**Short term outcome of laparoscopic sleeve gastrectomy**

**Abstract**

**Background:**  The incidence of morbid obesity is sharply increasing throughout the world. Obesity, and the accompanying elements of metabolic syndrome (dyslipidemia, hypertension, and diabetes mellitus), Increases the incidence and severity of cardiovascular disorders among patients. Bariatric surgery has the best efficacy regarding the management of obesity.

**Objective:** To assess the efficacy of sleeve gastrectomy in weight loss and improvement of co-morbidities related to obesity, especially diabetes, dyslipidaemias, hypertension, and osteoarthritis symptoms.

**Patients and methods:**  A prospective data collection of 100 patients underwent laparoscopic sleeve gastrectomy between April 2015 and June 2018 have been collected throughout a year.

**Results**: Mean EWL was 63.5%. Mean HBA1c has decreased from 8.5 to 6.4. Remission has occurred in 52% of hypertensive, 56% of osteoarthritis and 67% of obstructive sleep apnea syndrome patients.

**Conclusion:**LSG is a secure technique, it has a low incidence of major complications. It has a high success rate regarding the loss of weight and improvement/resolution of co-morbidities related to obesity.

**Keywords:**LSG laparoscopic sleeve gastrectomy, co\_morbidities .

**Introduction**

The incidence of morbid obesity is rising sharply all over the world. WHO has reported that 1.7 billion world wide are overweight (1). About 33% of the population are obese in the USA (BMI more than 30 kg / m2) (1). Obesity is associated with metabolic syndrome; both of them can increase the mortality and morbidity of cardiovascular disorders (2, 3). Bariatric surgery proved to be the most effective way to treat morbid obesity (4).

Not unexpectedly, in the last 20 years, the field of bariatric surgery has expanded exponentially (about 300,000 operations are conducted every year) and is considered one of the most common abdominal operations (5, 6). Surgical techniques have developed over the last 15 years; among them, Laparoscopic Sleeve Gastrectomy (LSG) has become the most accepted one. In the beginning, Laparoscopic Sleeve Gastrectomy (LSG) was not considered as a separate operation; instead, it was considered as part of the biliopancreatic diversion with duodenal switch (BPD-DS) that was described by Marceau et al. (7).

As Regan et al. has noticed the non-consistent long term loss of weight with LSG in super-obese patients, he has introduced it as part of a two-stage laparoscopic Roux-en-Y gastric bypass (RYGB) for super-obese individuals (8). As LSG has shown both safety and efficacy, Baltasar et al. has suggested that it could be used as a separate bariatric operation (9).

**Patients and method**

A prospective data collection of 100 patients underwent laparoscopic sleeve gastrectomy between April 2015 and June 2018 have been collected throughout a year. This study was conducted in the Department of General Surgery in Assiut University Hospitals, Kasr-Alaini New Teaching Hospital Cairo, and Santa Maria hospital in Italy.

Informed consent was obtained from each patient and approval of the study has been obtained from the Faculty of Medicine local ethics committee at Assiut University

Patients with BMI < 40 or < 35, and suffers from one or more of obesity-related co-morbidities and their ages ranged from 18 to 60 years old were included in this study whereas patients with curable endocrine diseases that may lead to morbid obesity, uncontrolled psychological disorder, the medical conditions that render operation very risky, not optimized lifestyle and no previous trials of medical treatment were excluded from our study.

All patients underwent pre-operative bariatric evaluation which includes medical and psychological tests to assess eligibility. For those who had some risk factors, we consulted cardiologists, pulmonologists, and endocrinologists. In addition to that patient had evaluated using. Fasting blood glucose and Glycated HB, Complete lipid profile, Measuring blood pressure for the hypertensive patient, Symptoms of osteoarthritis were estimated as expressed by Western Ontario and McMaster Universities Arthritis Index (WOMAC), Symptoms of obstructive sleep apnea syndrome based on Epworth sleepiness scale. BMI was calculated.

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The procedure start with dissection using an ultrasonic scalpel to free greater curvature from the omentum and this is completed toward the angle of His (see figure 1)

. We complete dissection distally up to 5 cm proximal to the pylorus. (see figure 2)

Then we introduce a 36 french bougie into the stomach. After that stapling the stomach along the left side of the bougie start from 5 cm proximal to the pyloric sphincter and ending 1.5 cm lateral to the angle of His (see figure3). Then we inject methylene blue through bougie to test for any possible leakage. A drain is inserted through the assistant port and along the staple line. Operative time and rate of conversion into open procedure were observed for all patients.

