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STUDY OF THE RATE OF EXCESS WEIGHT LOSS AFTER LAPAROSCOPIC SLEEVE GASTRECTOMY AND LAPAROSCOPIC GASTRIC PLICATION IN MORBIDLY OBESE PATIENTS

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ABSTRACT

Background: Bariatric surgery is considered to be the only effective treatment for morbid obesity. However, no consensus on the ideal procedure.

Objective: To compare the effectiveness of laparoscopic sleeve gastrectomy (LSG) and laparoscopic greater curvature plication (LGCP) in short term weight loss for management of morbid obesity.

Patients and methods: Forty patients presented for the study during the duration between August 2014 and August 2016. The patients were randomly divided into two equal groups: group A subjected to laparoscopic sleeve gastrectomy, and group B had laparoscopic greater curvature plication. All patients were submitted to preoperative assessment (history taking, physical examination, laboratory investigations, imaging studies, cardiopulmonary assessment), upper GIT endoscopy or Barium meal, and preoperative quality of life assessment. Patient education and supervised dietary instructions was provided. All patients were informed about the advantages and disadvantages of the two procedures and consented to be involved in this randomized study. The patient signed written consent for the procedure to be performed for him/her. Patients were followed up for overall outcome and postoperative complications.

Results: No major complications were observed in the early postoperative period. Two patients (one in each group) developed symptomatic cholelithiasis postoperatively. Five patients presented with mild stenosis symptoms (intermittent vomiting and intolerance to solid food), 3 patients were from group A and 2 from group B. There were no significant differences between the mean preoperative weights in both groups. After 2 weeks, 3 months and 6 months, both groups experienced almost the same amount of weight loss. On the contrary, after 12 months follow up, group A demonstrated a greater weight loss. Percentage of excess weight loss was significantly higher among group A compared to group B. Similarly, EWL% was significantly higher among group A compared to group B after 2 weeks follow up. All patients had adequate weight loss except for 2 patients in group B. Quality of life was assessed at the end of follow up period. All patients had a good or very good outcome, reflecting the overall level of satisfaction of patients. Fifteen patients had a good outcome in group A compared to 12 in group B; while 8 patients in group A had a very good outcome compared to 5 in group B; and the difference was statistically non-significant.

Conclusion: Both laparoscopic sleeve gastrectomy and laparoscopic greater curvature plication had a reasonable outcome on morbid obesity management, with preference of laparoscopic sleeve gastrectomy after 12 months postoperatively in the degree of weight loss, and overall complications rate.

Keywords: Obesity, bariatric surgery, laparoscopic sleeve gastrectomy, greater curvature plication.

Abbreviations:

AGB:	Adjustable gastric banding	**PCOS:**	Polycystic ovarian syndrome
BMI:	Body mass index	**QoL**	Quality of life
LGCP:	Laparoscopic greater curvature plication	**VSG:**	Vertical sleeve gastrectomy
LSG:	Laparoscopic sleeve gastrectomy	**EWL:**	Excess weight loss

INTRODUCTION

Obesity is characterized by excess body fat and is generally defined by the body mass index (BMI), which takes into account weight and height. This index is calculated by dividing weight in kilograms by height in meters squared; it is therefore expressed in kilograms per square meter (kg/m^2). The normal BMI is less < $25kg/m^2$; if the BMI is between 25 and 29.9 kg/m^2, it is called overweight, and obesity applies when BMI is more than $30kg/m^2$. Any BMI ≥ 35 or 40 is severe obesity, A BMI of ≥ 35 or 40–44.9 or 49.9 is morbid obesity, and A BMI of ≥ 45 or 50 is super obese **(Neupane et al., 2016).**

Obesity is one of the leading preventable causes of death worldwide. Large-scale American and European studies have found that mortality risk is lowest at a BMI of 20–25 kg/m^2 in non-smokers and at 24–27 kg/m^2 in current smokers, with risk increasing along with changes in either direction. In the United States, obesity is estimated to cause an excess 111,909 to 365,000 deaths per year, while 1 million of deaths in Europe are attributed to excess weight. On average, obesity reduces life expectancy by six to seven years: a BMI of 30–35 kg/m^2 reduces life expectancy by two to four years, while BMI > 40 kg/m^2 reduces life expectancy by 10 years **(Whitlock et al., 2009).**

In the latest WHO technical report for the prevention and management of obesity, surgery is considered to be the only effective treatment for morbid obesity. This type of surgery is called bariatric surgery (from the Greek word *baros*, which means weight). Besides its positive effects on weight loss and its acceptable rates of weight-loss maintenance, bariatric surgery is the treatment offering the best cost-effectiveness ratio in the medium term **(Neupane et al., 2016).** Vertical sleeve gastrectomy (VSG) and adjustable gastric banding (AGB) are the most commonly used restrictive approaches in bariatric surgery **(Chang et al., 2016).** These procedures proved good therapeutic methods for many patients but also they were associated with many complications, in gastric band like slippage of the band or erosion, gastric leaks, which may occur in vertical sleeve gastrectomy (VSG) **(Campos et al., 2007).**

