

Effect of Laparoscopic Mini Gastric Bypass on Weight and Type 2 Diabetes Mellitus in Morbid Obese Patients

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Abstract: Background: The high rate of morbid obesity worldwide is leading to development of many bariatric surgical procedures. The ideal bariatric surgery should be associated with less complications, sustained reduction in body weight and a short learning curve for surgeons. The laparoscopic mini gastric bypass (LMGB) is considered as a bariatric surgical procedure, which can satisfy the above conditions. The aim of this study was to evaluate the effects of LMGB on weight and type 2DM in morbid obese patients. **Patients and methods:** This was a prospective study which was done From August 2013 to January 2016. Fifty patients (28 females and 22 males) were included in this study at two bariatric centers. All patients underwent LMGB. Follow up was done at 1, 3, 6, 9 and 12 months postoperative. **Results:** Our present study demonstrated that LMGB after one year follow up had great effects on weight reduction, BMI and improvement or remission of blood glucose levels, significantly. **Conclusion:** LMGB is a safe, feasible and effective surgical bariatric procedure with acceptable effects on weight loss and glycemic control and remission. With a low rate of early postoperative complications. Still further clinical trials are needed for assessment of the late complications and the long-term effect on weight reduction and glycemic remission

Key words: Morbid obesity- mini-gastric bypass- Diabetes Mellitus

1. Introduction

Obesity is usually associated with multiple comorbidities such as hypertension, hyperglycemia and hyperlipidemia whereas weight reduction is associated with reduction of these metabolic and cardiovascular risks¹. Weight control could decrease the risk or delay the onset of appearance of type 2 diabetes mellitus (T2DM) in prediabetic obese people and the strict calorie restriction markedly limit the progression of Type 2DM in established patients².

The high rate of morbid obesity worldwide is leading to development of many bariatric surgical procedures, which have more and sustained effect on the long-term weight loss than that of nonsurgical treatment³. Bariatric surgery was proven to induce significant and long-term remission of T2DM and improvement or reduction of the metabolic and cardiovascular risk factors in morbid obese patients⁴.

Bariatric surgical procedures for obesity are considered as an attractive alternative, mainly due to satisfactory results in weight reduction, high effects on the resolution of comorbidities and the durability of achieved results⁵. In T2DM patients who are controlled with difficulty by medical treatment and modifying the life style, can be offered bariatric surgery which is an accepted and effective therapeutic option⁶. Bariatric surgery results in reduction in caloric intake and lowering the fat mass and body weight, leading to improvement of the insulin resistance,

glucose metabolism, makes changes in the release of adipocytokines and improving the quality of life⁷.

The ideal bariatric surgery should be associated with less complications, sustained reduction in body weight and a short learning curve for surgeons. Sleeve gastrectomy (SG), Roux-en-Y gastric bypass (RYGB) and adjustable gastric banding (AGB) are considered the most commonly used Bariatric surgical procedures⁸. One-anastomosis gastric bypass (OAGS) or the laparoscopic mini gastric bypass (LMGB) is considered as a bariatric surgical procedure, which can satisfy the above conditions. In 1997, the world's first Mini Gastric Bypass (MGB) was done by Rutledge who published the results in 2001⁹.

The use of single anastomosis, shorter operative time, fewer internal defects with the low incidence of internal herniation, the shorter learning curve of the procedures and the easier revision or reversal of the procedure; considered the mini gastric bypass (MGB) to be advantageous compared to Roux-en-Y Gastric Bypass (RYGB)¹⁰. On the Contrary, biliary alkaline reflux, Barrett's esophagus, marginal ulcers, stenosis of the anastomosis, leakage of the anastomosis and requiring revisional surgery made mini gastric bypass less popular¹¹.

The aim of this study was to assess the efficacy, advantages, and complications of LMGB on weight loss and on glycemic control, trying to find some evidences to support the use of LMGB in treating obesity and T2DM.

