Short-term outcome of laparoscopic sleeve gastrectomy (LSG) and laparoscopic gastric plication (LGP) in morbidly obese patients

Islam M. Ibrahim MD., Abd Elrahman Metwalli MD and Tamer Rushdy MD.

General Surgery Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt
dr_moh2003@yahoo.com

Abstract: Background: Exercise, diet, and medications are not usually enough in morbidly obese patients to provide satisfactory and durable weight loss. Bariatric surgery is the best modality for weight loss and for resolving the associated comorbidities. **Objective:** To compare short-term outcome of LSG and LGP for treatment of morbid obesity. **Patients and methods:** Thirty patients presented for the study during the duration between May 2015 and August 2017. The patients were randomly classified into two equal groups: group A subjected to LSG and group B had LGP. All patients were subjected to preoperative assessment (history taking, physical examination, laboratory investigations, imaging studies, and cardiopulmonary assessment), upper GIT endoscopy or Barium meal, and quality of life assessment. Patient education and supervised dietary instructions were provided. All patients were informed about the advantages and disadvantages of two procedures and consented to be included in this randomized study. The written consents were signed by patients for the procedure to be performed for them. Patients were followed up for postoperative complications and overall outcome. **Results:** No major complications were observed in the early postoperative period. Two patients (one in each group) developed postoperatively symptomatic cholelithiasis. Three patients presented with mild stenosis symptoms (intermittent vomiting and intolerance to solid food), two patients were from group A and one from group B. There was no statistically significant difference between the mean preoperative weights in both groups. After one month, three months and six 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, percentage of excess weight loss (%EWL) was significantly higher among group A compared to group B after one month follow up. All patients had adequate weight loss except for one patient 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. 12 patients had a good outcome in group A compared to 10 in group B; while three patients in group A had a very good outcome compared to two 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.
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1. Introduction

Obesity is a growing health problem in both developed and developing countries **(Sjostrom et al., 2007).**

Obesity results in different comorbid conditions, including diabetes, cardiovascular disease, obstructive sleep apnea, nonalcoholic steatohepatitis, hypertension. dyslipidemia, osteoarthritis, and cholelithiasis. Obesity increases the risk of many of these conditions (**Dixon, 2010).** Obesity is also an independent risk factor for a variety of cancers including breast, prostate, colon, and uterine cancer (**Wolin et al., 2010)**.

Exercise, diet, and medications are not usually enough to provide durable satisfactory weight loss in morbidly obese patients **(Sjostrom et al., 2007).**

Bariatric surgery is the best modality for weight loss and for resolving the associated comorbidities (**Buchwald et al., 2004)**.

Bariatric operations may be restrictive, malabsorptive, or both. Restrictive procedures are the most conservative bariatric surgery while malabsorptive method has durable weight loss but associated with vitamin deficiency and anemia (**Crea et al., 2011).**

LSG was among those surgeries that have widely been accepted as a successful stand-alone bariatric procedure. It involves a longitudinal gastric resection, achieved by endostapling devices, resulting into a gastric restriction as well as some hormonal effects that lead to a decrease in food intake. Despite this success there were concerns regarding its long staple

line with the threats of gastric bleeding and leaks (**Hildebrandt et al., 2012**).

LGP was subsequently developed and introduced by **Talebpour** in 2006 (**Talebpour and Amoli, 2007)** and promoted by other authors as an alternative restrictive bariatric procedure that could possibly avoid the innate complications of LSG (**Abdelbaki et al., 2012).** LGP involves a restrictive mechanism of weight loss through the reduction of gastric volume, by rows of sutures, without resorting to a gastric resection. In a recent review, EWL after LGP ranged from 53.4–67.1% at one-year follow-up, with an overall complication rate of eight% (**Abdelbaki et al., 2012**).

The aim of the current study is to compare the short-term outcome of laparoscopic sleeve gastrectomy (LSG) and Laparoscopic gastric plication (LGP) for treatment of morbid obesity.

2. Patients and methods

A) Study design:

This was a prospective randomized study, simply randomized by closed envelop method in which a comparison was held between 2 groups of patients who were scheduled for surgical treatment of morbid obesity:

Group (A): 15 cases, was managed by laparoscopic sleeve gastrectomy (LSG).

Group (B): 15cases was managed by, Laparoscopic gastric plication (LGP).