Good control of pain and hydration is required in the post-operative period. During hospitalization, Patients are observed to discover any signs suggesting leakage or bleeding, such as tachycardia, tachypnea, or fever. On the next day, a gastrograffine study is performed to detect if there is any leak. Then we advise the patient to start oral fluids. A few hours after the procedure, an oral tolerance check was performed and most patients were released on the second day after the operation. We usually discharge patients 1-2 days after surgery. Patients are advised to take analgesics for several days, one month of anti-coagulant, two months of proton pump inhibitors, and six months of multivitamins. All patients have to consume fluids only for 2 weeks, followed by 2 weeks of semi-solid and purified diet, after that patient can eat normal food Patients were scheduled for follow-up visits 6 months and 1 year after the procedure. Excess weight loss percentage (EWL percentage) was estimated. At the same time, the improvement/resolution of co-morbidities was assessed.

**Statistical analysis**: Statistics was conducted by SPSS "Ver. 21." Chicago. The USA. Data expressed as mean, standard deviation, and ratio. We used Chi. square to evaluate the significance.

**Results**

We included 100 cases of morbid obesity . Mean age patients was 33.7 ± 10.7 years with range between 18 and 60 years. Majority of patients were females(about 77%). All cases were completed laparoscopically with no conversion to open procedure.

The mean operative time was (82.89 ± 22.89 minutes) while the mean hospital stay was (1.56 ± 0.50 days). The mean BMI before surgery was 42.6 ± 5.08 kg / m2 ranging from 35 to 64 kg / m2. The most frequent comorbidities were osteoarthritis (89%) , dyslipidemia (75%) and obstructive sleep apnea syndrome (60%) followed by hypertension (25%) and diabetes mellitus (17%). The least common associated co-morbidity was infertility (3%).

The mean EWL was 40.3% after 6 months and 63.5% after 12 months.

Traction of HBA1c of 17 patients who have diabetes through one year has shown a significant reduction in the level of glycated hemoglobin after one year. The mean HBA1c (mean) before treatment was 8.5% but after one year the mean HBA1c has decreased to reach 6.4%.

Traction of blood pressure has shown 40% improvement and 28% resolution after 6 months and traction through one year has shown 52% resolution and 24% improvement.

Traction of blood lipid profile has shown 73% improvement and 13% resolution after 6 months and traction through one year has shown 52% resolution and 24% improvement.

Following joint pain associated with osteoarthritis has shown 78% improvement after 6 months and traction through one year has shown 56.2% resolution and 43.8% improvement.

Following symptoms associated with OSAS has shown 67% improvement and and traction through one year has shown 66.7% resolution.

Three patients have suffered from infertility one of them have got pregnant after 6 months ,and another one have got pregnant within one year .

. The Influence of LSG on obesity-related co-morbidities is summarized in the table (1).

**Table 1: Influence of LSG on obesity-related co-morbidities**

|  |  |  |  |
| --- | --- | --- | --- |
| 12 months after the operation | 6 months after the operation | Percent | Co-morbidity |
| 6.4706 | 7.3824 | 17 | Glycemic control (mean of HBA1c levels) |
| no improvement (24%)  Improvement (24%)  Remission (52%) | no improvement (32%)  Improvement (40%)  Remission (28%) | 25 | HTN |
| no improvement (0%)  Improvement (33%)  Remission (67%) | no improvement (13%)  Improvement (73%)  Resolution (13%) | 75 | Dyslipidemia |
| no improvement (0%)  Improvement (44%)  Remission (56%) | no improvement (23%)  Improvement (78%)  Remission (0%) | 89 | OA |
| no improvement (33%)  Improvement (0%)  Remission (67%) | no improvement (33%)  Improvement (67%)  Remission (0%) | 60 | OSAS |
| Got pregnant (66%) | Got pregnant (33%) | 3 | Infertility |

**Surgical Complications:**

Post-operative complications are shown in Table 2. Only two patients had major surgical complications. The first patient had developed reactionary hemorrhage that was controlled by conservative treatments and blood transfusion while the second patient had developed an intestinal injury that occurred accidently during introduction of the first port. The injury was discovered and repaired intraoperative.

Twelve patients in our study have suffered from minor complications in the form of fever, SSI, and vomiting. We reported a single case of mortality due to post-operative pulmonary embolism. **(Table 2).**

**Table 2: Major complications**

|  |  |
| --- | --- |
| Complications | Percentage |
| Hemorrhage  Intestinal injury  Fever  SSI  vomiting | 1%  1%  5%  4%  3% |

**Discussion**

Morbid obesity is sharply increasing globally, and this leads to growing risks of obesity-related co-morbidities and mortality (10). Obesity is common in Egypt, the prevalence among adult men (>20 years) is 26.4% (25.0 – 27.8) and among women (>20 years) is 48.4% (46.1 – 50.9) (11). As medical treatment alone failed to achieve satisfying weight loss in morbid obesity, bariatric surgery has shown to be the most effective option for those patients (12,13

In our study, we performed LSG for 100 morbidly obese patients. To evaluate the impact of LSG on obesity and other associated co-morbidities which include: DM, hypertension, OSAS, dyslipidemia, musculoskeletal pain, and % EWL after the surgery.

