An experience of laparoscopic sleeve gastrectomy in obese, morbidly obese, and super morbid obese patients

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ABSTRACT

الأهداف: تقرير تجربتنا في استئصال المعدة (التكميم) لدى الأشخاص المصابين بالسمنة، السمنة المفرطة، والسمنة المفرطة جداً ومقارنة فعاليتها بين مجموعات المرضى.

الطريقة: اشتملت الدراسة على 147 مريض خضعوا لاستئصال المعدة (التكميم) خلال الفترة من مارس 2008م حتى ديسمبر 2011م في قسم الجراحة، مستشفى الملك سعود الطبي، الرياض، المملكة العربية السعودية. تم تقسيم المرضى بناءً على معدل كثافة الجسم ماقبل العملية (سمنة 35–39.9 كلغ/متر مربع، سمنة مفرطة 40–49.9 كلغ/متر مربع، وسمنة مفرطة جداً أكثر من 50 كلغ/متر مربع). كما تم استبعاد المرضى الذين ليس لديهم مراجعات منتظمة ودورية العدد=38 وإدراج 108 مريض فقط في هذه الدراسة الاستباقية.

النتائج: كانت معدل خسارة الوزن في مجموعة السمنة المفرطة جداً (41.31 ± 21.23 kg). أن معدل خسارة الوزن بين مجموعة السمنة المفرطة جداً (24.31 ± 13.00 kg, p=0.009) أعلى بشكل إحصائي من مجموعة السمنة ومجموعة السمنة المفرطة(26.81 ± 15.56 kg, p=0.001) . كما أن نسبة خسارة الوزن المتوسطة أعلى لدى مجموعة السمنة (57.8%)، مجموعة السمنة المفرطة (42.5%)، ثم مجموعة السمنة المفرطة جداً (45.7%). ولكن كان ذلك مهم إحصائي بين المجموعات (F[2,105]=2.132, p=0.124). لم تسجل حالة وفاة ولكن ظهرت مضاعفات أساسية في 6 حالات تشمل تجمعات داخل البطن والتي تسبب تسرب التسرب، ونزيف الخط الأساسي، واقفار الأمعاء، وإصابة التجويف الوريدي السفلي.

خاتمة: أن استخدام جراحة استئصال المعدة (التكميم) تنتج خسارة للوزن فعالة ومقبولة في جميع مجموعات المرضى المصابة بالسمنة وذلك خلال فترة 30 شهر متابعة.

Objectives: To report experience with laparoscopic sleeve gastrectomy (LSG) in obese, morbidly obese, and super morbid obese patients, and to evaluate comparative efficacy of LSG among these patient groups.

Methods: A total of 147 patients underwent LSG between March 2008 and December 2011 at the Department of Surgery, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia. Patients were grouped according to the preoperative body mass index (BMI) into obese (35-39.9 kg/m^2), morbidly obese (40-49.9 kg/m^2), and super morbid obese (>50 kg/m^2). Patients who did not have a regular follow-up (n=38) were excluded, and 108 patients were included in this prospective study.

Results: The mean total weight loss (TWL) among the super morbid obese group (41.31 ± 21.23 kg) was statistically significantly greater compared to the obese group (24.31 ± 13.00 kg, p=0.009) and morbidly obese group (26.81 ± 15.56 kg, p=0.001). The mean percentage excess weight loss (EWL) was clinically significant among obese (57.8%), morbidly obese (42.5%), and super morbid obese patients (45.7%), however, it was not statistically significant between the groups (F[2,105]=2.132, p=0.124). There was no mortality; however, 6 major complications occurred including intra-abdominal collection with suspected leak, staple line bleeding, bowel ischemia, and inferior vena cava injury.

Conclusion: Laparoscopic sleeve gastrectomy resulted in satisfactory and effective EWL in all 3 groups of obesity patients at 30-months follow-up.

