disease, grade 4 gastroesophageal reflux disease (GERD) with a large hiatal hernia on esophagogastroduodenoscopy (EGD), a history of major abdominal surgery (splenectomy, colectomy, etc.) or bariatric surgery, a significant psychological disorder (depression, for example), and ongoing alcohol or drug abuse were among the exclusion criteria.

Using the sequentially numbered, opaque, sealed envelope (SNOSE) technique, the 50 patients were randomly randomized to receive either LRYGB or LMGB, resulting in 25 patients each group on the day of operation. After being fully informed about the assigned surgical treatment, all patients who gave their approval to participate in the study were asked to sign an informed consent agreement. Following surgery, each patient received postoperative care for a minimum of a year. Preoperative assessment included routine laboratory tests, hormonal assays, chest radiography, EGD, electrocardiogram, abdominal ultrasound to assess liver span and degree of fatty liver and done by sonographer using different ultrasound methods to detect and graduate hepatic steatosis and to determine grade of fibrosis using elastography-methods, such as transient elastography and two-dimensional shear wave elastography in patients with Non Alcoholic Fatty Liver Disease (NAFLD), and dietary habits. Patients were maintained on a low caloric diet that high in proteins and low in fats and carbohydrates for 2–3 weeks prior to surgery to reduce steatosis and potentially shrink liver [14]. Preoperative assessment of Qol using Moorehead-Ardelt Quality of Life Questionnaire II (M-A QoLQII) [15]. Preoperative level of postprandial GLP-1 (1 h after standard mixed liquid meal challenge) was measured using commercially available radioimmunoassay [Glucgon-like peptid (total) RIA Kit; Millipore, Billerica, MA, USA] as instructed by manufacturer.

Surgical technique

All the procedures were performed laparoscopically.

Technique of LRYGB [16]

When the gastric pouch was being created the chief surgeon stood between the patient's knees and on the left side when the bowel was being manipulated, the camera man on the right, and the assistant on the left. The nurse was standing where the patient's left foot was. Following the introduction of pneumoperitoneum, the insertion of five trocars, and the retraction of the left lobe of the liver, the construction of the gastric pouch occurs by forming a lesser curve-based window in the gastro-hepatic ligament, ~5–6 cm distal to the gastro-esophageal junction and closed to the lesser curvature gastric wall. The posterior gastric adhesions were addressed by the dissection continuing till the lesser sac opened. In order to prevent pouch ischemia and allow for the linear stapler passage, the window needs to be small between 1 and 1.5 cm. Subsequently, a transverse divide of the stomach is made using an endoscopic 45 mm linear stapler either EchelonFlex Endopath Stapler with 3.8 mm gold Echelon 60 mm reloads (product of Ethicon EndoSurgery Inc., Cincinatti, Ohio, USA) or EndoGIA Universal 12 mm stapler with 3.5 mm (blue) and 4.8 mm (green) single use straight or roticulator 60 mm loading unit or Endo GIA Reinforced Reload with Tri-Staple Technology 60 mm (Purple) Articulating Medium Thick (product of Covidien Autosuture, formerly Tyco Healthcare, Mansfield, Massachusetts, USA), according the availability; the line was usually produced somewhat below the first vascular arcade. Following the transverse split, the stomach was then further divided vertically up to the angle of his, resulting in a 30–50 cc pouch in the end. The mesentery was transected perpendicular to the bowel wall using Harmonic Scalpel or Ligasure to prevent potential bowel ischemia. The biliopancreatic limb, also known as the afferent limb, was then measured starting at the ligament of Treitz and transected using a stapling device to create the biliopancreatic (BP) limb. Following that, the jejunum's Roux limb can be raised in an antecolic-antegastric position. Afterwards, a 3 cm gastrojejunostomy is made from side to side using an endoscopic linear stapler and the defect closed with sutures. The roux limb is 150 cm between the jejunal division points. At this point, a side-to-side jejunojejunostomy is created by anastomosing the biliopancreatic limb to the distal portion of the jejunum. In order to reduce the danger of an internal herniation following surgery, the mesenteric defects are then closed with interrupted stitches made of nonabsorbable material. To make sure there was no leak, the methylene blue leakage test was conducted. Peritoneal drain inserted into the left subdiaphragmatic region.

