Laparoscopic Sleeve Gastrectomy: 2 cm versus 6 cm Distance from the Pylorus

Ahmad A. Maklad[a], Asmaa G. Rizk[b], Mohamed Y. Ahmed [b], Mohammed K. Elamaary[b]

[a] Qeft Teaching Hospital, The general organization for teaching hospitals and institutes.
[b] Bariatric unite, Department of General Surgery, Qena faculty of medicine, South Valley University, Qena, Egypt.

Abstract:

Background: The objective of this prospective randomized study was to study the effect of the residual gastric antrum size on the outcome of laparoscopic sleeve gastrectomy and to evaluate the effect of antral resection on weight reduction and complications after LSG.

Patients and Methods: Sixty patients underwent LSG as a primary bariatric procedure from November 2016 to March 2019 were randomized into two groups depending on the distance from the pylorus at which gastric division begins. In group (A), the distance was 2 cm from the pylorus, whereas the distance was 6 cm in group (B). The follow-up period was at least 6 months. Baseline and 3 and 6 month outcomes were analyzed including assessments of the percent excess weight lost (% EWL), reduction in BMI, morbidity, mortality, reoperations, quality of life, and co-morbidities.

Result(s): Sixty patients included in this study, whose mean pre-operative age was (32.48± 7.92) years, three (5%) patients were males and 57(95%) patients were females with a mean pre-operative BMI was (53.45 ± 8.00) Kg/m2. In group A, the mean % EWL was (33.1 ± 7.15) and (51.37 ± 8.57) at 3 and 6 months respectively. In group B the mean % EWL was (29.29 ± 6.1) and (46.44 ± 9.85) at 3 and 6 months respectively. Patients with the first staple line started 2 cm from the pylorus had better weight loss than those started 6 cm from the pylorus after 3 and 6 months, but this difference statistically insignificant.

Conclusion(s): LSG with 2 cm or 6 cm first staple firing from the pylorus produces significant weight loss after surgery. The 2 procedures are equally effective regarding %EWL, morbidity, quality of life, and improvement of co-morbiditieswith insignificant superiorities of 6 cm group.

KeyWords: Laparoscopic sleeve gastrectomy; Obesity, excess weight loss, residual gastric antrum.

Introduction:

The problem of obesity become epidemic proportions not only in Western countries but also all over the world ***(Flegal, 2010).***

Bariatric surgery now considered efficiently producing long-term weight loss, improving comorbidities and improving quality of life for the morbidly obese patient, currently; there is much interest in restrictive procedures with theirlower operative and nutritional risks

compared to mixed and mal-absorptive procedures ***(Brunault, 2011).***

Laparoscopic sleeve gastrectomy (LSG) in creating a narrowtube-like stomachdesigned to decrease appetite byreducingthe ability of the stomach to distend and producingthe sensation of

fullness with minimal oral intake***(Moy, 2008).***

LSG, first described astheinitialstageofa2-stagebilio-pancreatic diversion-duodenal switch (BPD-DS), isemergingasa popular operation for the treatment of morbid obesity, with acceptable morbidity and long-term weightloss compared with the laparoscopic Roux-en-Y gastric bypass (LRYGB) ***(Bohdjalian, 2010).***

The advantages of this procedure include the lack of an intestinal by pass; the advantage of not excluding the duodenum is to preserve the absorption of iron, calcium and other nutrients, and to prevent dumping syndrome and an astomoticulcers. There is an increasingly tendency to have this procedure being used more frequently, since it has proven to be effective inconsiderable weight loss thus avoiding gastrointestinal anastomoses, metabolic derangements, and internal hernias and shorter operating times; LSGhasa favorable complication profile, making it an especially attractive procedure for higher-risk patients***(Shi, 2010).***

Unfortunately, LSG has its own drawbacks as the potential complications related to the relatively long staple line, stricture of sleeved stomach and the irreversibility of the procedure***(Frezza, 2007).***

