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Laparoscopic Mini- Gastric Bypass in Management of Morbid Obesity A Prospective Study

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ABSTRACT

Background: In recent years, a surgical technique known as single-anastomosis gastric bypass (SAGB) or mini-gastric bypass (MGB) has been developed. Its frequency of performance has increased considerably in the current decade. This procedure proposes a simplification of Roux-en-Y bypass by performing a single anastomosis, with a significant reduction of technical complexity, shorter operative time and a potential reduction in morbidity and mortality.

Objective: This study aimed to evaluate if laparoscopic mini gastric bypass operation is safe and effective for treatment of different cases with morbid obesity and its associated comorbidities

Material and methods: This was a prospective study of 100 patients with morbid obesity submitted to laparoscopic MGB from March 2018 to January 2019. This study was conducted in the Bariatric Surgery Unit, at Assuit university hospital and Osama Taha group clinic. Demographic and clinical data were prospectively collected from the preoperative evaluations.

Results: The most important findings of this study were the safety and the high efficacy, which were translated into no mortality, very acceptable complications (early complication rate 4% and late complication rate 6 %). High excess weight loss (EWL) 72.26 ± 5.18 % and remission rate 92% of patients who had diabetes, as 100.0% of patients who had fatty liver, 96.0% of patients who had hyperlipidemia, 95.0% of patients who had sleep apnea and 94.0% of patients who had hypertension.

Conclusion: MGB/ one-anastomosis gastric bypass (OAGB) is a simple, safe, effective, easy to learn and easy to reverse procedure. It has acceptable complications and mortality rates.

Keywords: MGB, EWL, Morbid Obesity.

INTRODUCTION

Obesity, defined as a body mass index (BMI) > 30 kg/m^2, is a chronic illness identified in children, adolescents and adults worldwide. According to the World Health Organization, there are 42 million obese children under the age of 5 [(1, 2)].

Globally, a total of 1.9 billion and 609 million adults were estimated to be overweight and obese in 2015, respectively, representing approximately 39% of the world's population. The use of bariatric surgery has increased dramatically during the past decade it is currently the only modality that provides a significant, sustained weight loss for morbidly obese patients, with resultant improvement in obesity-related comorbidities. A prospective, controlled Swedish study involving 4047 obese patients, half of whom had undergone bariatric procedures, followed up over 14.7 years, found that when compared to usual care, bariatric surgery was associated with a significantly reduced number of cardiovascular deaths and a lower incidence of cardiovascular events in obese adults [(3)].

In recent years, a surgical technique known as single-anastomosis gastric bypass (SAGB) or mini-gastric bypass (MGB) has been developed; its frequency of performance has increased considerably in the current decade. This procedure proposes a simplification of Roux-en-Y bypass by performing a single anastomosis, with a significant reduction of technical complexity, shorter operative time and a potential reduction in morbidity and mortality. Several studies have demonstrated the benefits provided by this procedure, including excess weight loss and resolution of comorbidities equivalent or even higher than those observed after the Roux-en-Y gastric bypass. It is simpler and potentially more cost-effective, since less stapler cartridges are necessary [(4)].

This study was to evaluate if laparoscopic mini gastric bypass operation is safe and effective for treatment of different cases with morbid obesity and its associated comorbidities.

MATERIAL AND METHODS

This was a prospective study of 100 patients with morbid obesity submitted to laparoscopic MGB from March 2018 to January 2019. This comprised the initial part of our series and data were analyzed after all patients completed a follow up of 1 year.

Patient inclusion was according to criteria by the National Institutes of Health Development Panel (body mass index (BMI) > 40 kg/m^2 or BMI > 35 kg/m^2 with severe related comorbidity) [(5)], age after

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puberty to 55 years and patients applicable for 1 year follow up.

Exclusion criteria include chronic obstructive airway, bronchial asthma, obesity due to syndromes or monogenetic disease and GERD. Patients not applicable for 1 year follow up.

Preoperative evaluation included history, physical examination and measurement of blood pressure, weight, height, BMI, and waist circumference. Laboratory investigation included complete blood count, prothrombin concentration, random blood sugar, liver function tests, renal function tests, thyroid function, lipid profile, glycated hemoglobin (HbA1c) and serology for hepatitis or HIV. Preoperative low molecular-weight heparin was used only for high-risk patients to guard against DVT. Radiological modality included: abdominal us and echocardiography for cardiac disease patients.