Laparoscopic sleeve gastrectomy (LSG) was first used as first stage of two stage bariatric surgery for those with high surgical risk severely obese patients (BMI ≥ 60 kg/m^2). LSG is becoming a sole bariatric procedure due to its effectiveness on weight loss and comorbidities resolution. LSG is a restrictive procedure in which up to 80% of the stomach is vertically resected leaving a gastric tube or conduit preserving the vagi and pylorus. LSG is proved to have a weight loss effect within the range between gastric banding and bypass surgery. Moreover, it is a simple procedure with low morbidities and negligible long term nutritional deficiencies **(Abd Ellatif et al., 2014).** Laparoscopic greater curvature plication (LGCP) is a new bariatric restrictive procedure that avoids the complications linked with the permanent implant of an adjustable gastric ring, while also minimizing the possibility of leaks associated with sleeve gastrectomy. Also known as gastric imbrication and total vertical sleeve plication, the

procedure consists of reducing gastric volume by placing at least two rows of non-absorbable sutures on the greater gastric curvature. LGCP was first described in 2007 **(Talebpour and Amoli, 2007).** VSG shows > 60.0% (EWL) in medium-term results, but was associated in some studies with complications such as gastric leaks and fistulas. LGCP is similar to VSG by generating a gastric tube (but without gastric resection with its complications), some studies showed satisfactory weight loss **(Ramos et al., 2010).** LSG has gained popularity throughout the world. Large scale studies showed that LSG for obese patients has proved to be a technically easy, safe, and beneficial operation **(Jacobs et al., 2010).** On the other hand, LGP is an evolving surgical approach over the past few years. No sufficient and satisfactory data has been reported about the long-term effectiveness of this procedure **(Abdelbaki et al., 2012).**

The aim of our study was to compare the effectiveness of LSG and LGCP in short term weight loss for management of morbid obesity.

PATIENTS AND METHODS

The present study was a prospective randomized study conducted on morbidly obese patients, admitted to the Surgical Department (New Damietta University Hospital) between August 2014 and August 2016.

Inclusion criteria included: 1) age ranging between 18 and 50 years, 2) failure of conservative treatment for at least 1 year, 3) body mass index >35 kg/m^2 with comorbidity or BMI >40kg/m^2, 4) psychologically stable patients, and 5) the patient complete follow up during the duration between August 2014 and August 2016. Exclusion criteria included: 1) patients unable to comply with the needed postoperative life style changes explained to them, 2) extensive previous abdominal surgery, 3) large abdominal wall or hiatal hernia and pregnancy, 4) treatable endocrinopathies, 5) significant psychiatric disorder, 6) drug or alcohol abuse, 7) food addict, and 8) unfit for general anesthesia (American Society of Anesthesiologists ASA III or IV). The patients studied were randomly divided into two groups using closed envelop technique: group A (20 patients) subjected to laparoscopic sleeve gastrectomy (LSG), and group B (20 patients) had laparoscopic greater curvature plication (LGP). All our patients were submitted to the following preoperative assessment including history taking, physical examination, thorough laboratory investigations, imaging studies, cardiopulmonary assessment, upper GIT endoscopy or barium meal in trendlenberg position to rule out associated gastro-esophageal pathology, and preoperative quality of life assessment. Patient education and supervised dietary instructions were provided. A thorough understanding of operative changes including explanation of the operative technique, the anatomical changes, the possible benefits and risks as well as the dietary restrictions and the potential long-term nutritional concerns were done. All patients were informed about the advantages and disadvantages of the two procedures, and consented to be involved in this randomized study. After assigning the procedure to be performed (using

closed envelope technique), the patient signed consent for the procedure to be performed for him/her. All patients were scheduled for regular postoperative visits, weekly for 8 weeks, then after 3 months and 3 monthly thereafter, i.e. 6, 9 and 12 months postoperatively. The minimum period of follow up within this study was 12 months. After 6 months and 12 months postoperatively, the following parameters were assessed: Quality of life, follow up anthropometric measurements (percentage of excess weight loss (%EWL), percentage of excess Body Mass Index loss (%EBL), waist Hip Ratio (WHR), waist circumference, evaluation of co-morbidities, dietary habits, reoperation, and late procedure-related complications, e.g. GERD, nutritional deficiencies.

Statistical analysis: Statistical analyses were conducted using PC with the Statistical Package for the Social Science (SPSS) version 16.0 for Windows (SPSS Inc, Chicago, IL, USA). We performed a descriptive analysis of patients' baseline characteristics per group using frequency tabulations for categorical variables and mean and range for continuous variables. Student t-test was used for comparisons between quantitative variables of 2 groups. For the categorical variables, we used chi-square test for homogeneity or Fisher's exact test if required by sample size. All reported P values were two-tailed, and its value <0.05 was considered statistically significant.

RESULTS

The present work showed that group A (LSG) included 20 patients; 6 males (30.0%) and 14 females (70.0%) with age ranged from 18- 50 (mean age of 29.0± 9.7years). On the other hand, group B (LGP) included 20 patients, 16 females (80.0%) and 4 males (20.0%) with a mean age of 29.8±7.7 years (range 20-45). There was no significant difference between both groups as regards patient's age or gender. Anthropometric data revealed that weight in group A was 120.75±22.7, while in group B was 119.1±18.59 representing mean excess weight of 51.38±15.5 and 48.31±17.4 in groups A and B respectively. Group A had a mean height of 166.2±11.40 cm compared to 168.15±6.32 in group B. The mean BMI was 43.2±4.44 and 42.14±6.04 for groups A and B respectively. The difference between both groups was statistically non-significant as regard any of studied anthropometric measurement. Finally, there was no significant difference between both groups as regard to waist/hip ratio. All patients demonstrated a history of multiple trials of conservative measures for weight reduction. Everyone followed a diet regimen ranging from 4 to 7 years with a mean of 5.12 years. In group A, the mean maximal weight reduction in their lifetime was 10.1±4.6kg compared to 11.9±8.7 kg in group B. Eleven patients reported positive family history for obesity with 3 patients in group A and 8 in group B. Twenty-one patients (52.5%) had one or more co-morbidities related to obesity: Group A had 10 co-morbidities in 8 patients (40%) compared to 17 comorbidities in 13 patients (65.0%) in group B. Osteoarthritis of the lower limb joint was the most common comorbid condition in the study. Seven patients (3 in group A and 4 in group B) suffered pain and limitation of movement, in the ankle