One aspect of controversy is the extent to which the antrum is removed. When fashioning the sleeve the staple line may be started close to the pylorus or at some distance away, resulting in more or less antral excision. Practice between surgeons is highly variable***(Berger, 2016).***

Proponents of a radical antral resection argue that more restriction leads to better weight loss. They point out that since LSG alone is primarily a restrictive bariatric operation, the restriction must be profound to maximize weight loss***(Michalsky, 2013).***

Opponents of radical antralresection stress the importance of preserving the physiological emptying mechanism of the stomach, in order to avoid increased intraluminal pressure, arguing that consequences of raised intraluminal pressure could potentially include staple-line leak in the short-term and gastro-esophageal reflux in the longer term ***(Abdallah, 2014).***

This prospective randomized study was designed to compare between the beginning of sleeve gastrectomy 2 cm vs. 6 cm from the pylorus with special regard to intraoperative problems,weight loss, and improvement of comorbidities, postoperative complications and quality of life.

Patients and Methods:

Between November 2016 to March 2019,sixty morbidly obese patients obese patients who matched the inclusion criteria were submitted for LSG at Bariatric unite; Department of General Surgery in South Valley University Hospitals and enrolled in the trial. This prospective randomized study was carried out after the approval of ethical committee of the faculty of medicine, South Valley University, Egypt. All participating patients signed written informed consents after explaining to them the advantages and complications of the surgical procedure.

The inclusion criteria are:

- **I.** Age between 18 Years to 60 Years.
- **II.** BMI above 40kg/m²
- **III.** BMI between 35 kg/m² and 40 kg/m²with a major weight related medical condition (Hypertension, diabetes, sleep

apnea, fatty liver disease, heart disease and co-arthritis).

IV. Patients should have obesity lasting more than 5 years.

V. Patients should have tried other methods to lose weight and failed.

The exclusion criteria are:

I. Children below 18 years of age.

II. Patients over 60 years of age.

III. Patients unfit for surgery Patients with a secondary cause of obesity.

Only the data of patients who had completed their 3and6-month follow-up visits at the time of the study were further analyzed. Data collected included demographic characteristics, operative time, length of stay, postoperative complications, weight loss, improvement of co-morbidities, quality of life and food tolerance.

Randomization: Patients were randomized into 2 groups depending on the distance from the pylorus at which the gastric division begins. In group A the distance was 6 cm, and in group B the distance was 2 cm. Eligible patients wererandomizedintooneof2groupsusingsealedopaqueenvelopescontainingrandom numbers. Envelopes were drawn and opened at the time of anesthesia induction in the operatingroom.

All of the patients had a thorough preoperative evaluation in the form of

I. History taking: Age, sex, weight, BMI, history of previous operations (type, time, place, complications), Quality of life, Eating behavior and Evaluation of associated co-morbidity and treatment medication used.

II. Examination: **A) General**. Full general examination was done, focusing on cardiovascular and respiratory fitness. **B) Local.** Full abdominal examination focused on scars of previous operations and abdominal wall hernias.

III. Investigations: A) Laboratory. General pre-operative investigations for all the patients included routine pre-operative investigations. Thyroid profile was investigated and cortisol level. **B) Radiological**. All patients had pre-operative pelvi-abdominal ultrasound to show any intra-abdominal and pelvic organs pathology. A routine pre-operative screening barium meal was done to rule out presence of GERD and intrinsic lesions of the stomach or duodenum and when suspected upper endoscopy was done

C) Cardiovascular investigations. All patients had ECG and chest x ray and echo.

D) Respiratory investigations. To detect any significant pulmonary disorders by Chest X-ray and Pulmonary function tests. Patients with suspected sleep apnea syndrome underwent pre-operative sleep study. LMWH was routinely administered subcutaneously12h before operation and at intervals thereafter, for 10 days post-operative.

Operative Techniques: The patient is positioned in either one of the following two position. **Position (1)**the surgeon stands between the patient's legs, the assistant holding the camera on the right of the patient and the second assistant on the left. **Position (2)**the surgeon stands on the patient's right side, the assistant and the camera operator are on the patient's left side. Under general anesthesia, we use Optical trocars that allow visual control of the access to the peritoneum and the creation of the pneumo-peritoneum using CO2 up to pressure of 14 to 15 mmHg.