Surgical technique for MGB [5]

A liver retraction trocar positioned 12 mm under the xyphoid or slightly to the right. a 12 mm supraumbilical trocar for the camera. Third trocar in left upper quadrant, 12 mm, serving as the stomach retraction and linear stapler's operating axis. 3 cm below the costal margin, in the left anterior axillary line, is a 5 mm port assistant and a 12 mm port located 5 cm below the costal margin in the right midclavicular line. Creating a window on the lesser c sac by dissecting at the level of the crow's foot. At the level of the crow's foot, at a right angle to the lesser curvature, a single horizontal 45 mm endo-GIA cartridge was used to build the gastric tube. A calibrated bougie measuring 36 Fr is inserted into the stomach. Four or five vertical 60 mm endo-GIA reloads were fired in the direction of His angle. Before every shot, the calibrating bougie must to move under clear sight. Momentum is pulled upward between the residual stomach and the gastric tube. A gastric tube anastomosed with jejunal loop 200 cm distal to the ligament of the Treitz. An endo-GIA stapler was used to create the anastomosis in an antecolic, side-to-side, isoperistaltic way. The size of the anastomosis exceeded 3 cm. With 2/0 V-LOCK, the gastric and jejunal holes used to introduce the endostapler were closed with a continuous suture. To make sure there was no leak, the methylene blue leakage test was conducted. Regularly an abdominal drains used.

Postoperative care included Oral intake (fluid) will be resumed on day two after obtaining contrast study result and confirming that there is no leak. All patients with comorbid conditions will stop medical treatment, including oral hypoglycemic agents and insulin against type 2 diabetes mellitus (T2DM) after the operation where in diabetics mellitus (DM) during first month postoperatively, patient stopped all anti DM medication with strict follow-up by random and fasting blood glucose level and HB A1c after 3 months postoperatively and according to the results either to stopped medication or decrease the dose or take the full dose. Furthermore, the DM patients followed-up with endocrinologist. Drain will be removed when drainage is minimal (less than 50 cc/day). Postoperative follow-up at 6 and 12 months to assess weight loss and resolution of comorbidities, early and late postoperative complications and Serum GLP-1 will be measured 6 weeks after surgery.

Postoperative follow-up

Was carried out at 6 and 12 months to assess weight loss and resolution of comorbidities, early and late postoperative complications and Serum GLP-1 will be measured 6 weeks after surgery.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 20 for Windows (IBM Corp., Armonk, N. Y., USA) was used for performing the analysis. The distribution of the numerical data was tested using the Shapiro-Wilk test for normality. All data were normally distributed and were summarized as mean ±standard deviation (SD). Comparisons between the two groups were done using the Student T-test, paired t-test and Post Hoc test (Bonferroni adjusted) for pairwise comparisons. Categorical data were summarized as frequencies (count and percentage), and the associations between the studied groups were tested using the Mann–Whitney test, ANOVA, the Pearson's χ^2 test, Fisher's exact test or Monte Carlo correction test. A P-value less than 0.05 was adopted to interpret the significance of statistical tests.

Results

The baseline characteristics of our patients of both groups are shown. Both groups were matched in age, sex, mean weight, BMI with no significant difference in between except for waist hip ratio. Also, no significance difference between both groups regarding associated comorbidity and onset of obesity, surgical history, preoperative measurement GLP-1 preoperative quality of life assessment (Table 1).

The mean operative time was 152.1±38 min for the RYGB group and 120.9±22.3 min for the MGB group which significant shorter in MGB group (P<0.001). There was no significant difference between both groups neither in conversion rate, intraoperative mishaps, early postoperative complication nor the mean length of hospital stay (Tables 2 and 3).

