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Comparison of Excess Weight Loss Outcomes Between Laparoscopic Sleeve Gastrectomy and Laparoscopic Mini Gastric Bypass in Morbidly Obese Patients

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Abstract

Background Obesity is a complex, multifactorial, and largely preventable disease. The current most widely used criteria for classifying obesity is the body mass index (BMI). Surgical treatment for obesity (bariatric surgeries) has been shown to be effective for weight loss. The most performed bariatric surgeries were Roux-en-Y, nowadays; laparoscopic sleeve gastrectomy (LSG). laparoscopic mini gastric bypass (LMGB).

Objective To compare excess weight loss outcomes between LSG and LMGB.

Methods A prospective study; enrolling all patients underwent LSG and LMGB in Al-Imamein Al-Khadimein Medical City and number of private hospitals done by one surgical team during the period from January 1st to December 31st 2019. Patients initial BMI ranges from 45-55 kg/m^2. All patients were given a dietary regime after the surgeries. Patients weight records were followed up to one year after their surgeries in 3-, 6-, 9- and 12-months' intervals.

Results Ninety-seven patients had been operated for LSG and LMGB; 50 of them met the inclusion criteria distributed as 25 patients operated for LSG and 25 patients operated for LMGB; 80% were females and 20% were males with mean age of 37.66±9.99 years. Both surgeries were successful in terms of excess body weight loss (EWL); mean EWL for LSG and LMGB (calculated as ideal BMI=24.9 kg/m^2) at 3 months post-surgery follow up was 33.80±9.55% (P value 0.0001) with mean body weight 113.70±14.52 kg; 50.31±9.42 (P value 0.0001) at 6 months with mean body weight 102.36±12.83 kg; 62.06±9.75% (P value 0.0001) at 9 months with mean body weight 94.18±10.84 kg and 69.48±9.63 % (P value 0.0001) at 12 months follow up with mean body weight 88.90±9.61 kg. There was no significant difference for excess weight loss outcomes between LSG and LMGB in one year follow up. With Excess body weight loss at 12 months was 68.7% for LSG and 70.3% for LMGB

Conclusion Both LSG and LMGB are effective for excess body weight loss with insignificant difference between their excess weight loss outcome in one-year post surgery follow up.

Keywords Obesity, laparoscopic sleeve gastrectomy, laparoscopic mini gastric bypass, excess body weight loss

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List of abbreviations: BMI = Body mass index, EWL = Excess body weight loss, GERD = Gastro-esophageal reflux, LMGB = Laparoscopic mini gastric bypass, LSG = Laparoscopic sleeve gastrectomy, OAGB = One anastomosis gastric bypass, OGB = Omega gastric bypass

Introduction

Obesity is a complex, multifactorial, and largely preventable disease, affecting, along with overweight, over a third of the world's population today [(1)]. If secular trends continue, by 2030 an estimated 38% of

the world's adult population will be overweight and another 20% will be obese [2]. Obesity is typically defined quite simply as excess body weight for height, but this simple definition belies an etiologically complex phenotype primarily associated with excess adiposity, or body fatness, that can manifest metabolically and not just in terms of body size [3]. Obesity greatly increases risk of chronic disease morbidity—namely disability, depression, type 2 diabetes, cardiovascular disease, certain cancers—and mortality. Childhood obesity results in the same conditions, with premature onset, or with greater likelihood in adulthood [3].

Classification of body weight in adults

The current most widely used criteria for classifying obesity is the body mass index (BMI); body weight in kilograms, divided by height in meters squared (Table 1), which ranges from underweight or wasting (<18.5 kg/m^2) to severe or morbid obesity (≥40 kg/m^2). In both clinical and research settings, waist circumference, a measure of abdominal adiposity, has become an increasingly important and discriminating measure of overweight/obesity [4].

Table 1. Common classifications of body mass index in adults

Age	Indicator	Normal Weight	Overweight	Obese
≥20 years	BMI (kg/m^2)	18.50-24.99	Preobese: 25.00 -29.99	Class 1: 30.00-34.99 Class 2: 35.00-39.99 Class 3: 40.00-49.99 Class 4: 50.00-59.99 (super obese) Class 5: 60.00-69.99 (super super obese) Class 6: ≥70.00 (mega obese)

Risk factors for obesity

Obesity arises as the result of an energy imbalance between calories consumed and the calories expended, creating an energy surplus and a state of positive energy balance resulting in excess body weight. This energy imbalance is partially a result of profound social and economic changes at levels well beyond the control of any single individual [2].