We use five trocar as showed in fig (1) Begin detaching the greater omentum from the stomach distally up to 2 cm or 6 cm proximal to the pylorus fter mobilizing the greater curvature completely and

dissection of the fundus.The anesthetist introduces a 34-Fr bougie trans-orally up to the pylorus to guide the stapling and maintain an adequate lumen of the gastric sleeve. Transection of the stomach begins on the antrum 2 cm or 6 cm proximal to the pylorus towards the angle of His.

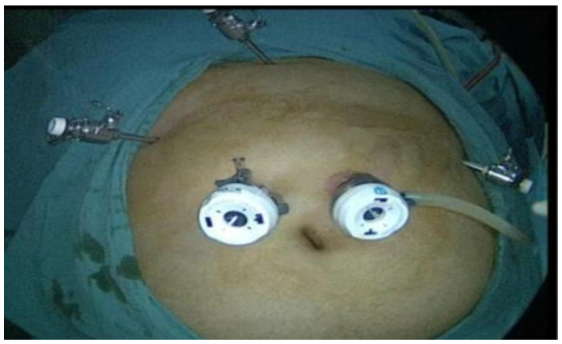

Figure. 1 Port distribution

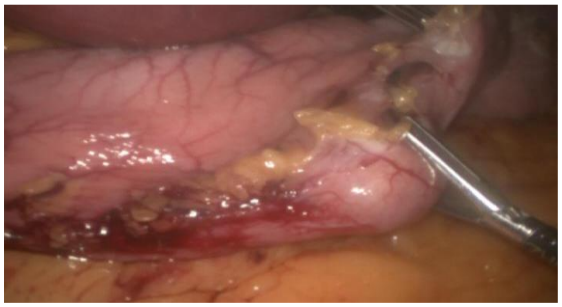

Figure. 2 Positioning of The bougie

Post-operative period: Oral liquid diet was resumed 12hrs post-operative, then the clear output drain was removed usually in the 2nd day and the patient was discharged if hemodynamically stable, pain free with no post-operative complications. On oral antibiotic, LMWH for 10 days post-operative, PPI for 6month within structions to follow a liquid diet for the first week, followed by a soft diet for another 3 weeks.

Subsequently, along term hypo-caloric, protein-enriched solid diet was maintained. Long-term oral daily supplements of vitamins and monthly administration of intramuscular vitamin B12 were given to all patients.

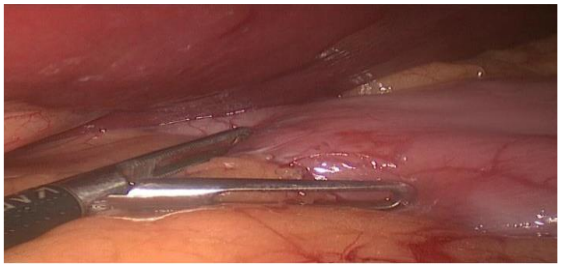

Figure.3 Measuring distance from the pylorus

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD).Qualitative data were expressed as frequency and percentage. The following tests will be done:•Independent-samples t-test of significance was used when comparing between two means• Chi-square (x2) test of significance was used in order to compare proportions between qualitative parameters •the confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: Probability (P-value)–P-value <0.05 was considered significant.–P-value <0.001 was considered as highly significant.–P-value >0.05 was considered insignificant.

Results:

Sixty patients underwent LSG from November 2016 to March 2019whose mean pre-operative age was (32.48± 7.92) years, three (5%) patients were males and 57(95%) patients were females with a mean pre-operative BMI was (53.45 ± 8.00) Kg/m^2.The patients were randomized into 2 groups, group **A** 30 patients and group **B** 30 patients. The most common co-morbid conditions were co-arthritisin 17 (28.33%) patients, arterial hypertension

in 11(18.33%) patients, OSAS in 14 (23.33%) patients, back pain in 15 (25%) patients, Dyslipidemia in13(21.66%) patients and diabetes mellitus in 3 (5%) patients.