Inclusion criteria:

- Age: between 18 and 55 years old.
- Co-morbidities: American society of anesthesia-logy (ASA) class I or II.
- patients required a body mass index (BMI) of >40 kg/m2 or >35 kg/m2 with at least one comorbidity.

Exclusion criteria:

- Age: less than 18 or above 55 years old.
- BMI > 65 kg/m2.
- patient's unfit for general anesthesia, (ASA) risk score [III].
- Inability to cooperate with the requirement of the study.
- Recent history of alcohol or drug abuse, current therapy of any anticonvulsant or immunosuppressive.
- Large abdominal wall or hiatal hernia.
- Pregnant females.
- Study psychological conditions that influence his/her perception of the protocol and postoperative evaluations and recommendations.

B) Study setting and time:

This study was conducted in the department of general surgery, Zagazig University Hospitals from May 2015 and August 2017.

C) Study tools:

All our patient are subjected to the following:

1] History taking:

- Demographic data including name, age, sex, residence, occupation, marital status, special habits of medical importance and menstrual history for females.
- Past history of previous operations, chronic diseases, drug allergy, chemotherapy or radiotherapy.

2] Physical examination: General examination for vital signs and other systems to assess fitness for surgery and anesthesia. Abdominal examination for masses and scars

3] Investigations:

1. Routine pre operative investigations: as complete blood count, coagulation profile (PT, PTT & INR), Liver and Kidney function tests, Viral markers, random blood sugar and ECG.
2. Imaging studies: Abdominal US, Barium meal study.
3. Other investigations: including upper GI endoscopy.

D) Administrative and ethical design and approval:

All patients were informed extensively regarding the potential benefits, complications and alternatives prior to the operation, and patient's availability for follow-up. Informed consent was obtained from all patients included in the study. The study was approved by the local ethical committee.

E) Study method:

Patient preparation: Anticoagulants were given 12 h preoperatively. The patient was kept NPO for 6 hours prior to the procedure. Prophylactic antibiotics were given with the induction of anaesthesia.

All patients fulfilled the criteria of the American Society of Anesthesiology (ASA) for fitness for surgery and anaesthesia.

Operative techniques: Using 5- or 10-mm Liga Sure device (Valleylab, Boulder, USA), the omentum and gastroepiploic vessels were dissected from the greater curvature, starting at 4 cm from the pylorus and continuing up to the left crus of the diaphragm and the angle of His.

The short gastric vessels, posterior gastric vein and posterior gastric attachments were carefully divided. A 32-Fr nasogastric tube was inserted and directed toward the pylorus.

Group A (15 patients) had laparoscopic sleeve gastrectomy (LSG). Gastric transection started four cm proximal to the pylorus using Echelon Flex Endo path with 60 mm green reload (Ethicon, Somerville, USA). The staplers were placed approximately one cm from the tube in the direction of the gastroesophageal junction. After completing the transaction, bleeding points were secured using 10-mm endoclips or Vicryl 3-0 (Ethicon, Somerville, USA) intra corporal sutures. In every case, we over sewed the staple line, using

Ethibond 3-0 (Ethicon, Somerville, USA) continuous suture. The transected stomach was then removed through the right 12-mm port. Air was injected into the stomach, and the staple line was inspected carefully for leaks. Abdominal drain was removed on the third post operative day after the patient started oral feeding **(figure 1: A, B, C, D, E).**