2. Methods

This is a prospective study which was done From August 2013 to January 2016.50 patients (28 females and 22 males) were included in this study at bariatric center, Elite Hospital, Riyadh, KSA and Military hospital, Taif, KSA and received approval from the local ethics committee.

Inclusion criteria was morbid obesity with BMI higher than 40 kg/m^2 or BMI over 35 kg/m^2 with at least one co-morbidity and patients with type 2 diabetes and BMI of $30\text{-}35 \text{ kg/m}^2$.

Exclusion criteria included pregnancy, lactation, and moderate to severe gastroesophageal reflux disease, severe cardiopulmonary diseases and presence of liver cirrhosis or portal hypertension.

All patients involved in this study underwent a multidisciplinary evaluation by cardiologist, endocrinologist, psychologist and nutritionist. Preoperative investigations were done (blood tests including complete blood picture, liver function tests, coagulation profile, renal function tests and ECG) and all patients had preoperative assessment by anesthesiologist. After full explanation about the surgical procedure and the possible complications, all patients signed the informed consent.

Technique;

We started the procedure by inducing a pneumoperitoneum through the left subcostal space by means of Veress needle through the camera port by means of a visiport. The first trocar (10 mm) for the camera is introduced midway between the xiphoid and umbilicus at midline. Another 2 (12 mm) trocars were positioned at the same level of the camera (first) port, one of them 5 cm to the right side of the first and the other 5 cm to the left side of the first one, at the same

level. The fourth trocar (5 mm) is inserted into the right side at the lower edge of the liver for introducing the liver retractor. The fifth and last trocar (5 mm) is positioned in a left sub-costal position, 10 cm away from the second trocar for retraction.

By using Covidien TriStapler® (Covidien plc, Dublin, Ireland) creation of long gastric pouch was done using 60-mm Purple and Tan cartridges over calibration tube 36 French (Figures 1, 2).

We started the dissection at incisura while the first firing was carried out with a stapler directed to left iliac fossa (figure3). Division of the Omentum was not routinely done.

A loop of small intestine 200 cm from DJ flexure was then brought up to the created gastric pouch in an ante colic, ante gastric fashion and Gastro-jejunostomy was performed side-to-side using Covidien Tristapler® 45 mm Purple cartridge (figures 5-8).

Then closure of the Stapler entry site was done in two layers using Vicryl 3-0 suture (figures 8 & 10). Fixation of the afferent loop to the gastric pouch via interrupted sutures to be few centimeters above the anastomosis reducing the severity of bile reflux postoperatively¹². A dilute methylene blue solution was used to perform leak test. No drains were used in most of the cases.

Intravenous fluids were given in the first postoperative day with danstrone ampoule every 12 hours and Proton pump inhibitors every 12 hours, while oral Fluid diet was commenced on the second day and patients were discharged. The first follow-up visit was done at day7 postoperatively where the sutures removed and next follow-ups were done at 1, 3, 6, 9 and 12 months.