Table 1 Comparison of the patients' baseline characteristic between both study groups

	Roux-en-Y bypass (n=25)	Laparoscopic mini gastric bypass (n=25)	*P*
Sex			
Male/female	4/21	5/20	1.000
Age (years)	38.2±9.9	40.9±10.7	0.307
Comorbidities			
DM	9 (36%)	9 (36%)	1.000
HTN	11 (44%)	5 (20%)	0.069
Lower limb DVT	2 (8%)	0	0.490
Venous stasis	2 (8%)	0	0.490
Delayed Menstruation	2 (8%)	0	0.490
Hypothyroidism	2 (8%)	0	0.490
Osteoarthritis	1 (4%)	4 (16%)	0.110
Stress incontinence	0	2 (8%)	0.490
Onset of obesity			
Adulthood/childhood	21/4	23/2	0.667
Past surgical history	17 (68%)	17 (68%)	1.000
Para-umbilical hernia	2 (8%)	0	0.490
Cholecystectomy	5 (20%)	0	0.050
Appendectomy	5 (20%)	4 (16%)	1.000
Caesarian section	3 (12%)	7 (28%)	0.157
Left varicose vein	2 (8%)	0	0.490
Hysterectomy	0	1 (4%)	1.000
Abdominoplasty	0	2 (8%)	0.490
Amputation	0	1 (4%)	1.000
Inguinal Hernia repair	0	2 (8%)	0.490
Dietary Habits			
Over eaters	16 (64%)	12 (48%)	0.516
Night eaters	5 (20%)	5 (20%)	
Sweet eaters	1 (4%)	3 (12%)	
Binge eaters	3 (12%)	3 (12%)	
Snackers	0	2 (8%)	
BMI	49.5±8	48.8±6.4	0.691
Waist circumference	144.2±14.3	152.7±5.9	0.004*
Hip circumference	157.2±13.3	164.2±4.8	0.011*
Waist/hip ratio	0.92±0.02	0.93±0.02	0.018*
Excess Weight	74.3±21.4	71.1±15.5	0.515
Serum GLP-1 at surgery	2.96±0.5	2.14±0.5	0.589
QOL preoperative			
Fair	5 (20%)	6 (24%)	0.573
Poor	19 (76%)	19 (76%)	
Good	1 (4%)	0	

BMI: body mass index; DM: diabetes mellites; DVT: deep vein thrombosis; GLP-1: Glucagon like peptide-1; HTN: hypertension; QOL: quality of life; *: Statistically significant at *P* less than or equal to 0.05.

Table 2 Comparison of the operative data and early postoperative morbidities between both study groups

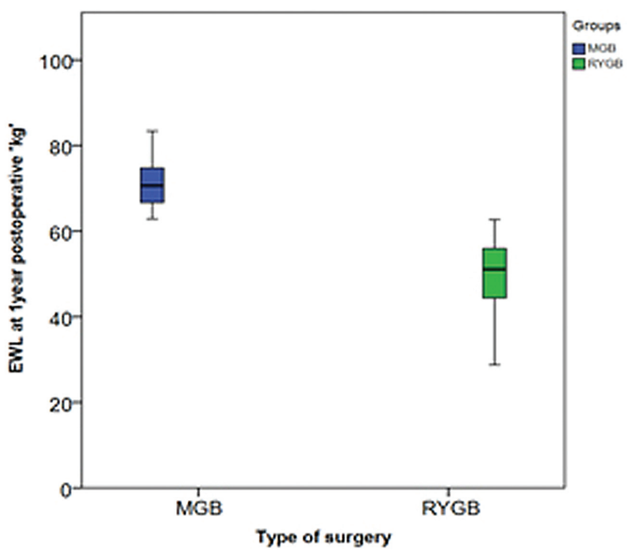
	Roux-en-Y bypass (n=25)	Laparoscopic mini gastric bypass (n=25)	*P*
Operative time 'min'	152.1±38	120.9±22.3	<0.001*
Length of Hospital stay 'days'	3 (3–15)	3 (3–10)	0.774