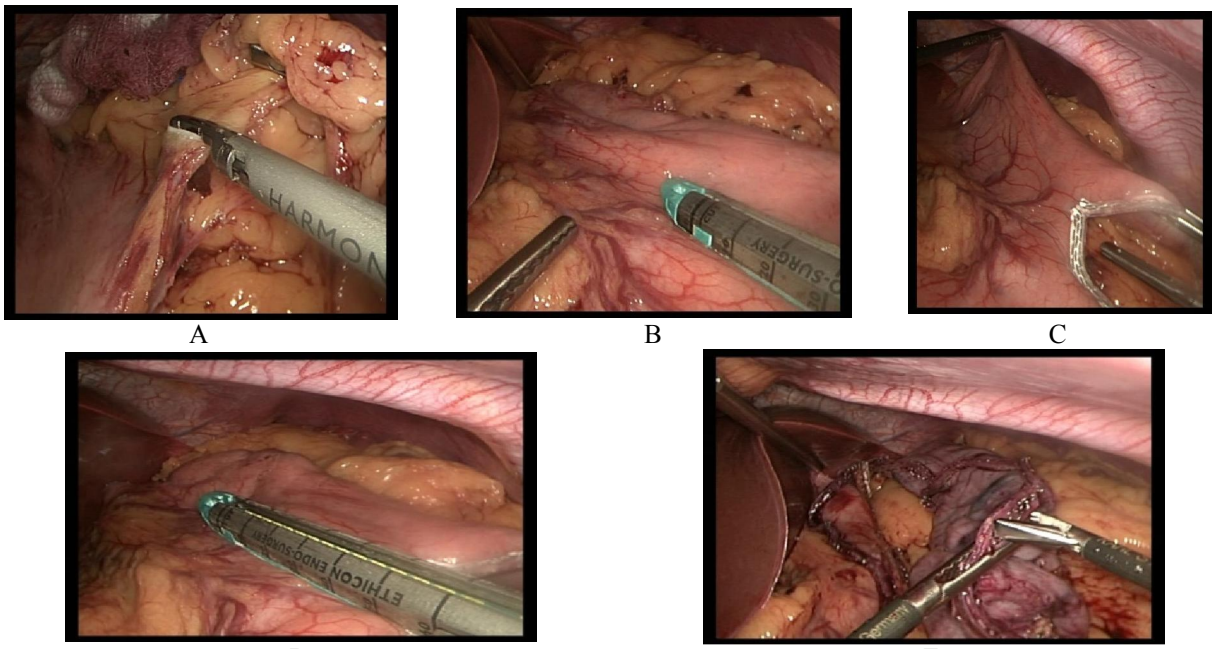

Figure 1: Steps of laparoscopic sleeve gastrectomy (LSG) **(A, B, C, D, E)**

Group B (15 patients) had laparoscopic greater curvature plication (LGP).

After omentum dissection, a row of 8–10 extra mucosal interrupted sutures of Ethibond 2-0 (Ethicon, Somerville, USA) sutures was placed just below the angle of His and continued distally to four cm of the pylorus over the 32-F gastric tube. The second row of extra mucosal running sutures of 2-0 Prolene (Ethicon, Inc.) was used as reinforcement and to narrow the stomach. No leak test was performed. an upper gastrointestinal endoscopy was routinely performed to assess the final stomach capacity and to confirm the patency of the created gastric pouch. A drain was then placed next to the gastric pouch **(figure 2: A, B, C).**

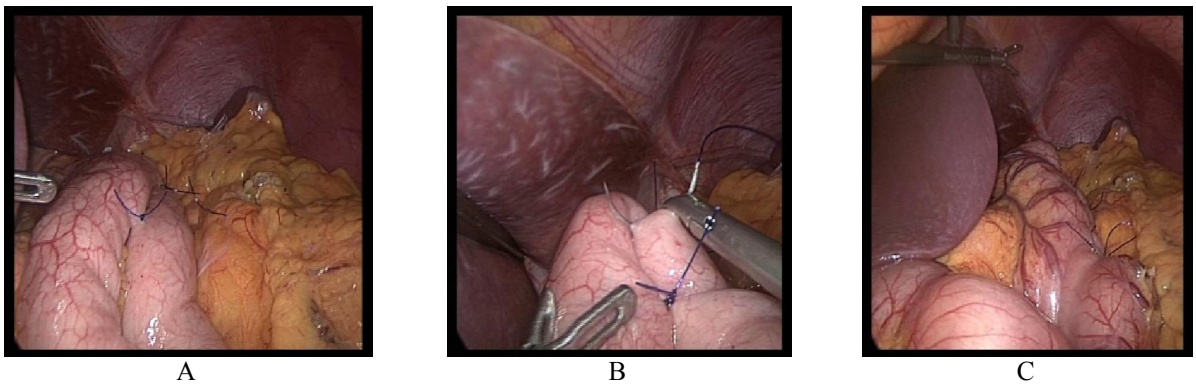

Figure 2: Steps of laparoscopic greater curvature plication (LGP) **(A, B, C)**

Post operative care and follow up: In the LGCP group, proton pump inhibitors (PPI) were administered intravenously during the postoperative period. Patients were discharged once they tolerated a liquid diet without vomiting. Patients were advised to eat soft diet 15 days after surgery and full diet 30 days after surgery. A daily single-dose PPI was prescribed for 30 days. In the LSG group, gastrographin meal was done on the second postoperative day. Patients were

allowed to drink clear fluids on the third postoperative day. Patients resumed a normal diet in 3 weeks.