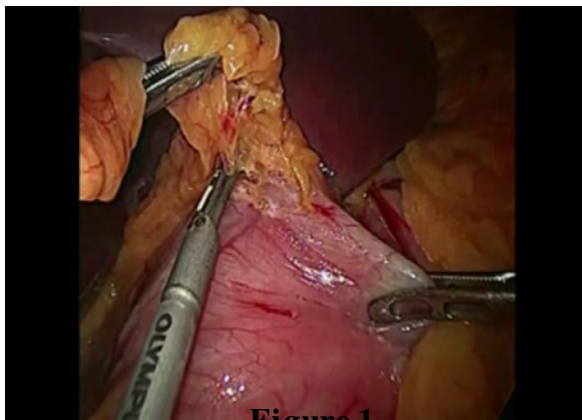


Figure 1

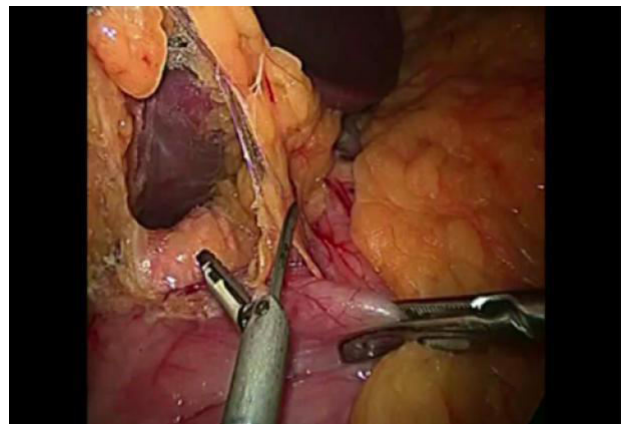


Figure 2

Figures (1) & (2): showing dissection at the lesser omentum at the beginning of the operation

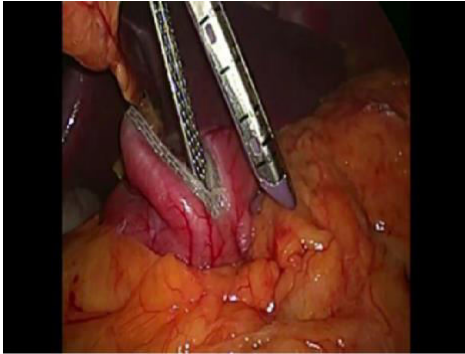


Figure 3

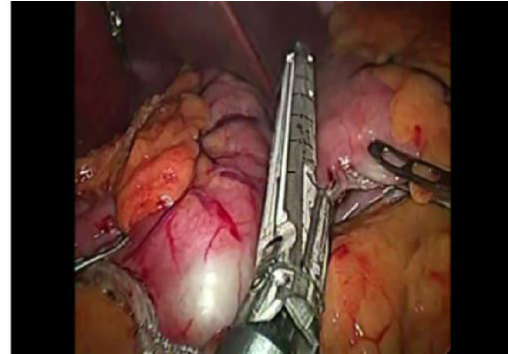


Figure 4

Figures (3) & (4): showing creation of the gastric pouch

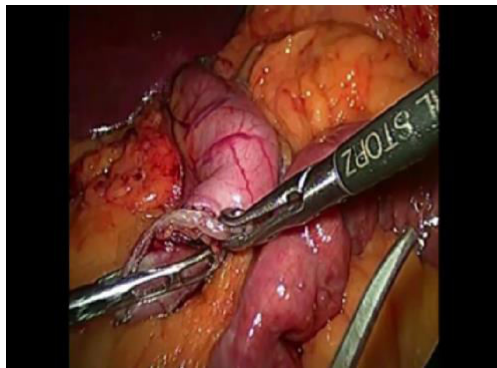


Figure 5

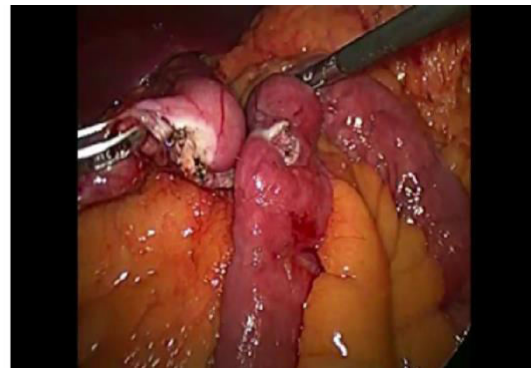


Figure 6



Figure 7

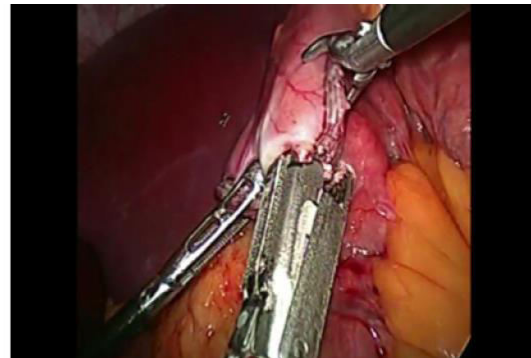


Figure 7

Figures (5-8): showing Gastro-jejunostomy side-to-side using Covidien Tristapler® 45 mm purple cartridge.