and/or knee joints. In addition, 2 patients suffered from low back pain in group B. Stress incontinence was noted in 5 patients (2 in group A and 3 in group B). Five patients had medically controlled hypertension (3 in group A and 2 in group B). Dyslipidemia was reported in 3 patients (1 and 2 in groups A and B respectively). Gastroesophageal reflux disease was present in 3 patients (1 and 2 in groups A and B respectively). In group B, one patient had intermittent asthma, and another was infertile. There was no statistically significant difference between both groups A and B as regard to comorbidities. Fourteen patients (35%) had a scar of previous operation: In group A, 2 patients (10%) had a scar of open appendectomy, while scars of cesarean section, paraumbilical hernia repair, and inguinal hernia repair were present in one patient (5.0% of total) each. In group B, 4 patients (20% of total) had a scar of an open appendectomy, while 3 patients (15.0%) had a cesarean section, one patient (5.0%) had a diagnostic laparoscopy, and another had an inguinal hernia repair (Table 1).

Routine laboratory investigations to all patients showed that all values were within normal range except one patient (5%) in group A and 2 patients (10%) in group B who had elevated lipid markers. Diurnal serum corticosteroids and thyroid profile were within normal ranges. Upper gastrointestinal endoscope was performed for all patients to rule out GERD, hiatal hernia or any ulcers and mucosal lesions. Moorehead-Ardlet Quality of Life questionnaire II showed that, in group A, 12 (60.0%) patients scored fair and 8 (40.0%) scored good; while in group B, 9 (45%), 11 (55%) were scored fair and good respectively. There was no statistically significant difference between groups A and B as regard to quality of life. The perioperative work-up, mean operative time, hospital stay and incidence of complications necessitating re-intervention or management were similar in both groups. Analysis of the cost was more dependent on the operative expenditure relating to each procedure. The only variables between bot procedures were the cost of staplers and cartilage reloads (average 4-5 cartilages) in the LSG group; and the cost of suture material in LGP group. From this analysis, we could roughly consider that the average cost of LGP was lower than that for LSG group.

All procedures were completed laparoscopically. The mean operative time was 131.25±27.67 minutes (range 90-180) in group A and 139.5±26.99 minutes (range 100-180 minutes) in group B. There was no significant difference between both groups ($p = 0.346$). The mean length of hospital stay was 2.0±0.65 days (range 1-4 days) and 1.55±0.89 days (range 1-4 days) in group B, with no significant difference between both groups ($p = 0.08$). There were no intraoperative complications in group B, while in group A, one patient had a small splenic tear resulting in minor bleeding that was controlled by compression and bipolar cauterization. There were no major staple line bleeding and there were no intraluminal gastric bleeding. Finally, there was no mortality.

No major complications were observed

in the early postoperative period (the first 30 days postoperatively). There was minor staple line bleeding in group A. However, one patient experienced continuous bleeding through the intraperitoneal drain and was re-explored and managed by laparoscopy (during the same admission) on day 1. Moreover, 6 (30%) patients' suffered from persistent nausea and vomiting in group B resulting in an increase in length of hospital stay in 3 out of 6 patients. On the other hand, in group A, 3 patients (15%) experienced persistent nausea and vomiting which in turn affected the hospital stay in 2 out of 3 patients. For both groups, the symptoms of nausea and vomiting were trivial and were managed by antiemetics successfully. Wound infection occurred in one patient in group B. One patient in group A had residual left subphrenic collection and presented with intermittent fever and persistent shoulder and left hypochondrial pain due to minor leak which managed by conservative measures. Another patient in group B developed intermittent high fever and abdominal pain 2 weeks after surgery necessitating readmission and investigation for potential surgical complications (U/S and CT scan). However, no complications were detected. Further investigations revealed acute hepatitis with high titer of HAV IgM (hepatitis A virus infection) as the cause of pain and fever.

Two patients (one in each group) developed symptomatic cholelithiasis post-operatively. Five patients presented with mild stenosis symptoms (intermittent vomiting and intolerance to solid food): 3 patients were from group A and 2 from group B. Group A patients were managed successfully by endoscopic dilation. As regard group B; one patient was managed conservatively while the other required endoscopic dilation (Table 2).

There were no significant differences between the mean preoperative weights in both groups. After 2 weeks, 3 months and 6 months, both groups experienced almost the same amount of weight loss reaching a mean weight of 111.83±19.84kg, 103.33±17.87 kg and 94.30±15.37 kg for group A respectively; and a mean weight of 112.95±18.73kg, 103.80± 17.88kg and 95.65±15.94kg for group B, respectively. On contrary, after 12 months follow up, group A demonstrated a greater weight loss with a mean weight of 80.9±12.77kg, while group B was 89.35±13.36kg. When mean weight at postoperative 2 weeks, 3 months, 6 months and 12 months was compared to preoperative mean weight, the weight loss was found significant starting from 3 months and progressing till the 12 months follow up.