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Obesity is associated with premature mortality, many other chronic conditions including hypertension, type II diabetes mellitus, stroke, osteoarthritis, obstructive sleep apnea and some cancers. It is also the cause of social stigma and decreased quality of life.[1] There is large evidence showing that effective weight loss is associated with a graded decrease in the risk of diabetes mellitus,[2] cardiovascular and cancer mortality,[3] hypertension,[4] and osteoarthritis,[5] as well as improved social functioning and quality of life.[6,7] The surgical treatment is now an established option for the individuals at high risk of complications from obesity. A systematic review and meta-analysis shows the efficacy of bariatric surgery in achieving effective weight loss and improvement or resolution of diabetes mellitus, hypertension, hyperlipidemia, and obstructive sleep apnea.[8] Bariatric surgery has also shown to reduce overall and cause specific mortality.[9,10] Laparoscopic sleeve gastrectomy (LSG) is now the most frequently performed bariatric surgery procedure. It was initially added as a modification to the biliopancreatic diversion (BPD), and then combined with a duodenal switch (DS) in 1998.[11,12] Gagner et al[13] adapted the BPD-DS to the laparoscopic approach in 1999, and subsequently in 2000, introduced the concept of staged approach in very obese patients where LSG was performed as the initial procedure.[14] With the revelation that the patients experienced considerable weight loss after LSG, it has become an accepted surgical alternative for adults with morbid obesity, and has now been proposed as a stand alone bariatric surgical procedure.[15] In the past few years, the number of surgeons reporting LSG as a definitive bariatric procedure is increasing. However, most of the earlier reports focused on the high risk obese patients where LSG was used as a bridge to definitive bariatric procedure. Recently, the researchers have published favorable results following LSG in morbidly obese,[16] and even in patients with class I obesity (BMI; 30-35 kg/m^2),[17] however, published evidence comparing the effectiveness of LSG in causing weight loss in obese, morbidly obese, and super morbid obese category of patients is scant. The aim of this study is to report our experience of LSG with all 3 categories of obese, morbidly obese, and super morbid obese patients, and to determine the comparative efficacy of LSG among these patients.

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Methods. The search for prior published literature was initiated by defining the key words, synonyms, and combination search words, which were identified as laparoscopic sleeve gastrectomy, sleeve gastrectomy, bariatric surgery, obesity surgery, bariatric surgery in different obesity groups, and sleeve gastrectomy in various BMI patient groups. The electronic resources - MetaLib available on the Cardiff University, UK website was used to access most databases, which included Cochrane Library, Embase, Medline (Ovid), Pubmed, Scopus, Web of Science via web of Knowledge, and Zetoc. Google and Voyager Library Catalogue were also used as search tools. Relevant journals and books available in local library were also hand searched. The reference lists of searched articles were also used to find more articles by accessing the specific journal websites. The initial inclusion criteria for search were kept wide regarding type of publication and the year of publication. Usually the evidence within the last 5 years is considered recent. The recent available evidence related to research question is limited, therefore the time limit on the search was widened to gather more evidence. This prospective study included 108 patients who underwent LSG at the Department of Surgery, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia between March 2008 and December 2011. A total of 147 patients were operated on during this period, however, 38 patients did not follow-up at this hospital and were excluded from the study. The study was approved by the Institutional Review Board. All the patients met the National Institute of Health consensus development conference criteria for bariatric surgery in adults.[18] Patients had a comprehensive multidisciplinary preoperative evaluation including surgical, endocrinology, medical, psychiatric, and anesthesiology work up, as well as gastrointestinal endoscopy. Informed consent was obtained after a thorough discussion regarding the surgical procedure, all potential advantages, possible complications, and side effects. All of the procedures were performed by the same team of surgeons. Standard surgical technique was used.[19] The patient was positioned supine during the operation with extension of arms in abduction, open legs, and reverse Trendelenburg position with 10° tilt. The surgeon worked standing between the legs of the patient, while the assistant and the cameraperson stood on the left and right sides of the patient. Abdominal insufflation pressure was set at 15