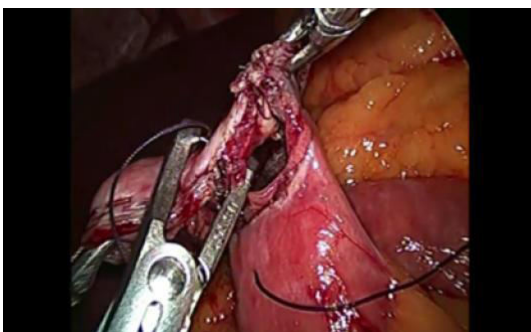


Figure 9

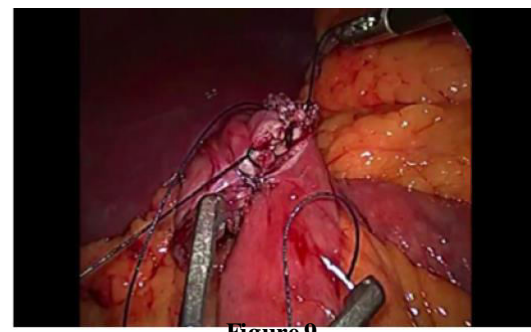


Figure 9

Figures (9 & 10): closure of the Stapler entry site

3. Results

From August 2013 to January, 2016, laparoscopic mini gastric bypass was performed in 50 patients (28 females and 22 males), 18 (36%) patients of the 50 patients were diabetic T2DM. The mean age was 37.5 ± 3.8 (range 20–65) years and the Mean BMI was 41.63 ± 4.2 kg/m^2 , the mean operative time was 79 ± 8.13 (range 57–150) minutes and the mean post-operative hospital stay was 1.6 ± 5.2 days (Table 1).

Table (1): Preoperative data (sex, age and BMI), operative time and hospital stay

Age	37.5 ± 3.8 years
Gender M/F	28/22
BMI	41.63 ± 4.2 kg/m^2
Diabetic /non diabetic	18/32
operative time (minutes)	79 ± 8.13
hospital stay (days)	1.6 ± 5.2

Two patients (4%) developed intraoperative bleeding and required blood transfusion. One patient (2%) had wound infection at the port site, he was treated by antibiotics and dressing for 5 days. Haematoma at port site occurred in one patient (2%) which was treated conservatively. All cases were done laparoscopically without conversion to open. There was no anastomotic leakage. Three (6%) patients had iron deficiency anemia within the 12 months follow up. There was no bile reflux or marginal ulcers. Perioperative mortality in this study was zero (0%) with no reported cases of weight regain (Table 2).

Regarding the weight loss outcomes (percent of excess weight loss % EWL & percent of total weight loss % TWL), at one month postoperatively, % of EWL was 23.5% and %TWL was 11.4%, While it was 46.5% & 18.7% respectively at three months. After 6 months, it was 58.3% & 26.5% respectively and after one year it was 75.8% & 35.6% respectively (Table 3) & (figure 1).

There were 18 (36%) patients with type 2 diabetes mellitus (T2DM) in this study, where fasting blood glucose and glycosylated hemoglobin level was

shown before and one month, three months, six months, and 12 months after surgery; all cases showed either improvement or resolution of their diabetes.

Eight patients (44.4%) of the eighteen diabetic patients were on Insulin treatment preoperatively and 10 (55.6%) patients were on oral hypoglycemic medication. Six months postoperatively 5 patients of those who were on insulin, were able to stop their Insulin and the other 3 patients showed reduction in their insulin dose. While the 10 patients who were on oral hypoglycemic medication, 6 of them stopped the medication and the other 4 patients showed decrease in the dose of the used oral hypoglycemic medication.