Operative Technique

A five-port technique was applied as described by Rutledge [(6)]**.** One 10-mm trocar for the camera, two 12-mm trocars as operating ports and two 5-mm trocars for retraction of the liver with paddle retractor and mobilization of the small bowel (SB) and stomach. A long and narrow gastric tube calibrated with a 36-French bougie was created, beginning by one horizontal gastrointestinal anastomosing (GIA), stapler loaded with cartridges (4.8 mm staples) at the level of the crow's foot a three to four vertical 60-mm GIA upward to the angle of His. In the majority of patients, there was no need for reinforcement of the staple lines with continuous sutures. Then, antecolic end-to side gastrojejunostomy using a posterior 30-mm roticulator Endo-GIA stapler and an anterior hand sutures at a distance 150–300 cm distal to the ligament of Treitz based on BMI of the patient was performed. We carried out this technique with the intent to make the gastric pouch longer and narrower. Therefore, stapling had to be vertical, perpendicular to the incision in the pouch, and above the posterior surface of the stomach so that the afferent loop comes from the back and is higher than the efferent loop. Also, we used a hanging suture between the gastric pouch and the afferent loop to be higher than the efferent one. Intraoperative methylene blue test for leak was performed in all patients. No nasogastric tube but intraperitoneal abdominal drain was inserted in the majority of cases.

Every patient that underwent a bariatric operation in this Study had a DVD recorded video from the laparoscopic camera. The time obtained from the camera recording was added to the patient file under the title of duration of surgery. So, the operative time in our study was the knife time that was recorded in the DVD video.

Postoperative Follow up of perioperative complications, assessment of weight loss, minerals and vitamins at 3, 6 and 12 months. Also, cure of comorbidities hypertension, diabetes mellitus, dyslipidemia, fatty liver, obstructive sleep apnea and polycystic ovary after surgery were followed up.

Ethical approval and written informed consent:
An approval of the study was obtained from Aswan University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation.

Statistical analysis

Statistical analysis was calculated using paired t test for continuous data that was carried out by using the SPSS version 15.0 for windows statistical package (SPSS Inc., Chicago, IL, USA). Results were reported in the form of mean ± SD or as percentages when appropriate. Statistical significance was generally set at p values < 0.05.

RESULTS

Table (1): Weight loss evaluation after MGB in 100 morbidly obese patients in follow-up at 1year

Item	Preoperative	After 3months	After 6 months	After 12months
1-Weight "kg"	124.55 ± 23.51	105.32 ± 18.36*** **P<0.000**	90.28 ± 14.08*** **P<0.000**	75.69 ± 10.49*** **P<0.000**
2-EWL "%"	--	30.29 ± 8.85 **P=0.375n.s**	50.70 ± 0.77** **P<0.001**	72.26 ± 5.18*** **P<0.000**
3-BMI"kg/m^2"	46.69 ± 6.99	39.70 ± 5.90* **P<0.03**	34.67 ± 4.92** **P<0.001**	28.16 ± 2.80*** **P<0.000**

*n.s:P>0.05 *:P<0.05 **:P<0.001 ***:P<0.000*

Each p-value was calculated by paired T-test we compare each value with just before follow-up.

In this study the average weight of patients' was 124.55 ± 23.51kg with significant reduction after 1 year follow up to 75.69 ± 10.49 kg (Table 1) and significant reduction in BMI from 46.69 ± 6.99 to 28.16 ± 2.80 after 1 year follow up. Also excess weight loss after 1 year was significant about 72.26 ± 5.18 %.

Table (2): Pre-operative characteristics of 100 morbidly obese patients submitted to laparoscope MGB

Item	Descriptive "n=100"
1- Duration of surgery "mins"	38.0 ± 12.1
2- Hospital stay "days"	1.1 ± 0.9
3- Mortality rate	0.0

Regarding mean operative time and length of hospital stay, in this study the mean value of duration of surgery was 38.0 minutes and hospital stay 1.1 days with no cases of death. (Table 2).