The mean operative time was (2.91 ± 0.73 Hr.) and the mean blood loss was (80.16 ± 49.52 ml). The mean hospital stay was (3.2 ± 2.3). There was no significant difference between both groups as regards the number of stapler used.

There was no significant difference in both groups as regards the mean length of hospital stay. No mortality was reported during follow up. There were no conversions to open surgery.

As regard the post-operative complication rates, 2 patients developed haemo-peritoneum both of them in (group A) and they passed by conservative treatment with blood transfusion and fresh frozen plasma and 4 patients developed wound complication, one patient was in (group A) and 3 patients were in (group B).

Table 1. Co-morbid conditions in both groups

	Total (n=60)		2 cm group (n= 30)		6 cm group (n= 30)		X^2	P
	No	%	No	%	No	%		
DM	3	5	1	3.33	2	6.66		
Hypertension	11	18.33	7	23.33	4	13.33	1.0	0.317
Co-arthritis	17	28.33	8	26.66	9	30	0.082	0.774
Back/joint pain	15	25	7	23.3	8	26.6	0.089	0.766
Sleep apnea	14	23.33	7	23.33	7	23.33	0	1.0
Dyslipidemia	13	21.66	7	23.33	6	20	0.524	0.469

Thirteen patients had persistent attacks of vomiting for more than 4 weeks, in(group A) and only 2 patients were in (group B), they were successfully managed conservatively by intra venous fluids and antiemetic with 3 patients in (group A)need hospital admission , then vomiting frequency decreased gradually in all cases after 3 months.

In-group B the mean % EWL was (29.29 ± 6.1) and (46.44 ± 9.85) at 3 and 6months respectively and the mean BMI change was (46.65 ± 7.14) and (39.62 ±6.4) at 3 and 6 months respectively.

The mean % EWL was (31.49 ± 6.7) and (49.19 ± 9.38) at 3 and 6 months respectively and the mean BMI change was (45.22 ± 7.2) and (37.81 ± 6.5) at 3and 6 months respectively.

In group A, the mean % EWL was (33.1 ± 7.15) and (51.37 ± 8.57) at 3 and 6months respectively and the mean BMI change was (43.8 ± 7.13) and (36.38 ±6.35) at 3 and 6 months respectively

The resolution in metabolic co-morbidities after 6 months was 100% for type 2diabetes, (90.9%) for arterial hypertension, (84.6%) for Dyslipidemia, (78.5%)for OSAS and (70%) for co-arthritis, noting that most of the co-

morbidities were improved after laparoscopic sleeve gastrectomy.
Bariatric Analysis and Reporting Outcome System (BAROS) quality of life score was surveyed after 6 months in both groups, and was equal between patients in both groups.

Table 2. Post-operative complications

	Total (n=60) mean ± SD	2 cm group (n= 30) mean ± SD	6 cm group (n= 30) mean ± SD	T	P
BMI, 3 months	45.22 ± 7.2	43.8 ± 7.13	46.65 ± 7.14	1.54	0.12
BMI, 6 months	37.81 ± 6.5	36.38± 6.35	39.62 ± 6.4	1.65	0.1
% EWL, 3 months	31.49 ± 6.7	33.1 ± 7.15	29.29 ± 6.1	1.83	0.073
% EWL, 6 months	49.19± 9.38	51.37±8.57	46.44±9.85	1.75	0.087

However, Patients from both groups experienced a significant improvement in QOL compared with baseline (P <0.05).
Food tolerance was significantly better in group (B) (22.4 ± 0.6) after 3 months compared to group (A) (18.8 ± 1.0) after 3 months. In both groups, the Quality of Alimentation scores increased significantly, after 6 months compared to the 3months.

The staple line failed in one case in group (B) where over sewing of the risky part of the staple line was done by a running suture, and no postoperative leakage was detected.