After one year, 11 (61%) patients of the diabetic patients had remission, when their glycosylated hemoglobin level was less than 6.0% without any medication.

Table (2) showing the numbers and percentage of post-operative complication

Variable	value
Iron deficiency anemia	3 (6%)
Bile reflux	0 (0%)
Wound infection	1 (2%)
Port site hematoma	2 (4%)
Marginal ulcer	0 (0%)
Conversion to open	0 (0%)
Anastomosis leak	
Intra operative bleeding needs blood transfusion	2 (4%)
Perioperative mortality	0 (0%)
Weight regain	0 (0%)

Table (4) The percentage (%) of total weight loss (TWL) and excess weight loss (EWL) during the follow up visits at 1,3,6 and 12 months after Mini Gastric Bypass

	1 Month	3 months	6 months	12 months
EWL (%)	23.5%	46.5%	58.3%	75.8%
TWL (%)	11.4%	18.7%	26.5%	35.6%

Table (4) showing the value of BMI, Weight and fasting blood glucose before and after LMGP with significant statistical differences *.

	Number of patients	Before LMGP	6 months After LMGP	P Value
Weight) kg(	50	113.5 ± 28.2	85.6 ± 17.2	< 0.001*
BMI) kg/m^2(	50	41.63 ± 4.2 kg/m^2	30.57 ± 4.13	< 0.001*
Fasting blood sugar mg/dL(	18	167.4 ± 63.8	90.24 ± 23.6	0.031



Figure 1 showing the % EWL & TWL at 1, 3, 6, 12 months.

4. Discussion

Morbid obesity is an epidemic disease and usually associated with multiple comorbidities. Bariatric surgery procedures have more and sustained effect on the long-term weight loss than that of nonsurgical treatment. The efficacy of any new bariatric procedure is primarily determined from the weight loss and comorbidity resolution achieved with it¹³.

LMGB is considered as a safer, faster, and effective procedure with a shorter learning curve for surgeons when compared to the LRYGB with a lower rate of complication in the short and long term follow up. LMGB is an acceptable alternative for RYGB with an easier surgical technique and acceptable outcome on weight reduction and glycemic control¹⁴.

This study involved 50 patients (28 females & 22 males), 18 (36%) of them were diabetic, with main BMI $41.63 \pm 4.2 \text{ kg/m}^2$ and mean age 37.5 ± 3.8 years. The mean operative time was 79 ± 8.13 minutes and the mean hospital stay was 1.6 ± 0.52 days. In a study done by **Carbajo et al.**¹⁵ the mean operative time was 93 minutes (70-155) and the mean hospital stay was 1.5 days. While **Peraglio**¹⁶ reported 78 minutes (41-147) as a mean operative time, and 1.2 days as a mean hospital stay which is similar to our results. Operative time was 120 minutes (90-120) and hospital stay was 5 days in a study done by **Piazza et al.**¹⁷ which is longer than our results. **Kular et al.**¹⁴ study showed 52 ± 18.5 minutes for operative time which was shorter than our operative time, and the hospital stay was 2 days. **Noun et al.**¹⁸ reported 94 ± 4.65 minutes as operative time and 1.85 ± 0.8 days as hospital stay. **Kim and Hur**,¹² reported his results as, operative time was 150.5

minutes (100-150) and hospital stay 5.3 days, these results were longer than our results.

In our study, two patients (4%) developed intraoperative bleeding that required blood transfusion, one patient (2%) had wound infection at the port site was treated by systemic antibiotic and daily dressing for 5 days, hematoma at port site occurred in one patient (2%) which was treated conservatively without intervention, there was no reported cases of leak from the anastomosis or from the gastric pouch. Within the first year follow up postoperatively, three cases (6%) had iron deficiency anemia diagnosed by CBC and serum ferritin level, who were treated by parenteral iron supplementation.