Percentage of excess weight loss was significantly higher among group A compared to group B, after 12 months follow up (77.95±12.28 kg vs 63.83±14.03kg, respectively, $p = 0.001$). Similarly, EWL% was significantly higher among group A compared to group B after 2 weeks follow up (18.01±5.39 vs 13.87±5.02 kg respectively, $p = 0.013$). On the other hand, there was no significant difference in EWL% after 3 and 6 months follow up, where group A had a EWL% of 34.71±10.54 and 52.01±12.75 respectively; and group B had EWL% of 33.85±12.46 and 51.37±16.30 respectively. All patients had

adequate weight loss except for 2 patients in group B who had inadequate weight loss (>30.0% EWL < 50.0%) where one patient only reached 39.5% EWL, while other reached 41.4% EWL. In addition, BMI loss was significantly higher among group A compared to group B after 12 months follow up (13.96±3.67 vs 10.58±3.24 respectively, p = 0.002). Similarly, BMI loss was significantly higher among group A compared to group B after 2 weeks follow up (2.97±0.99 vs 2.22±0.80 respectively, p =0.013). On the other hand, there were no significant difference in BMI loss after 3 and 6 months follow up (Table 3).

For subgroup analysis, patients in each group were divided into 3 subgroups according to their preoperative BMI: first from 35-39.9; the second 40-44.9, and the third > 45kg/m^2. At the first subgroup, there was significant increase of EWL% in group A when compared to group B (82.46±4.45 vs 68.87±15.66 respectively, p =0.046). Similarly, in third subgroup, there was significant increase of EWL% in group A when compared to group B (74.79±8.11 vs 56.39±10.72 respectively, p = 0.007). On the other hand, in the second subgroup, there was higher EWL% in group A, but the difference was statistically non-significant when compared to group B.

A total of 27 co-morbidities existed in both groups with 10 co-morbid conditions in group A and 17 in group B. Patients were assessed at the end of the follow up period for comorbidity remission. Total cure rate was 80.0% in group A and 69.0% in group B. Joint pain was the most common comorbid conditions in both groups. Pain resolved in all group A patients and in 75% of group B. However, one patient in group B described a tolerable joint pain that was easily controlled by a low dose of analgesia. Stress incontinence was present in 5 patients in both groups. Incontinence resolved in all patients of group A and in one out of 3 in group B, while the other 2 continued to suffer from incontinence but at lower rate than that preoperatively. Five patients had medically controlled hypertension in both groups (3 in group A and 2 in group B). Two out of 3 patients in group A were off medication compared to 1 out of 2 in group B. The remaining 2 patients (one in each group) had their anti-hypertensive drug dosage reduction. Dyslipidemia occurred in 3 patients (one in group A and two in group B). There was 100% cure rate of dyslipidemia in both groups resulting in a normal recorded lipid profile. Two patients with low back pain in group B had their symptoms resolved at the end of follow up period. Moreover, one patient with infertility has got pregnant at the end of the follow up period. Patients with asthma in group B had no improvement in his symptoms (Table 4).

Quality of life was assessed by Moorehead-Ardelt QoL questionnaire II at the end of follow up period. All patients had a good or very good outcome, reflecting the overall level of satisfaction of patients. Fifteen patients had a good outcome in group A compared to 12 in group B, while 8 patients in group A had very good outcome compared to 5 in group B. The difference was statistically non-significant (Table 5).

Table (1): Patient demographics, anthropometric measurements and co-morbidities in studied patients

Groups / Variables	Group A (LSG)	Group B (LGP)	P value
Age (years) (mean±SD; range)	29.0± 9.7; 18-50	29.8±7.7; 20-45	0.79
Gender (M/F) (n,%)	6/14 (30/70)	4/16(20/80)	0.46
Weight (kg) (mean±SD; range)	120.75±22.70;86-174	119.1±18.59; 86-175	0.80
Height (cm) (mean±SD; range)	166.2±11.40;151-190	168.15±6.32; 156-180	0.51
BMI (kg/m^2) (mean±SD; range)	43.2±4.44;36-52	42.14±6.04;35-60	0.53
Excess weight (kg) (mean±SD; range)	51.38±15.5; 29-88	48.31±17.4;26-102	0.56
Waist/Hip ratio	0.932±0.06	0.911±0.05	0.25
Osteoarthritis	3(15.0%)	4(20.0%)	0.67
Stress incontinence	2(10.0%)	3(15.0%)	0.63
Hypertension	3(15.0%)	2(10.0%)	0.63
Dyslipidemia	1(5.0%)	2(10.0%)	0.55
GERD	1(5.0%)	2(10.0%)	0.55
Low back pain	0(0.0%)	2(10.0%)	0.15
Intermittent asthma	0(0.0%)	1(5.0%)	0.31
Infertility	0(0.0%)	1(5.0%)	0.31
Previous scar	5(25.0%)	9(45.0%)	0.18

Table (2): Complications of groups A and B

Complications / Groups		Group A		Group B		P value
		n	%	n	%	
IO complications	Bleeding	1	5.0	0	0.0	0.31
Early complications	PONV	3	15	6	30	0.25
	Bleeding	1	5.0	0	0.0	0.31
	Wound infection	0	0.0	1	5.0	0.31
	Lt. subphrenic collection	1	5.0	0	0.0	0.31
	Jaundice	0	0.0	1	5.0	0.31
Late complications	Cholecystitis	1	5.0	1	5.0	0
	Gastric stenosis	3	15.0	2	10.0	0.63
Total		11	55.0	10	50.0	0.63
Mortality		0	0.0	0	0.0	0

Table (3): Weight evaluation in both groups A and B, preoperatively and at postoperative follow up.