mm Hg. Five trocars are placed as follows: first (T_1) - 10 mm trocar was placed 20 cm below the xiphoid process for the 30˚ camera; second (T_2) - 5 mm trocar on the left anterior axillary line; third (T_3) - 12 mm trocar on the left mid-clavicular line between the first and second trocars; fourth (T_4) - 12 mm trocar on the right mid-clavicular line; and fifth (T_5) - 5 mm trocar below the xiphoid process. The division of the vascular supply of the greater curvature of the stomach was the initial step of the procedure using a dissecting coagulator (UltraCision, Ethicon Endo-Surgery, Ethicon, Somerville, NJ, USA). The greater curvature was mobilized starting at a point, 4 cm proximal to the pylorus, lesser sac was entered, and the greater curvature ligaments (gastrosplenic and gastrocolic) were divided up to the angle of His, while staying close to the wall of the stomach. Particular attention was paid to the identification and mobilization of the angle of His through exposure of left crus of diaphragm in order to delineate the gastroesophageal junction, and achieve complete resection of the gastric fundus. Retrogastric adhesions were carefully cleared to completely mobilize the stomach, avoiding redundant posterior gastric wall, and exclude the fundus from the gastric sleeve. Once complete mobilization of the stomach was achieved, a 36 Fr orogastric tube was inserted through the oral cavity into the pylorus, and placed along the lesser curvature. The placement of orogastric tube provided the subsequent size and shape of the gastric sleeve, and prevented any gastroesophageal constriction. Gastric transection was started at 4 cm proximal to the pylorus, which preserved the antrum and physiological gastric emptying. A cutting stapler (Echelon Flex, Ethicon Endo-Surgery, Ethicon, Somerville, NJ, USA) was consecutively fired along the whole length of the orogastric tube until the angle of His, taking care not to narrow the stomach at the angularis. During the transection the stomach is inspected anteriorly and posteriorly avoiding any redundant posterior wall. After completion the staple line was inspected for bleeding and leak test was performed by infusing methylene blue into the gastric sleeve. The reinforcement of the staple line was not performed in all patients and seroserosal running suture reinforcement was used if required. The nasogastric tube and an intra-abdominal drain were placed and the resected stomach was removed through the periumbilical incision at the end of the procedure. The fascial defects were closed with nonabsorbable sutures to prevent port site hernia. The drain was usually removed on the second postoperative day. A Gastrografin study was performed on the first postoperative day, the nasogastric tube was removed, and fluid diet started. Patients were usually discharged on the second postoperative day once they were stable, mobile, and tolerating liquids. They were advised to continue on liquid diet for 2 weeks and follow-up in outpatient clinic for periodic physical and biochemical evaluations to detect weight changes and any nutrient deficiencies. Patients were followed-up every 3 months for the first year, and then every 6 months. The following patient parameters were registered into the database and retrieved for analysis; age, gender, preoperative BMI, comorbid conditions, length of hospital stay, follow-up period, initial excess weight, total weight loss, percentage of excess weight loss, and complications. Excess weight was calculated as the difference between the patient's current weight and the ideal weight.

The ideal weight was calculated using the Robinson formula (1983). Percentage of excess weight loss (EWL) is the ratio of weight loss at a given time over the total excess weight. All continuous data was assessed for normal distribution and presented as mean and standard deviation. One way ANOVA (Analysis of Variance) was used to determine differences between the studied obesity groups, and Tukey post-hoc test was carried out to know the actual size of difference. The Statistical Package for Social Sciences version 20 (SPSS,® IBM Inc, Chicago, IL, USA) was used for statistical analyses, and $p<0.05$ was considered statistically significant.

Results. One hundred and eight patients underwent LSG, and there were 80 females and 28 males. Thirteen patients out of the total were placed in the obese group (BMI; 35-39.9 kg/m^2), 63 in the morbidly obese (BMI; 40-49.9 kg/m^2), and 32 patients in the super morbid obese groups (BMI >50 kg/m^2). Patients in the obese group had a mean age of 31 years, and a mean BMI of 37.4 kg/m^2 (range: 35-39.9). The average initial excess weight was 42.8 kg, and after a mean follow-up of 8.6 months, the average total weight loss was 24.3 kg with an average EWL of 57.8% (**Table 1**). The patients among the morbidly obese group had a mean age of 32 years, and mean BMI of 45.1 kg/m^2 (range: 40-49.8). This patient group had a mean initial excess weight of 62.6 kg, and an average weight loss of 26.8 kg with 42.5% mean EWL after 6.7 months follow-up (**Table 1**). Super morbid obese patient group had a mean age of 31 years, and mean BMI of 55.6 kg/m^2 (range: 50.4-67.8). The patients in this group had an average initial excess weight of 88.3 kg, and a mean of 41.3 kg was lost after a follow-up of 10.8 months. The mean EWL was 45.7% (**Table 1**). Comorbid conditions were present among 61.5% patients in the obese group, while 41.2% of morbidly obese, and 50% of super morbid