Patient was educated by dieticians to consume five to six small meals each day and to avoid overeating and vomiting. Follow-up visits were scheduled at 1, 3, 6, and 12 months postoperatively.

The following parameters were assessed: operative time, hospital stay, postoperative complications BMI loss (BMIL), percentage of excess weight loss (%EWL) and changes in comorbidities.

3. Results

Table (1): Patient demographics in both groups

Variables		Group A (LSG)	Group B (LGP)	P value
Age (years)	(mean± SD) (range)	30.0± 8.2 (18-50)	32.8±6.8 (20-55)	0.32
Gender (M/F)	N %	4/11 (26.7%/73.3%)	5/10 (30%/70%)	0.7

This Table shows that there was no significant difference as regards patient's demographics in both groups.

Table (2): Patient anthropometric measurements in both groups

Variables		Group A (LSG)	Group B (LGP)	P value
Weight (kg)	(mean± SD) (range)	122.13±20.3 (85-173)	120.3±19.4 (85-174)	0.80
Height (cm)	(mean± SD) (range)	167.3±10.3 (150-188)	170.25±4.6 (156-182)	0.32
BMI (kg/m2)	(mean± SD) (range)	44.2±21 (36-52)	42.5±4.22 (35-60)	0.76
Excess weight (kg)	(mean± SD) (range)	50.16±14.6 (30-89)	49.22±16.3 (27-100)	0.87
Waist/Hip ratio	(mean± SD)	0.901±0.07	0.915±0.03	0.5

This Table shows that there was no significant difference between both groups as regard to anthropometric measurement and waist/hip ratio.

Table (3): Patient co-morbidities in both groups

Variables	Group A (LSG)	Group B (LGP)	P value
Osteoarthritis	2(13.3.0%)	3(20.0%)	0.62
Stress incontinence	1(6.7%)	2(13.3%)	0.54
Hypertension	2(13.3%)	1(6.7%)	0.54
Dyslipidemia	1(6.7%)	1(6.7%)	1
GERD	1(6.7%)	2(13.3%)	0.54
Low back pain	0(0.0%)	1(6.7%)	0.5
Intermittent asthma	0(0.0%)	1(6.7%)	0.5
Infertility	0(0.0%)	1(6.7%)	0.5

This table shows that Group A had 7 co-morbidities in 4 patients (26.6%) compared to 12 comorbidities in 6 patients (40.0%) in group B and Osteoarthritis of the lower limb joint was the most common comorbid condition in the study. There was no statistically significant difference between both groups A and B as regard to comorbidities.

Table (4): Patients with scar of previous operation in both groups

Variables	Group A (LSG)	Group B (LGP)	P value
Previous scar	1(6.7%)	2(13.3%)	0.54

This table shows that three patients (10%) had a scar of previous operation: In group A, one patient (6.7%) had a scar of open appendectomy, while In group B, 2 patients (13.3%) had a scar of an open appendectomy and cesarean section.

Table (5): the Operative time and length of hospital stay in both groups

Variables		Group A (LSG)	Group B (LGP)	P value
Operative time	(mean± SD) (range)	125.30±29.5 minutes (range 90-160)	130.5±25.8minutes (range 100-175 minutes)	0.61
Length of hospital stay	(mean± SD) (range)	2.0±0.7 days (range 1-4 days)	1.65±0.92 days (range 1-4 days)	0.25

This table shows that as regard the mean operative time and the mean length of hospital stay There was no significant difference between both groups (p = 0.25).

Table (6): Intra and postoperative Complications of groups A and B

Complications		Group A		Group B		P value
		n	%	n	%	
Intraoperative Bleeding		1	6.7%	0	0.0 %	0.5
Early Complications (the first 30 days postoperatively)	Vomiting	2	13.3%	4	26.7%	0.36
	Bleeding	1	6.7%	0	0.0 %	0.5
	Wound infection	1	6.7 %	2	13.3%	0.54
	Lt. subphrenic collection	1	6.7%	0	0.0 %	0.5
Late complications	Cholecystitis	1	6.7%	1	6.7%	1
	Gastric stenosis	2	13.3%	1	6.7%	0.54
Total		10	66.7%	9	60%	0.7
Mortality		0	0.0 %	0	0.0 %	0

This table shows that there were no statistically significant difference between both groups A and B as regard to intra and postoperative Complications.