Weight / Groups		LSG group	LGP group	P value
Preoperative		120.75±20.49; 86-174	119.1±18.59; 89-174	0.80
Postoperative Follow up	2 weeks	118.83±19.84; 80.5- 168	112.95±18.73; 84-169	0.86
	3 months	103.33±17.87; 74.5-150	103.80±17.88; 77-152	0.93
	6 months	94.30±15.37; 69-126	95.65±15.94; 73-136	0.78
	12 months	80.9±12.77; 64-103	89.35±13.36; 71-122	0.048
BMIL	2 weeks	2.97±0.99; 0.91-4.50	2.22±0.80; 0.91-3.88	0.012
	3 months	5.95±1.70; 3.70-8.13	5.50±2.02; 2.15-9.34	0.45
	6 months	9.17±2.33; 6.01-13.77	8.32±2.54; 4.0-12.94	0.25
	12 months	13.96±3.67; 8.82-19.97	10.58±3.24; 5.77-17.79	0.002
EWL%	2 weeks	18.01±5.39; 6.78-26.72	13.87±5.02; 4.35-25.0	0.016
	3 months	34.71±10.54;20.08-52.67	33.85±12.46; 14.58-55.19	0.80
	6 months	52.01±12.75;38.11-65.06	51.37±16.30; 27.08-80.79	0.89
	12 months	77.59±13.28; 58.83-86.75	63.83±14.03;39.49-86.36	0.003

Table (4): Comorbidity resolution in groups A and B

Groups / Comorbidity	Group A (LSG)		Group B (LGP)	
	PO comorbidity	Resolution	PO comorbidity	Resolution
Osteoarthritis	3	3(100.0%)	4	3(75.0%)
Stress incontinence	2	2(100.0%)	3	1(33.3%)
Hypertension	3	2(67.7%)	2	1(50.0%)
Dyslipidemia	1	1 (100.0%)	2	2(100.0%)
GERD	1	0(0.0%)	2	1(50.0%)
Back pain	0	0	2	1(50.0%)
Asthma	0	0	1	1 (100.0%)
Infertility	0	0	1	1 (100.0%)
Total	10	8(80.0%)	16	11(69.0%)
P	P = 0.052(NS)			

Table (5): Quality of life in groups A and B.

Groups / Quality	Group A (LSG)		Group B (LGP)	
	n	%	n	%
Very poor	0	0.0	0	0.0
Poor	0	0.0	0	0.0
Fair	0	0.0	0	0.0
Good	15	75.0	12	60.0
Very good	5	25.0	8	40.0
P value	0.50(NS)			

DISCUSSION

The ultimate goal of bariatric surgery is weight loss and the resolution of obesity-related comorbidities to improve psychosocial functioning and quality of life (QoL) in morbidly obese patients **(Kim and Kim, 2016).**

Obesity has been associated with a number of co-morbid conditions including hypertension, diabetes, osteoarthritis, obstructive sleep apnea, infertility and dyslipidemia **(Jiang et al., 2011).** More than half of our patients suffered from one or more co-morbid condition. Group B had more co-morbid conditions than Group A; 65% vs. 40% respectively ($p>0.05$). Osteoarthritis was the most common co-morbidity (17.5%) in our study groups. All patients complained of severe knee and/or ankle pains that limited their mobility and required high dosage of analgesics **(Jiang et al., 2012).** Similarly, spine problems presenting with low back pain was present in 2 patients of Group B. On the other hand, stress incontinence occurred in 5 patients (2 patients in Group A and 3 patients in Group B). It has been hypothesized that increased body weight results in an increase in intra-abdominal pressure together with a resultant weakening of the pelvic floor musculature, both of which ultimately lead to stress urinary incontinence **(Osborn et al., 2013).** Hypertension is a serious co-morbidity in morbidly obese patients, and has been shown to decrease life expectancy **(Sarkhosh et al., 2012).**

Access to the abdominal cavity can be a challenging step in any laparoscopic

procedure, and can be even more challenging in morbidly obese patients. This is because of the facts that these group of patients tend to have an increase in abdominal wall thickness together with a possible hepatic enlargement resulting from fatty infiltration. There are different methods of access of the peritoneal cavity such as using an open technique, a veress needle, or using optical trocars **(Kassir et al., 2014).** Both the veress needle and optical trocars techniques are usually referred to as closed access technique. The benefits of the optical trocar technique are clear optical entry, decreasing the force necessary for insertion as well as minimizing the size of entry site and hence reducing air leaks throughout the procedure **(Uranues et al., 2016).**