Table (3): Diabetes mellitus evaluation after MGB in 100 morbidly obese patients in follow-up at 1year

Item	Preoperative	After 3months	After 6 months	After 12months
1-RBS	294.40 ± 57.13	218.63 ± 44.26* **P<0.02**	201.94 ± 3.67** **P<0.001**	182.38 ± 4.71*** **P<0.000**
2-HbA1c	8.24 ± 1.91	6.27 ± 1.26* **P<0.02**	5.94 ± 1.04** **P<0.001**	5.61 ± 1.20*** **P<0.000**

*n.s:P>0.05 *:P<0.05 **:P<0.001 ***:P<0.000*
Each p-value was calculated by paired T-test we compare each value with just before follow-up.

In this study all 100 patient have type 2 DM. Patients showed significant decrease in random blood sugar and HA1c in 1 year follow up after surgery the mean RBS preoperative was 294.40 ± 57.13, while after 1 year follow up was 182.38 ± 4.71. Also, there was significant decrease in HA1c from mean 8.24 ± 1.91 to 5.61 ± 1.20 1 year after surgery. Remission was achieved in 92% with 86.0% of patients had complete remission, and 6.0% of patients had partial remission (Table 3)

Table (4): Hypertension & lipid profile evaluation after MGB in studied 100 morbidly obese patients in follow up at 1-year

Item	Preoperative	After 3months	After 6 months	After 12months
Blood pressure:				
• Systolic	136.3 ± 17.4	123.6 ± 14.38*	120.8 ± 18.4**	120.2 ± 9.4***
• Diastolic	83.2 ± 11.8	76.8 ± 9.8*	72.9 ± 10.8**	67.4 ± 7.4***
LDL	112.14 ± 54.14	81.2 ± 30.93** **P<0.001**	81.2 ± 27.07** **P<0.001**	61.87 ± 38.67*** **P<0.000**
HDL	42.54 ± 38.67	38.67 ± 3.86 **P=0.375**	42.54 ± 7.73 **P=0.595**	50.27 ± 7.73 **P=0.286**
Triglyceride	186.10 ± 141.72	141.72 ± 53.14** **P<0.001**	132.86 ± 62*** **P<0.000**	124 ± 53.14*** **P<0.000**
Total Cholesterol	174.02 ± 46.4	162.4 ± 30.93* **P<0.04**	158.55 ± 27.07* **P<0.02**	150.8 ± 27.07** **P<0.001**

*n.s:P>0.05 *:P<0.05 **:P<0.001 ***:P<0.000*

Each p-value was calculated by paired T-test we compare each value with just before follow-up.

In this study, 80 out of 100 patient diagnosed as hypertension with mean duration disease 73.56 ± 7.75 months". Regarding systolic & diastolic blood pressures, there were significance difference (decrease) comparing follow up at 3 months with preoperative.

Also, there were moderate significance difference (decrease) comparing follow up at 6 & 12 months with preoperative. The mean of systolic blood pressure preoperative was 136.3 ± 17.4 and of diastole was 83.2 ± 11.8. While after 1 year follow up the mean of systolic blood pressure was 120.2 ± 9.4 and of diastole was 67.4 ± 7.4. The remission was achieved in 94 % and improvement was achieved in 6% (Table 4).

In this study 80 out of 100 patients diagnosed with dyslipidemia. There was significant difference between preoperative lipid profile and those obtained after 1 year follow up of Tg (186 ± 141.72 Vs 124 ± 53.14), TC (174 ± 46.4 Vs 150.8 ± 27.07) and LDL (112.14 ± 54.14 Vs 61.87 ± 38.67). However no significant difference in HDL (42.54 ± 38.67 vs 50.27 ± 7.73) with 96% remission and 4% improvement (Table 4).

Table (5): Early postoperative Complication of studied 100 patients follow-up

Item	Descriptive "n=100"
1-Pulmonary embolism	0
2-Respiratory distress	2(2.0%)
3-Anastomosis leak	0
4-Abdominal bleeding	1(1.0%)
5-GIT bleeding	1 (1.0%)
6-Jejunal perforation	0
7-DVT	0
Total number	**4 (4.0%)**

Regarding early complications after MGB surgery. It occurred in 4% of patients. Respiratory distress occurred in 2.0% of patient, 2.0% had abdominal and GIT bleeding and neither one had anastomosis leak, DVT, Jejunal perforation nor pulmonary embolism (Table 5).