Surgical management of obesity

Surgical treatment for obesity (bariatric surgeries) has been shown to be effective for weight loss [6]. An ideal weight loss operation should be effective, easy to perform and safe. It should have a simple and effective "exit strategy", i.e., it should be easy to modify or reverse for inadequate weight loss, weight regain, excessive weight loss or other complications. The ideal operation should leave few adhesions and rarely cause hernias. The operation should be relatively inexpensive, and long-term complications should be rare and manageable. The surgical procedure should be a part of a program that includes careful postoperative follow-up, so that results can be continuously evaluated [7].

The most performed bariatric surgery was Roux-en-Y; nowadays; laparoscopic sleeve gastrectomy (LSG) [8], laparoscopic mini gastric bypass (LMGB) introduced by Rutledge follow LSG in popularity [7,9].

LSG, a restrictive bariatric surgery; is one of the most popular procedures (37%) in the world, it is a technically less complex procedure with short learning curve and effective weight loss [10,11]; but it suffers from two outstanding disadvantages including high risk of weight

regain and gastro-esophageal reflux disease (GERD) [12].

LMGB, also known as one anastomosis gastric bypass (OAGB) or omega gastric bypass (OGB), a malabsorptive type bariatric surgery; is a newly emerged procedure originated from Rutledge [7]. Due to safe and simple process as well as effective outcomes, LMGB has quickly become one of the most popular procedures in many countries [13]. Despite of popular status, the extension of LMGB is still limited by some concerns such as gastric and esophageal bile reflux, marginal ulcer, poor follow-up, and remnant gastric cancer [14].

This study aimed to compare excess weight loss outcomes between sleeve gastrectomy and mini gastric in one year.

Methods

This is a prospective study including all the patients underwent LSG and LMGB in Al-Imamein AL-Khadimein Medical City and number of private hospitals done by one surgical team during the period between January 1st 2019 to December 31st 2019. Patients were fully assessed prior to surgery regarding past surgical, past medical, psychological history and sent for anesthesiologist consultation for general anesthesia fitness; patients demographic and medical data were registered and written approval on using their data was documented. Patients weight records were followed up one year after their surgeries in 3-, 6-, 9- and 12-months intervals.

Inclusion criteria

Negative history of bariatric surgery nor gastric band or balloon, age 21-55 years, sex (male and female), BMI 45-55 kg/m^2, adherence to scheduled follow up visits, adherence to dietary regime instructed by the surgical team.

Exclusion criteria

Patients with previous bariatric surgery; gastric band or balloon, age less than 21 years or more than 55 years, BMI less than 45 kg/m^2 and more than 55 kg/m^2, skipped follow up visits, poor adherence to dietary regime instructed by the surgical team.

Statistical data analysis

Analysis of data was done using statistical packages for social sciences (SPSS) version 27. Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values). The significance of difference of different means (quantitative data) were tested using students-t-test for difference between two independent means or paired-t-test for difference of paired observations (or two dependent means). The significance of difference of different percentages (qualitative data) were tested using Pearson Chi-square test (X2-test) with application of Yate's correction or Fisher Exact test whenever applicable. Statistical significance was considered whenever the P value was equal or less than 0.05.

Results

From January 1st 2019 to December 31st 2019; 97 patients operated for LSG and LMGB in Al-Imamein Kadhimein Medical City and number of private hospitals; among them, 50 patients met the inclusion criteria described above; distributed as 25 patients operated by LSG and 25 patients operated by LMGB as a primary bariatric procedure; 40 (80%) were females and 10 (20%) were males with mean age of 37.66±9.99 yr (range 22-55 yr).

Patients mean initial body weight was 136.44±16.43 kg (BMI 49.80±3.94 kg/m^2); both surgeries were successful in terms of excess body weight loss (EWL); EWL was calculated using the formula:

$$\%EWL = \frac{\text{Preoperative Weight} - \text{Follow-Up Weight}}{\text{Preoperative Weight} - \text{Ideal Body Weight*}} \times 100$$

Ideal body weight was calculated as upper limit ideal BMI which is 24.99 kg/m^2; mean EWL for LSG and LMGB (calculated as Ideal BMI=24.9 kg/m^2) at 3 months post-surgery follow up was

33.80±9.55% (P value 0.0001) with mean body weight 113.70±14.52 kg; 50.31±9.42% (P value 0.0001) at 6 months with mean body weight 102.36±12.83 kg; 62.06±9.75% (P value 0.0001) at 9 months with mean body weight 94.18±10.84 kg and 69.48±9.63% (P value 0.0001) at 12 months follow up with mean body weight 88.90±9.61 kg as described in table (2) and table (3).