In the present work, the mean operative time was 131.25±27.67 min (range 90-180) in Group A (LSG) and 139.5±26.99 min (range 100-180) in Group B (LGP). Some authors reported a shorter mean operative time ranging from 50 to 98 minutes for LGP. The longer operative time in LGP was attributed to the routinely performed endoscopic examination of the plicated stomach at the end of the operation, and this in part consumed some time. Moreover, we employed 2 rows of plication, while other authors only performed a single row. Overall, LSG operative time was shorter than LGP, but this was found to be insignificant. All procedures were completed laparoscopically without any conversions**.** The mean length of stay was 2.0±0.65 days (range 1-4 days), and 1.55±0.89 days (range 1-4 days) in Group A (LSG) and Group B (LGP) respectively, showing no difference in hospital stay between the 2 groups (p=0.08). Only 5 patients (3 from Group B and 2 from Group A) required a longer hospital stay (>2days), and this was due to persistent vomiting and inadequate oral hydration. One possible explanation of the occurrence of post-operative vomiting in the LGP group in the early postoperative period as stated by **Ramos et al. (2010) and Skrekaas et al. (2011)** that mucosal edema from venous stasis that results from employing multiple rows of sutures. In the LSG group, the 2 patients who had persistent vomiting necessitating a longer hospital stay were later diagnosed with gastric stenosis. In fact, in Group B (LGP), severe nausea and vomiting only occurred in patients early on in the study. Afterwards, patients experienced less severe vomiting episodes due to proper counseling on proper hydration and tutoring them on what to anticipate in the post-operative period. Moreover, a modification of technique in LGP group was utilized, in which we created multiple small intraluminal gastric folds (by multiple plications on each side of the greater curve) instead of making a single large intragastric fold. On the other hand, in Group A (LSG), staple line twisting can sometimes result in a kink of the gastric pouch which in turn can result into a narrowing or a parital obstruction. This was avoided by proper alignment of stapler during successive staple fires. Overall symptoms of post-operative nausea and vomiting were higher among Group B (LGP). **Shen et al. (2013)** reported similar results. However, these symptoms were relatively easy to manage, and were later on prevented. In addition, post-operative nausea and vomiting after LSG has been reported by **Keidar et al. (2010)** and **Benevides et al. (2013)** who proposed a combination of haloperidol,

dexamethasone, and ondansetron for prevention of postoperative nausea and vomiting in LSG.

In group A, minor staple line bleedings occurred in 5 patients and were dealt with either by bipolar cauterization, titanium clipping or figure of eight absorbable suturing. There were no reported mortalities in our study. During the post-operative course, one patient in Group A (LSG) experienced continuous low flow bleeding through the intraperitoneal drain. Pulse was 110 beats per minute, BP was 110/60 mmHg. The patients were managed conservatively; fresh blood transfusion and anti-hemorrhagic measures, but there was no obvious improvement. The decision was to re-explore the patient for a possible source of bleeding. Patient was re-explored laparoscopically on his first postoperative day. After drainage of 300 cc of blood, there was a staple line bleeding which secured successfully by eight shaped figure absorbable sutures. Patient was monitored and discharged the next day with an uneventful postoperative course. In retrospect, this patient bleeding might have been controlled by conservative measures. However, we can explain the reexploration of this patient because all of his vital parameters were not improving, and we had a relatively low threshold for reexploration during the early phase of this study. Post-operative bleeding is one of the commonest complications associated with LSG. **Sabbagh et al. (2010)** described a similar scenario to what occurred to us, where one of his patients experienced intraperitoneal bleeding during the first 24 hours that necessitated reexploration laparoscopicaly and source of bleeding was controlled. **Kassir et al. (2015)** reported patients who suffered from trocar related intra-abdominal bleeding, resulting in death in one patient and relaparoscopic exploration of the other.

Gastric leak or fistula did not occur in any of the studied patient's groups. However, staple line leakage/fistula has been notoriously associated with LSG and remains as the most dreaded complication. It was described as the most common cause of morbidity in LSG patients **(Aurora et al., 2012).** Reports of gastric leak after LSG have been within the 1.4–5.3 % of cases (mean 2.4%) **(Burgos et al., 2009 and Sakran et al., 2013).**

The etiology behind the leak is still obscure. However, there is a general agreement that there are local risk factors that contribute to a leak such as an impaired suture line healing due to poor blood flow, and an infection. These risk factors contribute to a decrease in oxygen and a subsequent degree of ischemia to the tissue **(Casella et al., 2009 and Csendes et al., 2010).**

In our study, there was one minor leak in group A, and successful conservative management was done. **Talebpour and Amoli (2007)** had two cases of gastric perforation that required suture repair, while **Watkins (2012)** describes a patient following LGP who presented with free intraperitoneal air, and was found to have a herniated gastric fundus with a resultant fundic necrosis. The patient was converted to a sleeve gastrectomy with resection of the necrotic segment.

In our study, five patients presented with persistent obstructive symptoms in the form of persistent nausea, vomiting and sailorrhea: three patients were from

Group B (LGP), and 2 patients from Group A. Group A (LSG) patients presented 6 and 8 weeks post operatively. Oral Gastrograffin fluoroscopy revealed a pouch narrowing at the mid portion of the stomach. Both patients were managed successfully by endoscopic dilation. The endoscope passed easily in both cases, and they only needed a minimal amount of dilation to widen the narrowing. We, therefore, postulated that a stomach tube kink was behind the narrowing rather than a pathologic stenosis or a stricture. Fortunately, this kink was corrected by the passage of the endoscope. **Fischer et al. (2012)** reported that there was stenosis symptoms in 2 patients presenting around 5 and 8 weeks one was managed conservatively, while the other required endoscopic dilation. We believe that the second patient could have been managed conservatively, but it was early in the study, and we have a lower threshold for investigating the new technique. Interestingly, 4 out of the 5 patients had a longer hospital stay after their original surgery.