obese group had other comorbidity. Hypertension was the most common comorbidity followed by bronchial asthma and diabetes mellitus. The application of one way ANOVA revealed statistically significant differences between the studied groups as regards the mean BMI (F[2,105])=163.456, p=0.0001); mean initial excess weight (F[2,105]=117.569, p=0.0001); average follow-up (F[2,105]=3.350, p=0.039); and mean total weight loss (F[2,105]=8.610, p=0.0001); while no differences between the groups were found as regards the age (F[2,105]=0.476, p=0.622); and EWL (F[2,105]=2.132, p=0.124) (**Table 2**). Tukey post-hoc test revealed that BMI and initial excess weight was statistically significantly greater in the super morbid obese group (55.65 ± 4.76 kg and 88.34 ± 12.30 kg) as compared to the obese (37.39 ± 1.27 kg and 42.85 ±

Table 1 - Background data of patients that underwent laparoscopic sleeve gastrectomy included in a study at the Department of Surgery, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia.

Variables	N	Mean ± SD	95% confidence interval for mean		*P*-value
			Lower bound	Upper bound	
Age, years					
Obese	13	31.31 ± 7.973	26.49	36.13	0.622
Morbidly obese	63	32.87 ± 8.251	30.80	34.95	
Super morbidly obese	32	31.34 ± 7.782	28.54	34.15	
Total	**108**	**32.23 ± 8.044**	**30.70**	**33.77**	
Body mass index, kg/m²					
Obese	13	37.392 ± 1.2796*	36.619	38.166	0.0001
Morbidly obese	63	45.146 ± 2.8376*	44.431	45.861	
Super morbidly obese	32	55.656 ± 4.7605*	53.940	57.373	
Total	**108**	**47.327 ± 6.8524**	**46.020**	**48.634**	
Follow-up, months					
Obese	13	8.69 ± 7.941	3.89	13.49	0.039
Morbidly obese	63	6.73 ± 6.212*	5.17	8.29	
Super morbidly obese	32	10.81 ± 8.899*	7.60	14.02	
Total	**108**	**8.18 ± 7.464**	**6.75**	**9.60**	

SD - standard deviation, *Mean difference is significant between groups at 0.05 level

Table 2 - Study outcome of patients that underwent laparoscopic sleeve gastrectomy included in a study at the Department of Surgery, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia.

Variables	N	Mean ± SD	95% confidence interval for mean		*P*-value
			Lower bound	Upper bound	
Initial excess weight, kg					
Obese	13	42.85 ± 6.817*	38.73	46.97	0.0001
Morbidly obese	63	62.65 ± 9.104*	60.3	64.94	
Super morbidly obese	32	88.34 ± 12.307*	83.91	92.78	
Total	**108**	**67.88 ± 17.737**	**64.50**	**71.26**	
Total weight loss, kg					
Obese	13	24.31 ± 13.009*	16.45	32.17	0.0001
Morbidly obese	63	26.81 ± 15.560†	22.89	30.73	
Super morbidly obese	32	41.31 ± 21.235*†	33.66	48.97	
Total	**108**	**30.81 ± 18.370**	**27.30**	**34.31**	
% of excess weight loss					
Obese	13	57.869 ± 30.5992	39.378	76.360	0.124
Morbidly obese	63	42.538 ± 23.4696	36.627	48.449	
Super morbidly obese	32	45.762 ± 23.5400	37.275	54.250	
Total	**108**	**45.339 ± 24.6671**	**40.634**	**50.044**	

SD - standard deviation, *shows significant difference between obese and super morbid obese groups, †shows significant difference between morbidly obese and super morbid obese patients