*: Statistically significant at *P* less than or equal to 0.05

We follow-up all our patient for 1 year at 3, 6, and 12 months postoperative. There was a statistically significant decrease of weight than initial weight in both groups during the follow-up period. This significance increased with time during the follow-up period in both groups (*P* value of both groups ≤0.05). The weight loss significant higher in MGB group than RYGB group during follow-up. We reported other weight loss parameters like percentage of excess weight loss (PEWL) and waist hip ratio and body mass index (BMI) and excess body mass index loss (EBMIL) during the follow-up period. Both groups showed significant improvement of weight loss parameter, but it was significantly better in MGB group than RYGB group (Table 4 and Figs 1 and 2).

During the 1-year follow-up period there was no detected gastroesophageal reflux cases in the RYGBP group but there was one case in the MGB group. No case with dumping symptoms in the MGB group, whereas one patient had a dumping symptom in the RYGBP (4%) and were improved by dietary consultation. Neither early nor late complications were not statistically different between both groups. No mortality in both groups during the follow-up period.

Figure 1



Boxplot graph for excess weight loss at 1-year postoperative for both groups. EWL: excess weight loss; MGB: mini-gastric bypass; RYGB: Roux-en-Y gastric bypass.

Table 3 Comparison between the studied groups according to postoperative data

Postoperative	Roux-en-Y bypass (n=25) No (%)	Laparoscopic mini gastric bypass (n=25) No (%)	Test of Sig.	*P*
Complications	11 (44.0)	12 (48.0)	χ2=0.902	0.342
Early	6 (24.0)	9 (36.0)	0.440	0.507
leakage	2 (8.0)	2 (8.0)	0.360	FEp=0.548
Intra-abdominal abscess	1 (4.0)	0	0.0	FEp=1.000
Postoperative Bleeding	0	0	1.026	FEp=1.000
Wound seroma	1 (4.0)	3 (12.0)	0.0	FEp=1.000
Wound infection	1 (4.0)	2 (8.0)	1.111	FEp=0.605
Basal atelectasis	0	1 (4.0)	1.026	FEp=1.000
Mechanical ventilator	1 (4.0)	1 (4.0)	1.026	FEp=1.000
Late	5 (20.0)	3 (12.0)	0.173	FEp=1.000
Persistent vomiting	1 (4.0)	0	2.105	FEp=0.487
Incisional area	0	1 (4.0)	1.026	FEp=1.000
Anemia	1 (0.0)	0 (5.0)	1.026	FEp=1.000
Vitamin B12 deficiency	1 (4.0)	0	1.026	FEp=1.000
Constipation	1 (4.0)	0 (10.0)	2.105	FEp=0.487
Cholelithiasis	0	1 (4.0)	1.026	FEp=1.000
Bile reflux	0	1 (4.0)	1.026	FEp=1.000
Stomal ulcer	1 (4.0)	0	1.026	FEp=1.000
dumping	1 (4.0)	0	1.026	FEp=1.000
Mortality	0	0		
conversion	2 (8.0)	1 (4.0)	1.111	FEp=0.605