Three patients (5%) one (3.3%) in group (A) and two (6.6%) in group (B)developed de novo GERD.

Two patients (3.3%) both in group (B) had chronic calcularcholecystitis and had concomitant cholecystectomy with LSG in the same session.

Two patients (3.3%) one in each group had post sleeve gastrectomy cholelithiasis.

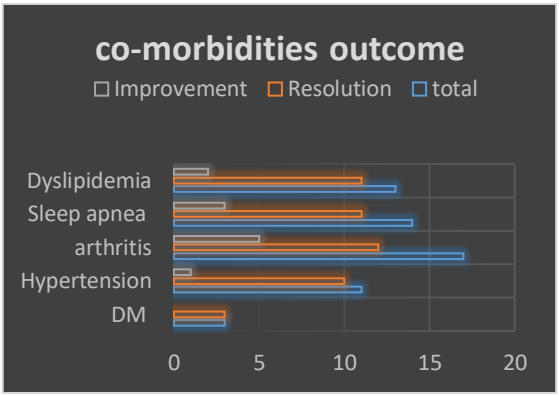

Figure 4. Co-morbidities outcome after 6 months

Discussion:
LSG is emerging as a popular operation for the treatment of morbid obesity, with acceptable morbidity and long-term weight loss compared with other procedures. Recently, the number of procedures performed has risen exponentially all over the world and has been adopted by a large number of surgeons due to its simplicity ***(Deitel, 2011)***.

LSG is not technically challenging and achieves satisfactory weight loss and resolution of comorbidities comparable to RYGB and better than LAGB. Several randomized trials have also demonstrated that LSG has weight reduction efficacy

similar to that of RYGB in the short- to mid-term ***(Diamanis, 2014).***

The preferred bariatric surgery has evolved in the past decades. RYGB had been regarded as the gold standard procedure since 1980. However, given the similar weight loss efficacies and the lower risk of surgical complications and long-termmicronutrient deficiencies of LSG, we expect that LSG will be the first choicebariatric surgery in the future ***(Wei, 2015).***

Another important advantage of LSG compared to RYGB or SAGB is the avoidance of the risk of gastric cancer that arises from the excluded remnant stomach. RYGB or SAGB precludes the option of screening the stomach andraises strong concerns in countries with high incidences of gastric cancer, such ascountries in Asia, South American, and some parts of Europe ***(Wu, 2013).***

Therefore, it is not surprising that LSG is particularly welcomed in Asia because of the concern of remnant gastric cancer. SG now accounts for more than 50 %of the bariatric surgeries in Asia and more than 70 % of the surgeries in Japan where gastric cancer is the leading cancer-related cause of death ***(Sasaki, 2014).***

Despite this clearly multi factorial mechanism, the size of the restriction performed is the most significant factor for weight reduction and maintenance. The resulting gastric remnant is reduced to < 50cc volume but functions normally; most foods can be consumed, albeit in small amounts, and gastric emptying is normal ***(ElGeidie, 2015).***

However, the LSG technique is not fully standardized and there are still many controversial technical issues. One of these issues is the beginning of gastricresection some surgeons prefer antral resection and beginning stapling 2 cm from pylorus, whereas others start 6 cm from the pylorus, there by preserving the gastric antrum ***(Sánchez, 2009).***

According to the consensus panel for LSG, the mean resection proximity to the pylorus was 5.6 ± 1.5 cm. Some surgeons prefer to start stapling 2 cm from pylorus, while others start 6 cm from the pylorus. More recently, in 2014, 120expert bariatric surgeons completed Web-based survey on aspects of LSG to identify best practice. The same survey was administered to 103 bariatricsurgeons attending the fifth International Conference on Sleeve Gastrectomy in2014. Most experts (77.5%) believe that a distance > 3 cm from the pylorus is recommended to start the stapling line ***(Gagner, 2016).***