Table (6): Late postoperative Complication of all studied 100 patients follow-up

Item	Descriptive "n=100"
1-Gastric pouch enlargement	0
2-Trocar site hernia	0
3-Anastomotic ulcer	0
4-EWL>100%	0
5-Iron deficiency anemia	4(4.0%)
6-Weight gain	0
7-Interactable reflux	2 (2.0%)
8-Insufficient weight low	0
Total	**6 (6.0%)**

Regarding late post-operative complication, it occurred in 6% of patients. The intractable reflux in this study was presented by 2% of patients. Iron deficiency anemia was detected in 4% of patients. There were neither cases of anastomotic ulcer, gastric pouch enlargement, trocar site hernia, EWL>100%, weight gain nor insufficient weight loss (Table 6).

Table (7): Percentage of patients with nutritional deficits at 1 year follow up

Item	3mons.	6mons.	12mons.
Vitamin/nutrient			
• **D**	19	23	18
• **B9(Folic Acid)**	33	18	19
• **B12**	5	4	8
• **Iron**	12	11	4
• **Calcium**	5	8	6
• **Albumin**	1	1	1

At 1 year follow up, the incidence of vitamin D deficiency was 18% and vitamin B9 deficiency was 19%. Also, vitamin B12 deficiency was 8%, iron deficiency was 4% and calcium deficiency was 6%, while albumin deficiency presented in 1% (Table 7).

Table (8): Outcomes of MGB on comorbid conditions in 100 morbidly obese patients at one year follow up

Item	No.	Percentage %	Remission %	Improvement %
1- Type II diabetes mellitus	100	100	92	8
2- Hypertension	80	80	94	6
3- Hyperlipidemia	80	80	96	4
4- Sleep apnea	75	75	95	5
5- Fatty liver	100	100	100	--
6- Polycystic ovarian disease	3	3	--	100

Regarding other obesity related comorbidities, 75% of patients suffered from OSA, at 1 year follow up remission rate was 95% and 5% improvement. There was 100.0% of patients that had fatty liver and showed remission of the disease and three female patients were diagnosed as having PCO and showed improvement of disease (Table 8).

DISCUSSION

A single or one-anastomosis gastric bypass (OAGB) or mini-gastric bypass (MGB) is recently developed surgical technique. In addition to certain advantages like its simplification of the technical complexity, shorter operative times and lower risk of leaks from one less anastomotic site. Furthermore, OAGB is easy to revise and reverse and produces good results as a revision operation after failed primary restrictive bariatric surgery. This technique leads to a considerable reduction in excess weight loss, as well as improved morbidity and mortality rates. According to studies into OAGB-MGB, the mean EWL was more than 70% over 5 years. Despite all advantages, any bariatric surgery has its own complications. In addition, the outcomes may be affected by a number of patient-related characteristics [6].

The most important findings of this study are the safety and the high efficacy, which were translated into no mortality, very acceptable complications (early complication rate 4% and late complication rate 6 %) and high EWL 72.26 ±5.18 %. Remission rates were 92% of patients who had diabetes, 100.0% of patients who had fatty liver, 96.0% of patients who had hyperlipidemia, 95.0% of patients who had sleep apnea and 94.0% of patients who had hypertension.

In this study, the average weight of patient were 124.55 ± 23.51 kg with significant reduction after 1 year follow up to 75.69 ± 10.49 kg and significant reduction in BMI from 46.69 ± 6.99 to 28.16 ± 2.80 after 1 year follow up. Also excess weight loss after 1 year was significant about 72.26 ± 5.18 %