Table (7): Weight evaluation in both groups A and B, preoperatively and at postoperative follow up.

Weight (kg) (mean± SD)		LSG group	LGP group	P
Preoperative		122.31±20.30	120.3±19.40	0.8
Postoperative Follow up	1 month	112.33±18.60	110.95±17.45	0.84
	3 months	104.65±16.70	105.80±16.75	0.85
	6 months	95.40±15.45	97.65±15.80	0.69
	12 months	82.8±14.65	90.35±14.55	0.18
EWL%	1 month	18.21±4.45	13.87±4.34	0.01*
	3 months	32.65±11.60	30.85±12.55	0.69
	6 months	50.25±13.80	48.37±17.65	0.75
	12 months	75.45±14.30	60.83±15.80	0.01*

Table (8): Comorbidity resolution in groups A and B

comorbidity	Group A		Group B	
	PO comorbidity	Resolution	PO comorbidity	Resolution
Osteoarthritis	2	2(100.0%)	3	2(66.7%)
Stress incontinence	1	1(100.0%)	2	1(50%)
Hypertension	2	1(50%)	1	0(00.0%)
Dyslipidemia	1	1 (100.0%)	1	1(100.0%)
GERD	1	0(0.0%)	2	1(50.0%)
Back pain	0	0	1	1(100.0%)
Asthma	0	0	1	1 (100.0%)
Infertility	0	0	1	1 (100.0%)
Total	7	5/7 (71.4%)	12	8/12 (66.7%)
P value	0.83			

Table (7) shows that there were differences between the mean preoperative weights in both groups. After 1 month, 3 months and 6 months, both groups experienced almost the same amount of weight

loss. On contrary, after 12 months follow up, group A demonstrated a greater weight loss with a mean weight of 82.8±14.65 kg, while group B was 90.35±14.55 kg.

Percentage of excess weight loss was significantly higher among group A compared to group B, after 12 months follow up (75.45±14.30 kg vs60.83±15.80 kg, respectively, p = 0.001). Similarly, EWL% was significantly higher among group A compared to group B after one month follow up (18.21±4.45 vs13.87±4.34kg respectively, p = 0.001). 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 32.65±11.60 and 50.25±13.80 respectively; and group B had EWL% of 30.85±12.55 and 48.37±17.65 respectively. All patients had adequate weight loss except for one patient in group B who had inadequate weight loss...

Table (8) shows that a total of 21 co-morbidities existed in both groups; with 7 co-morbid conditions in Group A (LSG) and 12 co-morbid conditions in Group B (LGP). Total cure rate was 71.4% in Group A (LSG) and 66.7% (LGP) in Group B. There was no statistically significant difference between the two groups as far as the cure rate.

Table (9): Quality of life in groups A and B

comorbidity	preoperative		Postoperative	
	Group A	Group B	Group A	Group B
	N (%)	N (%)	N (%)	N (%)
Very poor	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0%)
Poor	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0%)
Fair	9 (60.0%)	7 (46.7%)	0 (0.0%)	0 (0.0%)
Good	6 (40.0%)	8 (53.3%)	12 (80.0%)	10 (66.7%)
Very good	0 (0.0 %)	0 (0.0%)	3 (20 %)	5 (33.3%)
P value	0.46		0.41	

This table shows that Quality of life was assessed preoperatively by Moore head-Ardelt QoL questionnaire II showed that, There was no statistically significant difference between groups A and B as regard to quality of life. At the end of follow up period. All patients had a good or very good outcome, reflecting the overall level of satisfaction of patients. 12 patients had a good outcome in group A compared to 10 in group B, while 5 patients in group B had very good outcome compared to 3 in group A. The difference was statistically non-significant.

4. Discussion

The prevalence of obesity is increasing worldwide and the demand is rising every day for feasible, safe, and preferably low-cost methods of weight reduction (**Jaunoo and Southall, 2010**).

LSG has evolved from the first step of two-step procedure (duodenal switch) initially designed for the super-morbidly obese patients (**Marquez et al., 2010**).