Simple wound infection occurred in 1 patient in Group A (LSG), and one patient presented with intermittent fever and persistent shoulder and left hypochondrial pain. On CT scan a residual left subphrenic collection was noted but was minimal in amount. Patient was managed conservatively with no complications. This collection could have been a small hematoma that got infected, and once the patient was started on broad spectrum antibiotics, the fever went down and the pain subsided. Another patient in Group B developed intermittent high fever and abdominal pain 2 weeks after surgery necessitating readmission and investigation for potential surgical complications (Ultrasound and CT scan). However, no complication was detected. Further investigation revealed jaundice with underlying acute hepatitis with high titer of HAV IgM (Hepatitis A virus) as the cause of fever and pain. Patient was discharged on liver support medications. Two patients (one in each group) developed symptomatic cholelithiasis postoperatively after 6 months in Group A, and 4 months in Group B. Both patients underwent laparoscopic cholecystectomy. In our study the overall complication rate was 50% for Group A (LSG), and 55 % for Group B (LGP). However, major complications were 20% for Group A (LSG) and 15 % for Group B (LGP). A review of LSG reported an overall morbidity ranging from 0% to 17.5%, whereas the mortality rates were between 0% and 1.2% **(Fischer et al., 2012).**

The primary outcome of this study was to compare the rate of weight loss between the two groups. In our series, the EWL% among LSG patients was relatively higher than reported by **Nocca et al. (2008) and Sabbagh et al. (2010).** On the other hand, Group B (LGP) patients expressed similar EWL% to that reported by **Talebpour et al. (2012).** One study demonstrated age as a predictive factor for weight loss where it reported a greater weight loss in patients younger than 45 years old compared to older patients **(Nocca et al., 2008).** This could probably explain why our results were relatively higher than others since we have a relatively lower mean age than reported by other authors, where 85% of our patients and in particularly 90% of Group A (LSG) were younger than 45 years old.

Furthermore, proper dissection of all post gastric adhesions helped in controlling the gastric pouch size without leaving any remnant gastric fundus. This could additionally increase EWL%.

In comparison, EWL% was significantly higher among Group A (LSG) compared to Group B (LGP), at 12 months follow up. Similarly, % EWL was significantly higher among Group A (LSG) after 2 weeks follow up. On the other hand, there were no difference in EWL% after 3 and 6 months follow up. Similar results were reported by **Shen et al. (2013)**.

Subgroup analysis, where patients were divided according to their preoperative BMI revealed a significantly higher EWL% after 12 months among LSG patients in the subgroup ranges of BMI. On the other hand, in the middle subgroup of BMI, there was no statistically significant difference as far as EWL%. We can conclude from these results that in severely obese patients with a BMI >45 LSG managed to achieve a higher weight loss rate than LGP, and that was also found to be with a strong statistical significance. All patients had an adequate weight loss except for 2 patients in Group B (LGP) who had inadequate weight loss. One patient was a female with a preoperative BMI of 60 kg/m^2 and the other was a male with a BMI of 38.9 kg/m^2. Both patients were able to reach a EWL% of 39.5 and 41.4, respectively. This once again highlights the superiority of LSG in patients with high grade obesity. There was still no correlation between bougie size and weight loss probably due to variable confounding factors such as ghrelin level, patient eating habits, and pyloric function of residual stomach.

A total of 27 co-morbidities existed in both groups; with 10 co-morbid conditions in Group A (LSG) and 17 co-morbid conditions in Group B (LGP). Total cure rate was 80% in Group A (LSG) and 69% (LGP) in Group B. There was no statistically significant difference between the two groups as far as the cure rate. Joint pain was the most common co-morbid condition in both groups. Pain resolved in all Group A (LSG) patients, and in 75% of Group B patients. However, one patient in Group B described a tolerable joint pain that was easily controlled by a lower dose of analgesics. Notably, this patient has an inadequate weight loss reaching only 39.5 EWL%, and this could explain the failure of complete amelioration of symptoms. Stress incontinence was present in 5 patients in both groups. Incontinence resolved in all patients of Group A, and in 1 patient out of 3 in group B, while the other 2 continued to suffer from incontinence but at a lower rate than preoperatively. Five patients had medically controlled hypertension in both groups (3 in Group A and 2 in group B). Two out of 3 patients in Group A were off the antihypertensive medications compared to 1 out of the 2 patients in Group B. The remaining 2 patients (one in each group) had their antihypertensive drug dosage reduced. Dyslipidemia occurred in 3 patients (1 patient in Group A and 2 patients in Group B). There was a 100% cure rate of dyslipidemia in both groups resulting in a normal recorded lipid profile. Two patients with back pain in Group B had their symptoms resolved at the end of follow up period. Moreover,

one patient with infertility got pregnant at the end of the follow up period. This patient was suffering from polycystic ovarian syndrome (PCOS), and was actually referred to us for weight loss surgery in an attempt to improve her fertility parameters. One patient with asthma in Group B had no improvement in his symptoms.

Obesity and its related co-morbidities has been increased in the past couple of years. Bariatric surgery has been considered as the most reliable method for controlling obesity and hence improving co-morbidities, and in turn increasing survival rate **(Merlotti et al., 2017). Shi et al. (2010),** in a systematic review of LSG, reported an average combined resolution and improvement rate of diabetes, hypertension, hyperlipidemia, sleep apnea, degenerative joint disease, GERD, peripheral edema, and depression.