These are in agreement with **Hastimansooreh *et al.*** [7] study in which the average weight of patient was 126.04 ± 23.02 with significant reduction after 1 year follow up to 79.62 ± 15.52 kg and significant reduction in BMI from 46.62 ± 6.43 to 29.49 ± 4.7 after 1 year follow up. Also, excess weight loss after 1 year was significant about 81.63 ± 18.61. Also, different lines of evidence reported a significant post-OAGB-MGB excess weight loss after 1 year or more 80–93%**.** Moreover, **Carbajo *et al.*** [5] study showed that one year after surgery, BMI after SG??? was 28.9 ± 2.1 Kg/m^2, after Roux-en-Y gastric bypass (RYGB) 28.7 ± 2 Kg/m^2 and after OAGB 25 ± 1.6Kg/m^2 ($p < 0.001$), with excess body mass index loss (EBMIL) of 81.7 ± 6.3, 81.2 ± 5.9 and 100.4 ± 6.7%, respectively ($p < 0.001$). Pairwise analysis revealed that BMI after OAGB was significantly lower than after RYGB and SG ($p < 0.001$, respectively), while there were no significant differences between RYGB and SG ($p = 0.864$). Similarly, EBMIL after OAGB was significantly lower than after RYGB and SG ($p < 0.001$, respectively)**.**

Regarding mean operative time and length of hospital stay in this study, the mean value of duration of surgery was 38.0 minutes and hospital stay 1.1 days with no cases of death. The mean operative time in our study is significantly lower than that of other OLGB series in **Dimitrios *et al.*** [8]**.** Meta-analysis study in which the mean value of mean operative time ranged from 35 to 147.7 min and hospital stay ranged from 1.02 to 5.5 days with no cases of death. In the meta-analysis, the mean value of mean operative time in **Musella *et al.*** [9] study was 95 min, in **Rutledge and Walsh** [10] study it was 37.5 min and in **Noun *et al.*** [11] study it was 89 min which disagrees with our study.

In this study, all 100 patient had type 2 DM. Patients showed significant decrease in random blood sugar (RBS) and HA1c in 1 year follow up after surgery. The mean RBS preoperative was 294.40 ± 57.13 while after 1 year follow up, it was 182.38 ± 4.71 with significant decrease in HA1c from mean 8.24 ± 1.91 to 5.61 ± 1.20 1 year after surgery. Remission was achieved in 92% with 86.0% of patients had complete remission and 6.0% of patients had partial remission. This is in agreement with **Carbajo *et al.*** [5] who found remission of comorbidities as follows; OAGB showed significantly greater long-term resolution of T2DM, HT and DL, than RYGB and SG. On the other hand, RYGB and SG did not show significant differences in T2DM and HT remission, though the rates tend to be slightly better after RYGB. This confirms the actual evidence of non-superiority of RYGB over SG in T2DM and HT remission, but a clear superiority of OAGB over the other 2 techniques.

In this study, DM complete remission rates for those with disease duration< 2years, 2-5 years and > 5 years were 93.02%, 66.67% and 25% respectively. Partial remission rates for those with disease duration < 2years, 2-5 years and > 5 years were 4.65%, 16.67% and 12.5% respectively, while DM improvement rates for those with disease duration < 2years, 2-5 years and > 5 years were 2.32% 16.67% and 62.5% respectively. This is in agreement with **Lee *et al.*** [12] study in which T2DM remission rates for those with disease duration < 2 years, 2-5 years and > 5 years were (98.5%), (39.3%) and (37.3%), respectively.

Remission of diabetes achievement at 1-year follow-up in the current series was significantly higher in patients who were receiving oral hypoglycemic drugs before surgery than in those who were receiving an injection treatment ($p < 0.01$). Remission was 93.75% (30/32) in patients who were receiving a single oral hypoglycemic drug preoperatively. In patients treated with a bi-therapy, the remission rate was 96.77% (30/31) and 83.3% (5/6) in patients who were on three oral

hypoglycemic drugs. Diabetic patients who were discovered accidentally during the preoperative assessments showed 100% (10/10) complete diabetic remission. Patients who received preoperative insulin injection to control DM showed 52.83% (11/21) remission rate. This is in agreement with **Taha *et al.*** [13] study in which remission was 92.2% (142/154) in patients who were receiving a single oral hypoglycaemic drug preoperatively and 95.2% in patients treated with a bi-therapy (139/146) and 72.4% (21/29) in patients who were on three oral hypoglycemic drugs. Diabetic patients who were discovered accidentally during the preoperative assessments showed 100% (43/43) complete diabetic remission. Patients who received preoperative insulin injection to control DM showed 52% (52/100) remission rate .remission was significantly higher in patients who were receiving oral hypoglycaemic drugs before surgery than in those who were receiving an injection treatment**.**