6.81 kg, p=0.0001) and morbidly obese groups (45.14 ± 2.83 kg and 62.65 ± 9.10 kg, p=0.0001), while these were also significantly greater among morbidly obese group (45.14 ± 2.83 kg and 62.65 ± 9.10 kg) compared to the obese group (37.39 ± 1.27 kg and 42.85 ± 6.81 kg, p=0.0001). It also showed that patients among the super morbid obese group maintained a significantly longer follow-up (10.81 ± 8.8 months) compared to the morbidly obese patients (6.73 ± 6.21 months, p=0.031), however there were no significant differences between the obese (8.69 ± 7.94 months) and morbidly obese (6.73 ± 6.21 months, p=0.653) or between obese and super morbid obese groups (10.81 ± 8.8 months, p=0.653). The multiple comparisons using the Tukey post-hoc test also revealed that the total weight loss was statistically significantly larger among the super morbid obese patients (41.31 ± 21.23 kg) compared to the obese (24.31 ± 13.00 kg, p=0.009) and morbidly obese patients (26.81 ± 15.56 kg, p=0.001), whereas, there was no significant difference between the obese and the morbidly obese groups (p=0.882) (**Table 2**). Thirty-nine patients (26.5%) out of the total operated patients (n=147) could not have their follow-up at our hospital and were excluded from the study, as their detailed follow-up data was not available. They preferred a follow-up at the referring hospital as it was difficult for them to travel long distances frequently. The overall follow-up ranged from one to 30 months. The comparison of follow-up loss of weight and EWL in the 3 categories revealed a similar pattern with maximum loss being achieved in 18 months postoperatively. After 18 months, there was a decrease in the rate of weight loss. However, some of the patients in the obese category had a steeper loss of weight, and the near ideal body weight was reached within the first 6-9 months (**Figure 1 & Figure 2**). Median postoperative hospital stay was 3 days (range: 3-21 days). The shorter hospital stay was possible with a planned protocol involving prehospital preparation, shorter preoperative period, and early discharge. Median operative time was 124 minutes (range: 65-240 minutes). It was possible to complete the procedures laparoscopically for most of the patients and conversion to open surgery was required in one patient (0.68%) for the management of immediate complications. Six (4%) major postoperative complications were observed during the management of these patients. There was occurrence of one case of intestinal ischemia (0.7%), 2 cases of postoperative intra-abdominal collection (1.4%), and 3 cases of major bleeding (2%). All the complications were timely dealt, and fortunately there was no mortality. Intestinal ischemia occurred in a 33-year-old girl with a preoperative BMI of 41 kg/m^2 who had an uneventful procedure, and was readmitted on the 25th postoperative day with abdominal pain, fever and hematemesis. A CT scan revealed the diagnosis of small bowel ischemia, and the patient recovered after successful surgery and a prolonged ICU management. Such a complication reminds that these patients are high risk for thromboembolic events despite thorough work up and prophylaxis. Two patients were complicated by peri-splenic intra-abdominal collections with possible minor leaks although the leaks could be demonstrated radiologically. It was diagnosed on the ninth postoperative day in a 42-year-old lady having a preoperative BMI of 49 kg/m^2, and was successfully treated with a period of total parenteral nutrition (TPN) and antibiotics. A similar complication occurred in a 39-year-old male of preoperative BMI (51 kg/m^2) during the fourth postoperative week and was managed with CT guided aspiration of the collection and a

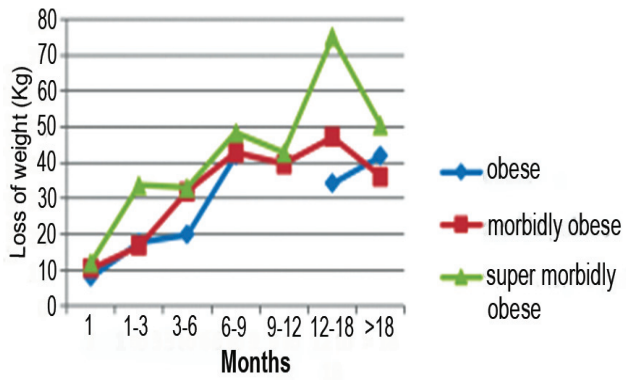

Figure 1 - Comparative loss of weight of patients that underwent laparoscopic sleeve gastrectomy included in a study at the Department of Surgery, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia.

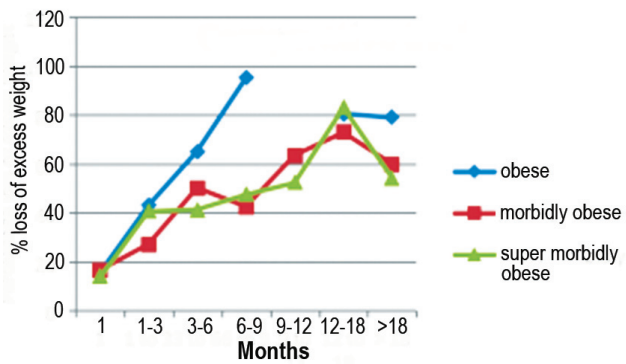

Figure 2 - Comparative percentage excess weight loss of patients that underwent laparoscopic sleeve gastrectomy included in a study at the Department of Surgery, King Saud Medical City, Riyadh, Kingdom of Saudi Arabia.