Quality of life (QoL) was analyzed by using Moorehead-Ardelt Quality of Life Questionnaire II (M-A QoLQII) at the end of follow-up period. For patients with co-morbidities the Bariatric Analysis and Reporting Outcome system (BAROS) with (M-A QoLQII) was used. All patients had good outcome. In Group A (LSG), 60% had a Good QOL outcome, compared to 75% in Group B (LGP). Very good QOL outcome was stated in 40% and 25% patients in Group A (LSG) and Group B (LGP), respectively. Surprisingly, the 2 patients with inadequate weight loss were very satisfied and recorded a good quality of life assessment. They were very grateful for the surgery that helped them ambulate much better with less pain and fatigue. Patients with a very good QoL reported great adherence to nutrition protocol that was provided by our team. Moreover, all patients who had co-morbidity displayed a very good QoL, even when there was just an improvement rather than a full cure. Quality of life was considered to be the true measure for the effectiveness of a surgical procedure.

The available studies show great variation in outcomes. Diabetic patients with obesity have a worsened quality of life compared to obese non-diabetics. Moreover, QoL improves more in the diabetes patient with remission and/or improvement compared to the non-diabetic group. They also correlated the improvement in QoL in diabetics with BMI loss. However, QoL in non-diabetics' population do not correlate with the BMI loss **(Prazeres et al., 2013).**

CONCLUSION

Both laparoscopic sleeve gastrectomy and laparoscopic greater curvature plication have a reasonable outcome on morbid obesity management with preference of laparoscopic sleeve gastrectomy after 12 months postoperatively in the degree of weight loss and overall complications rate.

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دراسة معدل فقد الوزن الزائد بعد العمليات الجراحية من نوعية تكميم المعدة وطيها بإستخدام المنظار الجراحي لمرضي السمنة المفرطة

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خلفية البحث: تمثل جراحات السمنة الطريقة الفعالة الوحيدة في علاج السمنة المفرطة، لكن لم يتم الإتفاق علي أفضل تلك الطرق.

الهدف من البحث: المقارنة بين فعالية تكميم المعدة من ناحية وطي المعدة من ناحية أخري بإستخدام المنظار الجراحي في علاج السمنة المفرطة.

المرضي وطرق البحث: إشتملت الدراسة علي ٥٤ مريضاً بالسمنة المفرطة، وتم إستبعاد ١٤ منهم لعدم انطباق شروط التضمين في الدراسة عليهم أو بسبب رفض المريض المشاركة في الدراسة. وأجريت الدراسة بمشاركة ٤٠ مريضا تم تقسيمهم إلي مجموعتين متساويتين طبقا لنوع التدخل الجراحي لعلاج السمنة: الأولي خضعت لجراحة تكميم المعدة بالمنظار، والثانية خضعت لطي المعدة بالمنظار. وقد تم تقييم جميع المشاركين في الدراسة قبل التدخل الجراحي عن طريق أخذ التاريخ المرضي كاملا، والقيام بفحص إكلينيكي شامل، والقيام بالإختبارات المعملية والإشعاعية اللازمة، وتقييم جودة الحياة. وبعد شرح الدراسة والهدف منها، تم أخذ الموافقة من كل مريض علي المشاركة في الدراسة. وقد تم متابعة كل المرضي لمدة ١٢ شهرا بعد الجراحة، وتقييم الفرق بين المجموعتين بالنسبة لنجاح الجراحة في خفض الوزن، والمضاعفات التي حدثت لمرضي كل مجموعة أثناء فترة المتابعة.

النتائج: لم توجد مضاعفات خطيرة في المرحلة الأولي من المتابعة (الشهر الأول بعد الجراحة، بينما لوحظ أن إثنان من المرضي (واحد في كل مجموعة) عانيا من حصوات بالمرارة. وحدثت أعراض للضيق لدي ٥ من المرضي (تمثلت تلك الأعراض في حدوث قيء متقطع، وعدم تحمل الأطعمة الصلبة): كان ثلاثة منهم في المجموعة الأولي، وإثنان في المجموعة الثانية. ولم توجد فروق ذات دلالة إحصائية بين مجموعتي الدراسة بالنسبة للوزن قبل التدخل الجراحي، وبعد أسبوعين، و٣ أشهر و٦ أشهر بعد الجراحة، بينما أظهرت المجموعة الأولي إرتفاعا في إنخفاض الوزن بعد الجراحة بـ ١٢ شهرا مقارنة بالمجموعة الثانية. وكانت نسبة الخفض في الوزن الزائد وإنخفاض مؤشر كتلة الجسم أعلي في المجموعة الأولي بعد ١٢ شهرا عند مقارنتها بالمجموعة الثانية. وأظهر جميع المشاركين في الدراسة إنخفاضا في الوزن بطريقة جيدة ما عدا إثنين من المرضي في المجموعة الثانية.

الإستنتاج: لكل من تكميم المعدة أوطيها بالمنظار نتائج مقبولة وجيدة في مرضي السمنة المفرطة، ولكن تميزت جراحة تكميم المعدة بنتائج أفضل بعد ١٢ شهرا من المتابعة بالنسبة لمؤشر إنخفاض الوزن، ومدي حدوث المضاعفات أو رضا المريض.