In this study, 80 out of 100 patients diagnosed as having hypertension with mean duration disease 73.56 ± 7.75 months. Regarding systolic & diastolic blood pressures there were significance difference (P<0.05) comparing follow up at 3 months with preoperative. Also, there were moderate significant difference (P<0.001) comparing follow up at 6 & 12 months with preoperative. The mean of systolic blood pressure preoperative was 136.3 ± 17.4 and of diastole was 83.2 ± 11.8. While after 1 year follow up the mean of systolic blood pressure was 120.2 ± 9.4 and of diastole was 67.4 ± 7.4. The remission was achieved in 94 % and improvement was achieved in 6%. Weight loss is well-known to result in reduction in blood pressure in many studies. In **Schiavon *et al.*** [14] study, at 12 months, patients with obesity and hypertension who underwent gastric bypass plus medical therapy were significantly more likely to reduce ≥ 30% of the number of medications while maintaining controlled blood pressure than patients managed with medical therapy alone. Notably, half of the patients in the surgical group were able to maintain systolic and diastolic blood pressure < 140 mm Hg and 90 mm Hg respectively without the need for medications (remission of hypertension).

In this study 80 out of 100 patients diagnosed with dyslipidemia. There was significant difference between preoperative lipid profile and those obtained after 1 year follow up. Of Tg (186 ± 141.72Vs 124 ± 53.14), TC (174 ± 46.4Vs 150.8 ± 27.07) and LDL (112.14 ± 54.14Vs 61.87 ± 38.67). However, no significant difference in HDL (42.54 ± 38.67 vs 50.27 ± 7.73) with 96% remission and 4% improvement. This is in agreement with **Carbajo *et al.*** [15] study that showede differences between preoperative levels and those obtained 2 years after OAGB of Tg was 123.6 ± 56.3 mg/dL vs. 84.7 ± 33.6 mg/dL (p < 0.001), TC was 194.3 ± 43.9 mg/dL vs. 173.6 ± 34.8 mg/dL (p < 0.001), HDL was 43.6 ± 9.8 mg/dL vs. 61.5 ± 12.6 mg/dL (p < 0.001) and LDL was 124.8 ± 36.0 mg/dL vs. 97.3 ± 25.0 mg/dL (p < 0.001). All were all statistically significant. They also suggested that final changes in LDL levels are independent of weight loss and confirmed OAGB as an effective malabsorptive procedure with a greater impact in cholesterol fractions than restrictive procedures that have not demonstrated a real, long-term beneficial impact.

In this study, early complication after MGB surgery occurred in 4% of patients. Respiratory distress occurred in 2.0% of patient, 2.0% had abdominal and GIT bleeding. Neither one had anastomosis leak, DVT, Jejunal perforation nor pulmonary embolism. This is in agreement with **Madhok *et al.*** [16] who did not report any leak, bleed, or deep venous thrombosis. In **Carbajo *et al.*** [15] study, junction perforation occurred in 0.8% and pulmonary embolism in 0.08%.

Regarding late post-operative complication, it occurred in 6% of patients. The intractable reflux in this study was presented by 2% of patients. This reflux rate is similar to most of the published studies of omega-loop gastric bypass (OLGB), as in **Kular *et al.*** [17] study, it was 2%, in **Musella *et al.*** [18] study, it was 0.9%. The studies of **Noun *et al.*** [11] and **Tolone *et al.*** [19] reported no cases of reflux after OLGB.

Also in this study, iron deficiency anemia was detected in 4% of patients. There was no cases of anastomotic ulcer, gastric pouch enlargement, trocar site hernia, EWL > 100%, weight gain nor insufficient weight loss. In **Carbajo *et al.*** [15] study, incidence of severe iron deficiency anemia was 1.25% and required parenteral iron and those with mild iron deficiency anemia were up to 30 % and required only oral iron.