course of antibiotics. Three cases of major bleeding occurred; 2 had staple line bleeding and one had inferior vena cava injury due the trocar. The staple line bleeding occurred in a female patient (BMI: 62 kg/m^2), and a male patient (BMI: 45 kg/m^2). In both patients, postoperative bleeding was suspected due to clinical instability and large hemorrhagic output through the drain. Both were laparoscopically re-explored, staple lines were reinforced with running PDS suture with effective outcome and uneventful recovery of these patients. The third major bleeding occurred in a 25-year-old girl with a preoperative BMI of 43 kg/m^2. She developed hypotension just after the placement of trocars and significant intraoperative bleeding was observed. Immediate conversion to open surgery with laparotomy incision was made and laceration in the inferior vena cava was identified. The vascular surgery team was involved, bleeding was controlled, and repair of the vein was performed. The sleeve gastrectomy was deferred due to significant blood loss. She received 12 units of packed RBCs, made an uneventful recovery, and remained well on follow-up but still reluctant for another attempt for LSG.

Discussion. Durable weight loss is the most important parameter, which measures the effectiveness of any bariatric surgery procedure. The success of treatment has been defined as weight loss >50% of excess weight, maintaining, or even losing further after surgery.[20] Early, non-randomized data suggested that LSG was efficacious in the surgical management of morbid obesity. However, it was not clear if weight loss following LSG was sustainable in the long term, and therefore, it was not possible to determine what percent of patients would require further revisional surgery following LSG.[21] Recently published longer term data shows that after 8-9 years of LSG, 55% of patients had >50% mean EWL, and the patient acceptance remains good.[22] In addition to the stable and adequate weight loss, LSG has also been shown to achieve resolution/improvement in comorbidities in a high percentage of patients. Therefore, it can be considered a definitive operation for morbid obesity.[23]

In this study, LSG was performed as a definitive procedure. Maximum mean weight loss occurred in the super morbid obese patients (41.3 kg), which was significantly higher than the obese (mean; 24.3 kg, p=0.009) and morbidly obese (mean; 26.8 kg, p=0.001) group of patients. Effective EWL was achieved in all 3 studied groups; obese (57.8%), morbidly obese (42.5%), and super morbid obese (45.7%), however, no statistically significant difference was found between the groups. There are no available studies, which have compared the results between these 3 groups of patients, and most of the contemporary studies either give results from one group of patients, or a combination of all 3 groups. Saif et al[24] in a cohort of 82 patients with a baseline BMI (55.7 kg/m^2) have reported percentage of excess BMI loss of 58.5% at year one, 63.1% at year 3, and 46.1% at year 5. A study of 135 patients with a mean preoperative BMI of 66.1 kg/m^2 where LSG was performed as a first stage procedure, or as a primary procedure showed a EWL of 37.9%, and 47.3% at 6 months and 12 months.[25] Gentileschi[16] in his experience of 200 patients with LSG has reported median EWL 63.6% at 27.2 months of follow-up. In a case series where LSG was performed for 23 adolescent patients with a baseline BMI of 52 ± 9 kg/m^2, the reported EWL was 32% at 3 months, 38% at 6 months, and 40% at one year.[26] Catheline et al[27] carried out LSG in a cohort of super obese patients (n=30, mean BMI: 66 kg/m^2), which resulted in an average weight loss of 56 kg and average EWL of 51% at 3 years follow-up. Sarela et al[22] have reported 76% EWL at year one, and >50% EWL in 55% of the LSG only patients at 8-9 years. The results in our study are comparable with the contemporary researchers considering the shorter follow-up and suggest that LSG is equally effective as a definitive bariatric procedure in all 3 categories of obese patients.