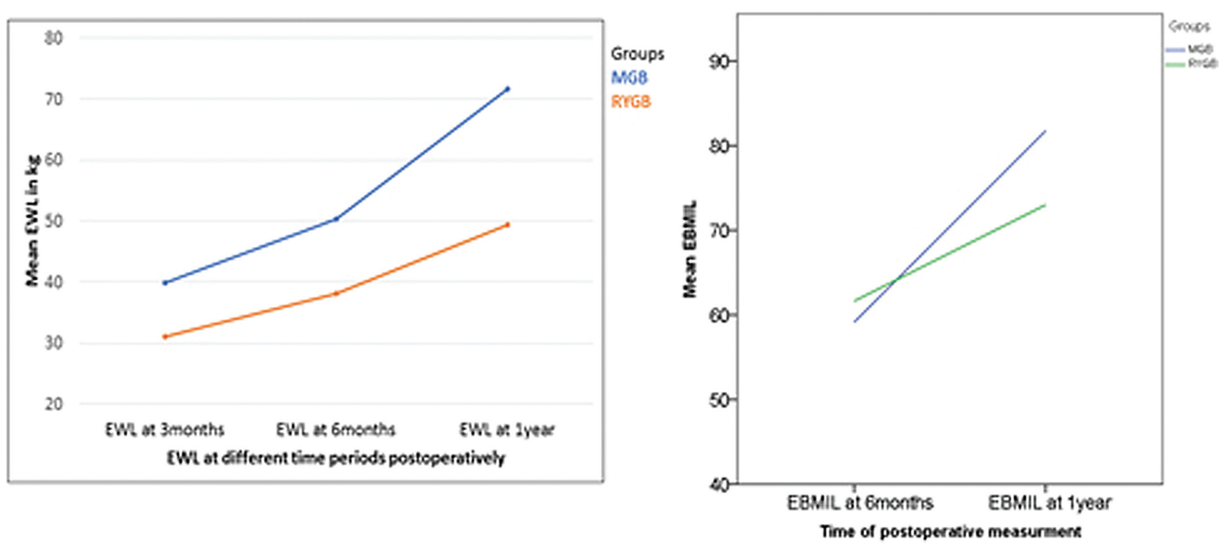
χ^2:Chi square test; Z: Z for Mann Whitney test.

Table 4 Comparison of the postoperative body weight and metabolic outcomes between both study groups

	Roux-en-Y bypass (n=25)	Laparoscopic mini gastric bypass (n=25)	*P*
BMI			
6 months postoperative	38.7[a]±5.9	35.15[a]±4.3	0.010*
1 year postoperative	31.6[b]±3.9	30[b]±2.8	0.065
Weight			
6 months postoperative	104.2[a]±18.1	93.2[a]±11.4	0.007*
1 year postoperative	85.2[b]±12.2	79.6[b]±6.3	0.030*
Waist/hip ratio			
6 months postoperative	0.85[a]±0.03	0.82[a]±0.03	0.002*
1 year postoperative	0.82[b]±0.04	0.79[b]±0.03	0.003*
EWL			
3 months postoperative	31.1±5.8	39.9±3.3	0.001*
6 months postoperative	38.2±8.4	50.4±7.1	0.001*
1 year postoperative	49.4±8.6	71.6±5.2	0.001*
p0	<0.001*	<0.001*	
EBMIL			
6 months postoperative	45.9±10.4	59.2±10.5	0.001*
1 year postoperative	74.8±9	80.7±8.4	0.011*
p0	<0.001*	<0.001*	
QOL Post			
Fair	2 (8%)	2 (8%)	0.803
Poor	5 (20%)	3 (12%)	
Good	18 (72%)	20 (80%)	
p0	<0.001*	<0.001*	
GLP-1 after 6 weeks	19.78±2.7	10.08±0.9	<0.001*
HTN			
Cured	7 (28%)	5 (20%)	1.000
Improve	4 (16%)	0 (0%)	0.110
DM			
Cured	4 (16%)	3 (12%)	0.247
Improve	5 (20%)	6 (24%)	0.157
Improve Venous stasis	2 (8%)	1 (4%)	0.492
Improve of Osteoarthritis	1 (4%)	4 (16%)	1.000
Cured Menstrual problems	2 (8%)	2 (8%)	0.492
Cured urinary Incontinence	0	2 (8%)	0.492

BMI: body mass index; DM: diabetes mellites; EBMIL: excess body mass index loss; EWL: excess weight loss; GLP-1: Glucagon like peptide-1; HTN: hypertension; QOL: quality of life; p_0: *P* value for comparing between pre and post in each group; *: Statistically significant at *P* less than or equal to 0.05.

Figure 2



Comparison of excess weight loss and excess body mass index at different postoperative time periods between both study groups.