Regarding excessive weight loss, **Rutledge** [10] reported excessive WL in 1% in his series and suggested selected reversal to normal anatomy as the reoperation of choice. **Lee** [20] revised 23 of 1322 patients were anemic (1.7%). The most common cause was malnutrition in 9 patients (0.7%). A conversion to SG due to efficacy in improving malnutrition without regaining body weight, was recommended in this case. **Noun *et al.*** [11] reported excessive weight loss in 4 patients (0.4%) with reversal in 2 and conversion to SG in the other 2. The Italian group submitted 7 of 818 patients (0.8%) to late reoperations, indication was EWL of >100% in only one (0.1%) [18]**.**

Referring to nutritional deficiencies, it is widely known that malabsorptive procedures are associated with the highest risk of developing them, in comparison with restrictive or mixed procedures, such as Roux-en-Y gastric bypass (RYGB). International postoperative guidelines recommended

supplementation with multivitamin and mineral tablets and periodical laboratory controls, in order to detect early deficiencies that can be specifically supplemented [15].

In this study, at 1 year follow up, the incidence of Vitamin D deficiency was 18% and vitamin B9 deficiency was 19%. While vitamin B12 deficiency was 8%., Iron deficiency was 4%, calcium deficiency was 6%, while albumin deficiency presented in 1%. In **Carbajo *et al.*** [15] study, at follow up of 1 year postoperatively the incidence of vitamin D deficiency was 29.5 % and of B9 (Folic Acid) was 8% while B12 was 5.5% of patients. Iron deficiency was found in 19% while calcium deficiency was found in 4.5% of patients.

Surprisingly, there were no significant differences in the specific supplementation needs during the first postoperative year between groups of patients undergoing SG, RYGB and OAGB, as primary bariatric procedures. At 2 years after surgery, iron needs were higher in patients undergoing RYGB and OAGB. At 5 years, iron and folic acid needs were higher in the RYGB and OAGB groups. As a mostly malabsorptive procedure, it could be expected that specific supplementation needs should be greater in patients undergoing OAGB than in those ones undergoing RYGB, especially when considering that in some subjects the biliopancreatic limb was up to 350 cm long. The main reason for such low deficiency rates is the assessment of the total bowel length, allowing a customize measure for obtaining optimal weight loss without associating nutritional deficiencies. A recent report demonstrated that with the customized lengths of the limbs, based on the total bowel measure, the malnutrition rate was 1.1%, requiring surgical treatment for common limb elongation in less than 0.1% of the cases [15].

Sleep apnea is common in morbidly obese patients. Bariatric surgery is rapidly efficient on sleep apnea and MGB is reported to have a significant efficiency on obstructive sleep apnea (OSA). In this study, 75% of patients suffered from OSA, at 1 year follow up remission rate was 95% and 5% improvement. In **Chevallier *et al.*** [21] study, at 5 years the rate of obese patients who required continuous positive airway pressure treatment (CPAP) decreased from 19.5 to 9.5%.

In this study, there was 100.0% of patients have fatty liver and showed remission of the disease and three female patients were diagnosed as having PCO and showed improvement of disease. In **Carbajo *et al.*** [15] study, remission was demonstrated in most patients for other metabolic conditions like hyperlipidemia and liver steatosis when the first biochemical tests were ordered at the 3rd postoperative month with remission rate that was 100% of patients but regarding PCO, patients showed 100% improvement with.

Lee *et al.* [20] reviewed the available literature of more than 7000 OAGB/MGB operations and found that randomised controlled trials and long-term data demonstrated the procedure to be a simpler and safer alternative to Roux-en-Y gastric bypass (RYGB). There is also good evidence of efficacy for metabolic syndrome. Ten years' experience of OAGB/MGB showed superior weight loss, lower body mass index (BMI) and lower revision rate compared to RYGB. The operation was found to be more effective for type 2 diabetes mellitus (T2DM) compared to laparoscopic sleeve gastrectomy (LSG) at 1-year follow-up.

A recent long-term study of OAGB/MGB with 10-years follow-up showed superior outcomes to RYGB and LSG. The **Carbajo group** reported the safety and efficacy of OAGB/MGB after a 12-year follow-up, which showed 70% excess weight loss (EWL), while 15 years' experience with MGB showed higher EWL and lower revision rate compared to RYGB and LSG [15].

CONCLUSION

MGB/OAGB is a simple, safe, effective, easy to learn and easy to reverse procedure. It has acceptable complications and mortality rates. Therefore, MGB has the ability to be an excellent alternative to RYGB in treatment and remission of diabetic obese patients, comorbidities and EWL achievement with significantly lower complication rate.

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