The major scepticism in accepting LSG as a definitive bariatric procedure was weight regain after initial weight loss. The trend of induced initial weight loss after LSG was also evident from the results of this study. The maximum loss of weight and EWL was achieved between 12-18 months in all 3 categories of the patients, and then the trend was maintained with some decrease (**Figure 1 & Figure 2**). However, patients in the obese group (BMI: 35-39.9 kg/m^2) had a more rapid reduction in weight in the first 6 months with a second peak around 12-18 months. No patient had a weight regain in this study, but a longer follow-up is required to highlight this possibility. A similar trend was noticed by Kakoulidis et al[17] in patients with class I obesity (BMI: 30-35 kg/m^2) where the patients on an average lost 100% of their excess BMI in the first 6 months. However, now after 8-9 year follow-up post LSG, satisfactory sustained weight loss has been reported, and LSG is recommended as a definitive bariatric procedure.[22] A large gastric pouch, spontaneous gastric dilatation, switching to high calorie liquid diet, and limited potential of LSG in causing weight loss are the usual factors considered for poor weight loss or weight regain following LSG.[19]

The sizes 28-60 Fr (mean 36) of the gastric tube has been used by different surgeons to calibrate the gastric pouch.[28] The authors used 36 Froro gastric tube with favorable results. The researchers have used size 32 Fr22 and 34 Fr27 gastric tubes and shown a larger EWL, but it has also been reported that short-term weight loss did not differ significantly when bougie size 40 Fr was compared with size 60 Fr in creation of the gastric sleeve. Gastric resleeve is a valid option if gastric pouch dilatation is considered the reason for weight regain. We believe that enough evidence is available to support LSG as a definitive bariatric procedure, and patients with less satisfactory weight loss should be followed-up extensively before resorting to a second complex bariatric procedure.

We started the gastric resection 4 cm proximal to the pylorus and reinforce the staple line sparingly depending upon its length, precision of the end result, and bleeding from the area. Placing a drain is still our preference as it helps in earlier detection of postoperative bleeding and leak. The bariatric surgeons who gathered at the Third Consensus International Summit for Sleeve Gastrectomy began gastric resection at a mean 4.8 cm (1.5-7 cm) proximal to the pylorus, 67.1% reinforced the staple line mostly with buttress material, and 57.6% left a closed suction drain.[28] In this series, 6 major complications occurred (4%). Two patients (1.4%) had perisplenic collections with suspected gastric leak. Both patients had higher preoperative BMI (49 and 51 kg/m^2), and presented in second and fourth weeks postoperatively. The leak could not be demonstrated in these patients and were managed with CT guided drainage, TPN, and antibiotics. It is important to emphasize that small leaks may present as intra-abdominal collection in the earlier weeks postoperatively. A recent systematic analysis studying the frequency of leak in 4,888 patients after LSG has revealed an overall risk of 2.4%, with 2.9% risk in patients with BMI >50 kg/m^2, and 2.2% risk with BMI <50 kg/m^2. It is also reported that 89% of leaks occurred in the proximal third of the stomach, which was not related to the staple height, or use of buttressing but the frequency was significantly low if bougie size 40 Fr or greater is used.[29] Two patients had suture line bleeding, which was managed by laparoscopic re-exploration. One of our patients had inferior vena cava injury and the other had bowel ischemia, which are major potentially fatal complications but fortunately there was no mortality. The LSG is a safe procedure with a reported mortality of 0.1 ± 0.3%.[28] However, the occurrences of such major complications do remind us that such laparoscopic procedure should be performed with utmost surgical precision, preoperative planning, and postoperative vigilance.

The major limitation of this study is the lack of consistent follow-up in all patients. Only 73.5% of the patients had a regular follow-up at our center until the present. The major reason being that bariatric surgery is still a growing field in Saudi Arabia with a few dedicated centers offering obesity surgery. Our center is a major referral center covering large catchment area of the kingdom, which makes it very difficult for some of the patients to travel long distances for regular follow-ups. It is hoped that in the future, better follow-up facilities would be available to report long term results in such patients. Despite its limitations, we believe that this study provides preliminary evidence for more elaborately designed and robust comparative studies, to evaluate LSG in various categories of obese patients leading to the discovery of the most acceptable bariatric surgical procedure with uniform guidelines for future practice.

In conclusion, our preliminary data suggest that LSG is a safe procedure. It is an effective definitive bariatric procedure in all 3 categories of obese, morbidly obese, and super morbid obese patients resulting in approximately 50% loss of excess weight at 30 months follow-up. However, a long-term follow-up is required to determine sustained weight loss, which may preclude the need for a second bariatric procedure. The authors support the growing consensus that LSG can be safely pursued as a stand-alone obesity surgery procedure.

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