Table 2. Initial BMI and weight records 3-, 6-, 9- and 12-months post-surgery

Parameter	Mean±SD (Range)	P value
Initial body weight (Kg)	136.44±16.43 (108-176)	-
Height (m)	1.65±0.07 (1.49-1.81)	-
Initial BMI (Kg/m^2)	49.80±3.94 (43.55-55.10)	-
Ideal body weight (Kg)	68.20±6.07 (55.28-81.57)	-
Excess body weight (Kg)	68.24±12.52 (48.18-96.22)	-
Post-operative weight 3 months	113.70±14.52 (87-141)	0.0001*^
Post-operative weight 6 months	102.36±12.83 (81-132)	0.0001*^
Post-operative weight 9 months	94.18±10.84 (71-117)	0.0001*^
Post-operative weight 12 months	88.90±9.61 (65-111)	0.0001*^

*Significant difference from initial body weight using Paired-t-test at 0.05 level, ^Significant difference from previous body weight using Paired-t-test at 0.05 level

Table 3. EWL (%) in 3-, 6-, 9- and 12-months for LSG and LMGB

EWL (%)	Mean±SD (Range)	P value
Percent of reduction of EWL 3 months (%)	33.80±9.55 (10.82-65.48)	-
Percent of reduction of EWL 6 months (%)	50.31±9.42 (30.86-84.65)	0.0001*^
Percent of reduction of EWL 9 months (%)	62.06±9.75 (47.65-97.42)	0.0001*^
Percent of reduction of EWL 12 months (%)	69.48±9.63 (55.79-97.42)	0.0001*^
Post-operative BMI at 12 months (Kg/m^2)	32.50±2.61 (25.43-38.06)	0.0001*
Change in BMI after 12 months	17.30±3.52 (11.47-23.66)	-
Percent of change in BMI after 12 months	34.53±5.38 (25.44-44.20)	-

*Significant difference from initial measurement using Paired-t-test at 0.05 level, ^Significant difference from previous measurement using Paired-t-test at 0.05 level.

The results also show that there was no significant difference for EWL outcomes between LSG and LMGB in one year follow up (in 3-, 6-, 9- and 12-months weight records data) as detailed in table (4) and table (5) with P value >0.1 (significant P value at 0.05 level).

Table 4. LSG versus LMGB weight loss comparison

Variables	Type of surgery		P value
	LSG mean±SD (Range)	LMGB mean±SD (Range)	
Initial body weight (Kg)	135.16±16.69 (108-176)	137.72±16.40 (110-163)	0.587
Height (cm)	1.66±0.08 (1.55-1.81)	1.65±0.07 (1.49-1.80)	0.607
Initial BMI (Kg/m^2)	49.00±3.77 (43.55-54.95)	50.60±4.01 (44.53-55.10)	0.155
Ideal body weight (Kg)	68.66±6.49 (59.82-81.57)	67.74±5.72 (55.28-80.68)	0.598
Excess body weight (Kg)	66.50±12.33 (48.18-96.22)	69.98±12.71 (50.18-89.34)	0.331
Post-operative weight 3 months	112.52±16.05* (87-141)	114.88±13.04* (92-136)	0.571
Post-operative weight 6 months	101.52±14.17* (82-132)	103.20±11.57* (81-121)	0.648
Post-operative weight 9 months	93.08±10.97* (75-117)	95.28±10.81* (71-114)	0.479
Post-operative weight 12 months	89.28±9.71* (76-111)	88.52±9.69* (65-106)	0.783

*Significant difference from initial measurement using Paired-t-test at 0.05 level

Table 5: LSG versus LMGB excess weight loss (%) comparison

Variables	Type of surgery		P value
	LSG mean±SD (Range)	LMGB mean±SD (Range)	
Percent of reduction of EWL 3 months (%)	34.90±11.22 (10.82-65.48)	32.70±7.60 (13.93-43.66)	0.421
Percent of reduction of EWL 6 months (%)	51.17±11.45 (30.86-84.65)	49.44±6.98 (39.81-61.57)	0.522
Percent of reduction of EWL 9 months (%)	63.33±11.40 (47.65-97.42)	60.78±7.78 (49.34-77.72)	0.360
Percent of reduction of EWL 12 months (%)	68.70±11.05 (55.79-97.42)	70.27±8.12 (57.64-89.68)	0.570
Post-operative BMI at 12 months (Kg/m2)	32.46±2.87 (25.43-38.06)	32.54±2.38 (27.06-37.10)	0.915
Change in BMI after 12 months	16.54±3.51 (11.47-23.34)	18.05±3.43 (11.87-23.66)	0.130
Percent of change in BMI after 12 months	33.58±5.77 (25.44-44.20)	35.47±4.90 (26.09-43.05)	0.218

Discussion

Bariatric surgeries; especially LSG and LMGB have gained in popularity for treatment of morbid obesity in United states of America and all around the world [15]. This is partly because both procedures have been found to be faster, relatively easier and have close or better weight loss outcomes compared to previously gold- standard Roux-en-Y gastrojejunostomy (in the beginning of 21st century) with better postoperative profiles [16], LSG is a restrictive procedure and LMGB has a predominant malabsorptive effect with modulation of intestinal hormones with the risk of micronutrient deficiency [17].