The most frequent controversy against radical pyloric antrum resection is that it may alter the gastric evacuation process. LSG is anticipated to have an impact on gastric motility patterns because it affects both the proximal and distal stomachin many significant ways. General speaking, LSG may affect stomach emptying via several mechanisms; removal of the fundus with its capacitation and propulsive abilities, altered compliance and contractility of the resulting narrow and non-distensible sleeve, thus elevating the intra- gastric pressure, and removal of the gastric pacemaker area in the body of the stomach. However, studies addressing the topic of gastric emptying following LSG have yielded conflicting results ***(Elli, 2015).***

As regard percentage EWL in our study the mean percentage EWL was (31.49 ± 6.7) and (49.19 ±9.38) at 3 and 6 months respectively. In group A, the mean % EWL was (33.1 ± 7.15) and (51.37 ± 8.57) at 3 and 6months respectively and the mean BMI change was (43.8 ± 7.13) and (36.38 ±6.35) at 3 and 6 months respectively. In group B the mean % EWL was (29.29 ± 6.1) and (46.44 ± 9.85) at 3 and 6months respectively and the mean BMI change was (46.65 ± 7.14) and (39.62 ±6.4) at 3 and 6 months respectively.

Patients with the first staple line started 2 cm from the pylorus had better weightloss

than those started 6 cm from the pylorus after 3 and 6 months, but this difference statistically insignificant.

Studies addressing the effect of pyloric antral resection on weight loss have shown conflicting results. Jacobs et al showed no statistically significant difference in the percentage excess weight loss following creation of a 4- versus 7- cm antral pouch ***(Jacobs, 2010).***

ElGeidie et al. reported that weight loss was better in patients with a 2-cmresection margin than that in-patient with 6-cm resection margin was at 6 months postoperatively; however, this difference disappeared at 12 months, and the authors associated this weight loss result with short-term vomiting episodes***(ElGeidie, 2015).***

McGlone et al. reported that weight loss at 24 months is better following antral resection (AR) than antral preservation (AP), a feature that not seen at 12 months. These findings suggest that the advantage of AR over AP for weight loss increases over time. ***(McGlone, 2018).***

The International Hepatology Committee considers that the metabolic condition achieved by LSG goes beyond simple weight loss, which makes the surgery more metabolic in nature and not purely restrictive, as formerly thought ***(Nobili, 2015).***

Abdallah et al. reported that the improvement and resolution of comorbidities was as the following, hypertension showed the best resolution rate (88 %) followed by OSAS (72 %),and the lowest was joint pain (34 %). with more antral resection associated with better rates of improvement and resolution of these comorbidities ***(Abdallah, 2014).***

In our study, the resolution in metabolic co-morbidities after 6 months was 100%for type 2 diabetes, (90.9%) for arterial hypertension, (84.6%) for Dyslipidemia,(78.5%) for OSAS and (70%) for co-arthritis, noting that most of the comorbidities were improved after laparoscopic sleeve gastrectomy. This metabolic resolution is statistically insignificant between both groups.

Bleeding is a serious early complication of LSG with an incidence of up to 5%.Intuitively, one might expect that AR would lead to a higher incidence of staple linebleed than AP because the staple-line passes through the antrum, which has a thicker wall than other parts of the stomach, and thus is likely to be more susceptible to stapler failure. This study, however, shows no difference between AR and AP in incidence of bleed ***(Janik, 2017).***

In our study, two patients developed haemoperitoneum both of them in (group A)one of them female patient 45 years old HTN and the other female patient 37years old on antiplatelet treatment. Both of them passed by conservative treatment with blood transfusion and fresh frozen plasma concomitant with stoppage of low molecular weight heparin.