Two cases of RYGB were converted to open surgery, in the first case the conversion due to difficulty in bringing the jejunal loop to perform gastrojejunostomy due to sever pelvic adhesions post hysterectomy. The second case there was a leakage on intraoperative methylene blue test, the case converted to open procedure because of anatomical difficult to repair site of leakage laparoscopically which present posterior aspect of gastric pouch, repair by coated Vicryl 2/0 suture.

In MGB group there was one case of conversion due to transfixing injury of the jejunal loop. During handling, and difficulty to repaired laparoscopically and necessitated to exploration.

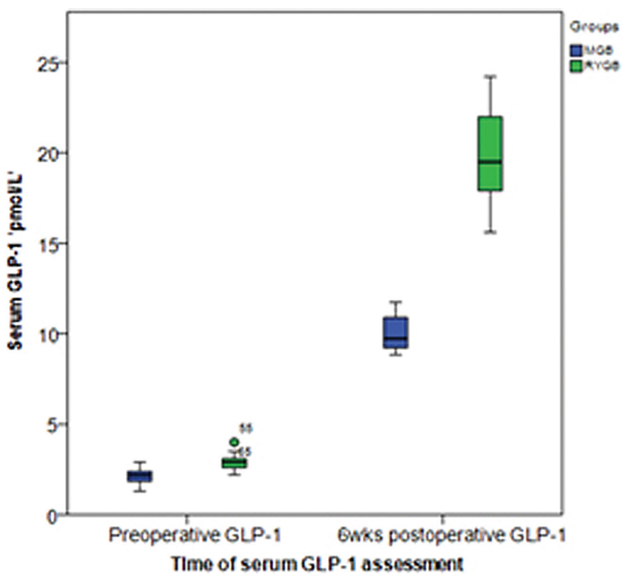
After the RYGB and MGB all comorbidities were improved. Remission levels of these comorbidities were identical with no statistically relevant difference between the two groups at 6 months after surgery (Table 4).

In particular, T2DM, we reported a high rate of resolution in both groups. Five cases were able to stop insulin treatment in the RYGBP group, and reduction of antidiabetic medication occurred in 4 cases versus 3 cases stopped insulin and 6 cases reduced their medication in MGB, respectively. (Remission defined as Hba1c of <6.5% without medication).

The Quality of life of studied patients and their satisfaction toward both operations were assessed using Moorehead-Ardelt Quality of Life Questionnaire II (M-A QoLQII) by the end of follow-up. Six elements were used to assess the patient's subjective perception of QoL in the areas of: overall self-esteem, physical health, social interaction, work satisfaction, sexual satisfaction and eating behavior. There was significant improvement of quality of life in both groups. The overall results ranged from fair to very good in both group with no significant difference in between (*P* value>0.05).

6 weeks postoperative Postprandial GLP-1 show significant increase in postprandial GLP-1 (with *P*<0.001). Preoperative postprandial GLP-1 was comparable in both groups with not statistically different. Postoperative both groups showed significant increase in postprandial GLP-1(with *P*<0.001) in both groups; but the increase in postprandial GLP-1 was significantly higher in group A (L RYGB) than group B (RYGBG) (Fig. 3).

Figure 3



Boxplot graph comparison of serum Glucagon like peptide-1 pre- and postoperatively for both study groups. MGB: mini-gastric bypass; RYGB: Roux-en-Y gastric bypass; GLP-1: Glucagon like peptide-1.

Discussion

MGB is fairly a new bariatric operation that has shown initial good results regarding weight loss, feasibility, and safety. However, the long-term results remains controversial [5]. Therefore, the Roux-en-Y gastric bypass has been completed over 30 years is still the gold standard bariatric procedure [11].