In this study, both surgeries were successful for obesity treatment at 12 months post-surgery point with mean percentage of EWL 69.48±9.63 (success excess weight loss >50%) [18].

Most of the operated patients were females (80%) versus 20% of male gender; this demographic data correlates greatly with most of the studies data discussing bariatric surgeries as in Kochkodan et al. study, which discusses physiologic and psychological gender differences in bariatric surgery [19]. This may correlate to female being more concerned about their look and body weight than males.

There was no significant difference in excess weight loss between LSG and LMGB in 3-, 6-, 9- and 12 months' records.

The percentage of EWL in LSG patients 12 months after the surgery was 68.7%, which correlate with Kansou et al. results (EWL 71.4±19.0; mean initial BMI 46.4±6.5 kg/m^2) [20].

The percentage of EWL in LMGB patients one year after the surgery was 70.3%, which correlates with Rutledge results (EWL 68% at 12 months; mean Initial BMI 47±7 kg/m^2) in his 1273 case LMGB experience study [7].

In our series, there was no significant difference in excess weight loss between these surgeries in 12 months follow up after the surgery; these results are comparable with Shivakumar study in 2018 complemented that there was no significant difference between LMGB and LSG in terms of excess body weight loss (% EWL for LSG 63.97±13.49 and LMGB 66.19±10.93 with mean initial BMI 44.57±7.16 kg/m^2) in the first year of his study [21], although mean initial BMI in this study was 49.00±3.77 for LSG and 50.60±4.01 for MGB which explains the difference in approximate %EWL from Shivakumar study.

Current results are also correlated with another study performed by Kular et al. in 2014 stated that both surgeries are effective for weight loss in morbidly obese patients without significant difference in % EWL in the first two years after the surgery (%EWL for LSG 69±22.5 and LMGB 63±21.2 with mean initial BMI 44±3.1 kg/m^2); also Kular et al. stated that weight loss is sustained more in LMGB patients as it's a malabsorptive procedure and no future stomach dilatation occurs (which affects meals size and hence weight regain) [22].

Another study conducted in Egypt; comparing the effectiveness of these surgeries in super obese patients (mean BMI was 67.12±3.95 kg/m^2 for LSG patients and 65.12±5.89 kg/m^2 for LMGB patients) showed insignificantly higher excess weight loss for LMGB patients in one year follow up; confirming the effectiveness of both surgeries with almost same excess weight lose outcome [23].

On the other hand, a number of studies showed that LGMB is superior to LSG regarding %EWL in one year as Wu et al. meta-analysis study, which included a total of 20 articles examining 4064 LMGB patients and 3733 LSG patients; results revealed more %EWL in 6 and 12 months follow up for LMGB patients [24], and Plamper et al. study comparing mini-gastric bypass with sleeve gastrectomy in a mainly super-obese patient group; in this study mean initial BMI for patients operated for LSG was 54.6 kg/m^2 versus 54.1 kg/m^2 for LMGB patients with superior %EWL after one year for LMGB (67.2%) [25].

Another meta-analysis study carried by Magouliotis et al. in 2017 also reveals increased weight loss outcomes for LMGB over LSG [26]. The data conducted by these meta-analysis studies are positive for LMGB to be superior than LSG in terms of EWL, also, the

presence of compatible studies increases the need for detailed further studies to be carried out.

The current study included preoperative BMI range of 45-55 kg/m^2 with mean BMI of 49.8 kg/m^2, comparable studies initial mean BMI was 45.3 kg/m^2, no comparable researches published for the range of BMI conducted by our study.

It's important to mention that the calculation of %EWL varies significantly (<17%) depending in ideal body weight definition and preoperative values used; this highlights the necessity for a standardized values for recording weight loss in bariatric studies. researchers should describe their methods clearly, and readers should keep this calculation methods variability in mind when interpreting the %EWL [27].

This study concluded that both LSG and LMGB are effective for %EWL with insignificant difference between their excess weight loss outcome in one year post surgery follow up.

The limitation of current study was small patient sample. Also, patients were followed up for relatively short time period (12 months).

We recommend that patients should be followed up longer period (in total 3-5 years after the surgery) for more informative results to be obtained regarding long term %EWL, also, we recommend enrolling more patients in the study.

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Author contribution

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Conflict of interest

The authors declare that they have no conflict of interest.

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