Many surgeons leave most of the antrum for its pumping and emptying action and to prevent nausea and vomiting, Rudolf strongly recommend sprotecting the antrum ***(Rudolf, 2007).***

Mohamed et al. reported that Ninety percent (90.6%) from the group 3cm suffered from repeated vomiting (twice or more daily) within the first six months compared to (60.7%) from 6cm group, which had a strong significant difference with p-value 0.021. On the other hand they find that (32.1 %) of patients in 6cmgroup developed no vomiting at six months versus (6.3%) of 3cm group***(Mohamed, 2015).***

In our study Thirteen patients had persistent attacks of vomiting for more than 4weeks, in (group A) (43.33%) and only 2 patients were in (group B) (6.6%). (This difference is statistically significant), intra venous fluids and antiemetic

successfully managed them conservatively with three patients in (group A) need hospital admission, and then vomiting frequency decreased gradually in all cases after 3 months.

Kirkil et al reported the results of 562 patients who undergone LSG. The updated BAROS score was significantly correlated with percentage EWL in bivariate analysis($p<0.001$), and the results were, 26 patients (4.6%) were classified as failures; 86(15.3%) fair; 196 (34.9%) good; 144 (25.6%) very good, and 110 (19.6) excellent results ***(Kirkil, 2018).***

In our study BAROS quality of life score was surveyed after 6 months in both groups, and was equal between patients in both groups. We observed no significant difference between the two groups, but Patients from both groups experienced a significant improvement in QOL compared with baseline ($P<0.05$).

Conclusion

LSG has gained popularity as a primary bariatric procedure due to its comparative simplicity with good short-term outcome as regard improvement in comorbidities, increasing of QoL and weight control. LSG 2 cm from the pylorus is more restrictive as it is effective in term of %EWL without increasing the rate of complications significantly and it has a high resolution rate of GERD but it is also associated with de novo GERD and more nausea, vomiting and food intolerance especially in the early postoperative period.

Increasing size of sample and long-term follow-up to assess the durability of this achieved weight loss and the persistence of remission of comorbidities recommended.

References:

Abdallah E, Nakeeb El A, Youssef T, Abdallah H, Ellatif M. A, Lotfy A,et al, (2014). Impact of extent of antral resection on surgical outcomes of sleeve gastrectomy for morbid obesity (a prospective randomized study). ObesSurg 24(10):1587–94.

Berger E. R, Clements R. H, Morton J. M, Huffman K. M, Wolfe B. M, Nguyen N. T et al (2016). The Impact of Different Surgical Techniques on Outcomes in Laparoscopic Sleeve Gastrectomies: The First Report from the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP). Ann Surg; 264(3):464–73.

Bohdjalian A, Langer F. B, Shakeri-Leidenmuhler S,GfrererL,Ludvik B, Zacherl J, et al. (2010). Sleevegastrectomy as sole and definitive bariatric procedure: 5-year results for weight loss and ghrelin. ObesSurg; 20:535–40.

Brunault P, Jacobi D, Léger J, Bourbao-Tournois C, Huten N, CamusV, et al. (2011). Observations regarding ‘quality of life’ and ‘comfort with food’ after bariatric surgery: comparison between laparoscopic adjustable gastric banding and sleeve gastrectomy. Obes Surg. 21(8):1225–31.

Deitel M, GagnerM, EricksonA. L and Crosby R. D, (2011). Third international summit: current status of sleeve gastrectomy .SurgObesRelatDis; 7:749–59.

Diamanis T, Apostolou K.G, AlexandrouA,GriniatsosJ, Felekouras E andTsigris C, (2014). Review of longterm weight loss results after laparoscopic sleeve gastrectomy. SurgObesRelat Dis.; 10:177–83.

ElGeidie A, ElHemaly M, Hamdy E,El Sorogy M, AbdelGawad M and Nabil GadElHak, (2015). The effect of residual gastric antrum size on the outcome of laparoscopic sleeve gastrectomy: a prospective randomized trial. SurgObesRelat Dis.; 11:997–1003.

Elli E, Gonzalez-Heredia R, Sarvepalli S and Masrur M, (2015). Laparoscopic and Robotic Sleeve Gastrectomy: Short- and Long-Term Results. ObesSurg; 25:967-74.