Our study compared the short-term efficiency and feasibility of the LMGB versus the LRYGBP. The key finding of our research was that a substantially greater weight loss was achieved by the MGB procedure at 1 year than the RYGBP procedure (EWL % 39.9 vs. 51.6%, *P*=0.001). This result is consistent with reports from Lee *et al.* [17] that found a greater percentage of EWL with the MGB than with the RYGBP (72.9 vs. 60.1%) at 5 years. In a multiple regression model, the weight loss superiority of MGB over RYGBP was independent of age, sex, initial weight and a history of previous bariatric surgery [17]. All of our patients in both groups were matched for the baseline characteristics in trying to avoid basis of patient's selection. It is still unclear why percentage of EBL is better with the MGB compared with the RYGBP, but it may be due to the greater malabsorptive effect of the long jejunal omega loop of 200 cm.

In our result LMGB was a safe and feasible procedure (significant shorter operative time), significant shorter hospital stay but both groups showed comparable early and late postoperative complication with no significant difference in between both groups.

Wei Lee *et al* [18]. study in 2015 was a large retrospective analysis of 519 patients who have undergone laparoscopic sleeve gastrectomy (LSG) as a primary bariatric operation and selected two matching groups from a prospectively collected data: 519 of these patients have undergone laparoscopic Roux-en-Y gastric bypasses (RYGBs) and 519 have undergone single anastomosis (mini) gastric bypasses (MGBs) [18]. The RYGB group's operating time was significantly longer than those of the other two groups. MGB and LSG have had a similar time of operation. The LSG had quicker flatus passage and shorter hospital stay than did the other two groups. The complication rate was the lowest in the LSG group (1.6%) followed by the MGB (1.9%) and RYGB (2.3%) groups. This operative outcomes matched with our results but the complication rate in our study was comparable with no significant difference that might be due to the small sample size.

In our study, we had one patient with bile reflux esophagitis in MGB group. The postoperative esophagitis and gastritis caused by bile reflux was a disadvantage of LMGB. The conventional gastric bypass of the Mason loop recorded 70% of irritating bilious vomiting and gastritis [19]. This can really happen with a small high gastric pouch in the old loop GBP, and the loop adjacent to the esophagus would result in an alkaline reflux esophagitis. Therefore, the gastric bypass of the Mason's loop was displaced by gastric bypass of Roux-en-Y fashion. In LMGB or BII gastrectomy, however, alkaline reflux esophagitis may not be a problem because the anastomosis is placed low in the stomach and far away from the esophagus.

AS regard improvement of obesity related comorbidities our results showed an obvious amelioration of obesity related comorbidities which almost parallel to other published studies. Our results showed that both operations had therapeutic effects on pre-existing obesity related comorbidities. Both operations showed significant resolution of preoperative comorbidities.

Lee WJ. *et al* [20]. performed a randomized controlled study in Taiwan . They compared thirty cases of gastric bypass and another thirty cases underwent LSG for T2DM control. RYGB showed a more metabolic control than sleeve gastrectomy with remission rate of 93% versus 47%, respectively. While Vidal J *et al* [21]. study reported that RYGB and LSG had comparable rates of resolution of the metabolic syndrome (62% for LSG; 67% for RYGB).

Lee *et al* [17]. research involved 1,657 cases undergoing gastric bypass surgery (1,163 for LMGB and 494 for LRYGB). At the end of follow-up period of 5 year revealed an improvement in obesity-related comorbidities without significant difference in between and both operation achieved resolution of metabolic syndrome more than 80% in both groups [17].

E. Disse *et al* [22]. study included: 20 MGB patients and 61 RYGBP matched patients. All comorbidities were improved in both groups. Also, both group had a same Remission rates of obesity comorbidities, at 6 months after postoperative. Regarding T2DM, In the RYGBP group, six patients were able to stop insulin medication (75%), and 15 had their oral antidiabetic drugs reduced (65%) versus 1 (100%) and 3 (37.5%) in the MGB group, respectively [22].

Jean Marc Chevallier *et al* [23]. study included 1000 obese patients who underwent LMGB. Results regarding the resolution of comorbidities concluded that the level of remission of T2DM was 85.7%, after 26 months. The resolution rate for dyslipidemia was 80.6% at 2 years, 52.1% for hypertension, 50% for sleep apnea, and 36.5% had less joint problem.