There was no cases of bile reflux or marginal ulcer, our perioperative mortality in this study was zero (0%), with no reported cases of weight regain, all cases in this study were done laparoscopically without the need for conversion to open.

Carbajo et al.,¹⁵ reported 2 cases (0.9%) of intraoperative bleeding, 17 cases (8.1%) iron deficiency anemia, 2 cases (0.9%) needed Conversion to open surgery, Leakage was happened in 4 (1.9%) cases, with no reported cases of reflux or wound infection, with 0.9% Perioperative mortality.

In a study done by **Musella et al.**¹⁹ there was bleeding in 25 cases (2.5%), leakage in 10 cases (1%), reflux in 8 cases (0.9%), Conversion to open surgery in 12 cases (1.23%), reoperation in 20 cases (2%), iron deficiency anemia in 44 cases (5.3%) and Perioperative mortality was 0.2%.

Kim and Hur,¹² reported 2 cases (1.2%) of bleeding, 1 (0.6%) case of leakage, 22 (12.8%) cases of dyspepsia and ulcer, 12 (7%) cases of iron deficiency anemia, 1 (0.6%) case needed Conversion to open

surgery, no reported cases of reflux, with 0(0%) Perioperative mortality.

Noun et al.¹⁸ showed bleeding in 15 cases (1.61%), dyspepsia and ulcer in 6 cases (0.65%), leakage in 4 cases (0.42%), no reported cases of reflux or iron deficiency anemia, no cases needed Conversion to open surgery, with 0% Perioperative mortality.

Rutledge and Walsh²⁰ reported their results as, 0.12% for wound infection, 1.08% for leakage, 4.9% for iron deficiency anemia, 0.17% conversion rate to open surgery, 0.08% Perioperative mortality, with no reported cases of reflux and dyspepsia.

The present study reported the weight loss outcomes after LMGB as %EWL & %TWL, at 1, 3, 6 and 12 months follow up. For %EWL it was 23.5%, 46.5%, 58.3% and 75.8% respectively. For %TWL, it was 11.4%, 18.7%, 26.5% and 35.6% respectively.

In a study done by **Abdolreza and Sima**,²¹ % EWL after 1, 3, 6 and 12 months were 29.13%, 54.4%, 76.5 and 93.6% respectively. This results were higher than our results. While **C. D. Parmar et al.**,²² reported %EWL at 6, 12, 18 and 24 months as 60.1%, 79.5%, 82.6 and 94.8% respectively, and %TWL at 6, 12, 18 and 24 months as 27.5%, 36.8%, 38.3% and 40.8% respectively. Which is similar to our results for %EWL and %TWL at 6 and 12 months. **Robert Rutledge**,⁹ reported excess weight losses (%EWL) of 68% at 12 months and averaging 77% at 24 months. **Kularet al.**,¹⁴ reported %EWL of 84%, 91%, 88%, 86%, 87%, and 85% at years 1–6, respectively.

In this study, there were 18 (36%) patients with T2DM, after 12 months follow up the remission rate was 11 (61%) patients. **Wang et al.**²³ reported 100% remission rate after 2-year for 79 T2DM patients who ceased medication. **Kim and Hur**,¹² reported that remission of T2DM was achieved in 53% patients after 12 months follow up and increased to 63% and 90% after 24 months and 36 months, respectively. While the remission rate was 84.4% in T2DM after 5 years in a study done by **Musella et al.**¹⁹. **Milone et al.**,²⁴ reported remission rate 87.5%.

In our present study, we demonstrated that LMGB after one year follow up had great effects on weight reduction, BMI and improvement and remission of blood glucose levels, significantly.

Conclusions

LMGB is a safe, feasible and effective surgical bariatric procedure with acceptable effects on weight loss and glycemic control and remission. With a low rate of early postoperative complications. Still further clinical trials are needed for assessment of the late complications and the long-term effect on weight reduction and glycemic remission.

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