Thereafter, LSG became an independent bariatric procedure and was promising in the short- and middle-term outcomes (**Zhang et al., 2014**). However, some complications are associated with LSG, such as esophagitis, stenosis, bleeding, fistulas and gastric leaks (**Tang et al., 2015).**

LGCP is notably similar to that of LSG: Both result in gastric tube formation and elimination of the greater curvature, but LGCP has the advantages of a reversible restrictive technique without gastrectomy and no risk of leakage from the staple line. However, the long-term efficacy is under investigation. There are few studies comparing it with LSG (**Fried et al., 2012; Brethauer et al., 2011).**

The main 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).**

The present work shows that both groups were comparable in age, gender and BMI measurement that was similar to other studies **(Grubnik et al., 2016; ToprakS et al., 2016).**

This study shows that no statistically significant difference between both groups **A** and **B** as regard to comorbidities that was similar to other studies (**Grubnik et al., 2016; Chouillard et al., 2016).**

In the present work, the mean operative time was 85.30±19.5 minutes (range 65-140) in Group A (LSG) was shorter than Group B (LGP) 96.5±15.8minutes (range 75-155 minutes) in Group B (LGP), but this was found to be insignificant. That was in agreement with other studies (**Grubnik et al., 2016; Chouillard et al., 2016).**

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. However, In group **A** in the early postoperative period one patient experienced continuous bleeding through the intra peritoneal drain and was re-explored (minor

staple line bleeding) and managed by laparoscopy (during the same admission) on day one that was similar to other study **(Sabbagh et al.,2010).**

The mean length of hospital stay was 2.0±0.7 days (range 1-4 days), and 1.65±0.92 days (range one-four days) in Group A (LSG) and Group B (LGP) respectively, showing no difference in hospital stay between the two groups (p=0.08) that was similar to other studies ((**Grubnik et al., 2016; ToprakS et al., 2016).**

In this study four (26.7%) patients' suffered from persistent nausea and vomiting in group **B** resulting in an increase in length of hospital stay in two out of four patients. On the other hand, in group **A**, two patients (13.3%) experienced persistent nausea and vomiting which in turn affected the hospital stay in one out of two patients. For both groups, the symptoms of nausea and vomiting were trivial and were managed by anti emetics successfully that was similar to other study **(hen et al., 2013).**

Other studies explain the occurrence of post-operative vomiting in the LGP group in the early postoperative period due to mucosal edema from venous stasis those results from employing multiple rows of sutures **(Grubnik et al., 2016; ToprakS et al., 2016).**

The present study revealed that three patients presented with mild stenosis symptoms (intermittent vomiting and intolerance to solid food): two patients were from group **A** and one from group **B**. Group **A** patients were managed successfully by endoscopic dilation. As regard group **B**; one patient was managed conservatively that was similar to other study **(Fischer et al., 2012).**

Left subphrenic collection occurred in one patient in Group A (LSG), and presented with intermittent fever and persistent shoulder and left hypochondrial pain and diagnosed by CT scan and 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.

Two patients (one in each group) developed symptomatic cholelithiasis postoperatively after six months in Group A, and four months in Group B. Both patients underwent laparoscopic cholecystectomy.

The study at hand demonstrated that 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 one month follow up. On the other hand, there were no difference in EWL% after three and six months follow up that was close to other study (**Hen et al., 2013).**

The current study showed that a total of 19 co-morbidities existed in both groups with seven comorbid conditions in group A and 12 in group B. Patients were assessed at the end of the follow up period for comorbidity remission. Total cure rate was 71.4% in group A and 66.7% in group B. Joint pain was the most common comorbid conditions in both groups. Pain resolved in all group A patients and in 66.7% 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 three patients in both groups. Incontinence resolved in all patients of group A and in one out of two patients in group B, while the other one continued to suffer from incontinence but at lower rate than that preoperatively. Three patients had medically controlled hypertension in both groups (two in group A and one in group B). One out of two patients in group A was off medication compared to one out in group B. The remaining one patient (in group A) had their antihypertensive drug dosage reduction. Dyslipidemia occurred in two patients (one in group A and one in group B). There was 100% cure rate of dyslipidemia in both groups resulting in a normal recorded lipid profile. One patient 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.

Other study reported an average combined resolution and improvement rate of diabetes, hypertension, hyperlipidemia, sleep apnea, degenerative joint disease, GERD, peripheral edema, and depression (**Shi et al., 2010).**

The present study showed that all patients had a good or very good outcome, reflecting the overall level of satisfaction of patients. 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.

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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