The processes of postsurgery T2DM resolution is not fully known. Definitely, the weight loss induced by surgery and the subsequent reduction in fat mass and lipotoxicity are crucial for the long-term benefits of metabolic function. Data demonstrate that the positive impact of bariatric surgery on T2DM is due to hormonal mechanisms other than weight loss alone [24].

The four possible mechanisms underlying DM remission post Gastric Bypass surgery are including decreased intake and weight loss hypothesis, the ghrelin hormone hypothesis, the hindgut hypothesis, and the foregut hypothesis. None of these hypotheses actually exclude the other, so any mixture may be functional to some extent; thus, it is difficult to plan a study to explain the exact mechanism [25].

Our data showed postoperative GLP-1 show significant increase (with $P<0.001$) in both groups; but increased in postprandial GLP-1 significantly higher in group A (L RYGB) than group B (MGB).

Peterli *et al* [26]. compared the effects of LRYGB with those of LSG on fasting, and meal-stimulated insulin, glucose, and glucagon-like peptide-1 (GLP-1) levels. Both groups demonstrated significant increase of postprandial GLP-1 levels.

In their systematic review and meta-analysis Jirapinyo and colleagues concluded that RYGB is associated with a significant increase in the level of after meal GLP-1. This transition appears to be in combination with a decrease in fasting insulin and fasting glucose levels [27]. Postprandial GLP-1 levels has served several important applications. It may be beneficial in assessment of the response to treatment, help in modification or adding the therapy, and may help in the creation of new procedures.

limited number of research study the effect of MGB on postoperative GLP-1. Kim *et al* [13]. conducted study on 12 T2DM Korean patients, with BMI ranged from 23.1 to 30 kg/m^2 (ranges from overweight-mild obesity according to the Asian criteria of obesity). All patients reported significantly increased GLP-1 levels and decreased GIP levels postoperatively, regardless of the duration of DM.

The actual mechanism by which GLP-1 levels increase following gastric bypass surgery still unclear. In the hindgut theory, where nutrients faster reach the distal gut, which may lead to more activation of L-cells and hence a higher GLP-1 level secretion. Conversely, in foregut theory the exclusion of duodenum and proximal jejunum after RYGB may prevent the secretion of an inhibitory agent (anti-incretin factor). Therefore, less inhibition of proximal gut leading to increase incretin secretion. recently, RYGB has been found to alter both the levels and composition of bile acids, which can play a crucial role in the metabolism of glucose. More free bile acids delivered to the distal gut, leading to more bile acids free for reabsorption, which leads to increased serum bile acids. Increased free ileal bile acids activate TGR-5 and FXR leading to increased GLP-1 production and improve glucose homeostasis [5,27,28].

In this study, there was no significant difference between LRYGB and LMGB regarding postoperative quality of life assessment after 1 year. That is consistent with other studies [17].

Both RYGB and LMGB can significantly boost overall quality of life ranking. However, the improvement was only in mental, physical, and social spheres. After surgery, the disease-specific and core symptom domains decreased because most patients developed certain gastrointestinal symptoms mainly related to vomiting, slow eating and abdominal discomforts. LRYGB patients experienced greater level of abdominal pain in common symptom analyzes than LMGB. This is presumably due to the complexity of the bypasses. In the other hand, LMGB patients experienced a greater level of passage of oil stool and diarrhea that could be related to decrease absorption power of the intestine [17,18].

The limitations of our study include the small sample size, the follow-up period was short 1 year, and therefore late complications could be overlooked in both categories.

Conclusion

MGB has a greater weight loss than LRTGB within 1 year follow up and similar metabolic control compared with RYGBP. Also, MGB has a significant shorter operative time and hospital stay also no patient reported with malnutrition during follow up period. Both operations have comparable results regarding operative, postoperative complication and improvement of postoperative quality of life. Both operations significantly increase postoperative GLP-1.

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Conflict of interest

There are no conflicts of interest.

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