ElSobky A andMashaal A, (2019). Comparison between antral resection in laparoscopic sleeve gastrectomy and classical laparoscopic sleeve gastrectomy. Egyptian J Surgery 38:570–574

Flegal K. M, Carroll M. D, Ogden C. L and Curtin L. R, (2010). Prevalence and trends in obesity among US adults, 1999 – 2008. JAMA 303:235–41.

Frezza E. E, (2007). Laparoscopic vertical sleeve gastrectomy for morbid obesity.The future procedure of choice?Surg Today.; 37(4): 275–81.

Gagner M, Hutchinson C and Rosenthal R, (2016). Fifth International Consensus Conference: current status of sleeve gastrectomy. SurgObesRelat Dis.; 12:750–6.

Jacobs M, Bisland W, Gomez E,Plasencia G, Mederos R, Celaya C et al, (2010). Laparoscopic sleeve gastrectomy: a retrospective review of 1- and 2-year results. SurgEndosc; 24(4):781-5.

Janik M. R, Walędziak M, Brągoszewski J,Kwiatkowski A and Pasnik K, (2017). Prediction Model for Hemorrhagic Complications after Laparoscopic Sleeve Gastrectomy: Development of SLEEVE BLEED Calculator. ObesSurg; 27(4):968–72.

Kirkil C, Aygen E, Korkmaz M. F andBozan M. B, (2018). Quality of life after laparoscopic sleeve gastrectomy using BAROS system. ABCD Arq Bras Cir Dig; 31(3):e1385.

McGlone E. R,Gupta A.K,Reddy K.M. and Khan O.A, (2018). Antral resection versus antral preservation during laparoscopic sleeve gastrectomy for severe obesity: Systematic review and meta-analysis, Surgery for Obesity and Related Diseases, (18)30113-8.

Michalsky D, Dvorak P, Belacek J and Kasalicky M. l, (2013). Radical resection of the pyloric antrum and its effect on gastric emptying after sleeve gastrectomy.ObesSurg; 23(4):567–73.

Mohamed A. EL-Masry, Muhamed EL-Marzouky andYehia Fayez M.D, (2015). The Impact of Pyloric Pouch Size (3 cm and 6 cm) in Sleeve Gastrectomy on Postoperative Reflux and Vomiting Med. J. Cairo Univ., Vol. 83, No. 2, September: 119-125.

Moy J, Pomp A, Dakin G, ParikhM, andGagnerM. l, (2008). Laparoscopic sleeve gastrectomy for morbid obesity. Am J Surg.; 196(5):e56–9.

Nobili V, Vajro P, DezsofiA,Fischler B, Hadzic N, Jahnel J, et al, (2015). Indications and limitations of bariatric intervention in severely obese children and adolescents with and without nonalcoholic steatohepatitis: ESPGHAN Hepatology Committee Position Statement. J PediatrGastroenterolNutr.; 60(4):550-61.

Rudolf A. Weiner, Sylvia Weiner, Ingmar Pomhoff,Jacobi C, Makarewicz W andWeigand G (2007). Laparoscopic Sleeve Gastrectomy – Influence of Sleeve Size and Resected Gastric Volume. Obesity Surgery, 17, 1297-1305.

Sánchez-Santos R, Masdevall C, BaltasarA,Martínez-Blázquez C, García Ruiz de Gordejuela A, Ponsi E, et al, (2009). Short- and mid- term outcomes of sleeve gastrectomy for morbid obesity: the experience of the Spanish National Registry.ObesSurg; 19: 1203–10.

Sasaki A, Wakabayashi G andYonei Y, (2014). Current status of bariatric surgery in Japan and effectiveness in obesity and diabetes. J Gastroenterol; 49(1):57–63.

Shi X, Karmali S, Sharma A and Birch D. W, (2010).A review of laparoscopic sleeve gastrectomy for morbid obesity.ObesSurg; 20: 1171–7.

Wu C. C, Lee W. J, Ser K. H,Chen J. C, Tsou J. J, Chen S. C, et al, (2013). Gastric cancer after mini-gastric bypass surgery: a case report and literature review. Asian J Endosc Surg.; 6:303–6.