In our sample, the pre-operative mean BMI was 47 kg / m2, which also decreased after one year to 30.3 kg / m2. Moreover, this is also consistent with Wang et al., who recorded a mean loss of BMI at one year from 40.8 kg / m2 to 27.9 kg / m2 (18).

In our study, the average %EWL after one year was 63.5%. We found that our findings agree with the observed broad range mentioned by other studies(14-18) Accordingly, the percentage of EWLs varies between 64.3%, as reported by Franco et al. (19), and 86%, as reported by Han et al.) (20), was reported one year after the LSG. Noun et al. also matched this and stated that 90% of weight loss has happened in the first six months and then becomes stable. At an EWL value of 76 percent after post-operative month 12. The mean pre-operative BMI was down at 12 months to 24.7 ± 2. The mean weight loss percentage was 25.3 percent of the initial weight at that time. Substantial weight loss occurred in most cases, hitting the 50 percent EWL at one year with 96.8 percent (21).

These outcomes are increasingly attributed to variability in patient compliance with pre- and post-operative guidelines and his behaviors, in particular, those relating to eating patterns and activity also the size of the bougie used and the distance of the beginning of stapling from the pylorus varies significantly in the outcomes of weight loss.

Regarding improvement in glycemic control, 17 patients among the LSG group in our study had diabetes; the mean HBA 1c has significantly decreased from 8.5 to 7.3, then 6.4 at 6, 12 months, respectively. Moon Han et al. reported a 100% resolution of the DM after six months (22). Gill R et al. documented a resolution in 66.2% of diabetic patients, improvement in 26.9%, and stabilization of condition in 13.1%(23). Similar results to our study were found in a study by Zabadi et al. (24).

The improvement in blood pressure control occurred in 6 out of 25 patients after LSG that was documented by decreasing the dose of the antihypertensive drugs needed to control their blood pressure 12 months post-operatively and resolution of hypertension have occurred in 13 patients. Moon Han reported a resolution of hypertension in 13 of 14 patients (92.9%) (25). Almogy et al. noticed hypertension in 62% of their sample, and 38.1% has shown improvement post-operative (26). Another study that was conducted in 2008 by Sammour et al. that has been conducted on 100 patients has shown improvement in 60% of hypertensive obese patients (n = 45) within one year after LSG (27).

Regarding the improvement of dyslipidemia, improvement of dyslipidemia has occurred in 18 out of 75 patients 12 months post-operatively and resolution have occurred in 39 patients. This is matched to a study conducted by Li K et al in Canada in 2011 and revealed resolution of dyslipidemia in 45% of patients after LSG (28).

Rawlin et al have performed A 5-year retrospective study at Wright State University, Dayton, Ohio showed excellent resolution hyperlipidemia (100 %), after LSG (29).

Regarding obstructive sleep apnea syndrome, in our study complete resolution of OSAS has occurred in 40 out of 60 patients 12 months after performing LSG. This result is matched with a 76% resolution after LSG as shown by the study performed by Behrens in 2011 (30).

Zhang et al have reported a 91% resolution of OSAS 1 year after LSG (31).

Regarding osteoarthritic joint pain, the majority of our patients who performed LSG (89%) were suffering from osteoarthritic pain, fortunately, 56% of them had resolution Zhang et al has performed a study on 200 patient to show a Reduction in obesity-related comorbidities after LSG, there was 66.7% resolution of musculoskeletal pain 1 year after LSG (31).

Regarding operative time, hospital stay, and rate of conversion:

The majority of our patients were discharged after 1 or 2 days except for those who developed complications. The mean duration of surgery was 83±23 minutes The mean operative time varies in the literature between 70-143 min (range 45-210 min.) as shown by Cottam et al (32).

All of the sleeve gastrectomy procedures were completed laparoscopically with 0% conversion to open procedure. Our results agree with Vuolo et al (33).

Intestinal injury and staple line bleeding which was controlled by conservative measures including blood transfusion were the only major complications in our study. In all cases, some authors advise staple line re-enforcement in the form of tissue glue applied over the staple line, such as Armstrong et al (34), others (such as Dapri et al) advise using sutures to conduct the enforcement (35).

Twelve patients in our study have suffered from minor complications in the form of fever, SSI, and vomiting. A prospective study has shown complications in 13% of cases, that include: leak in 2.5%, thromboembolic disorders in 0.8%, hemorrhage in 1.5%, complications of the wound in 1.8%, as reported by Sjöström et al (36) The rates of Complications differs significantly between authors with stable line leakage being the most worrisome one (37) no cases with leakage have occurred in our study

The mortality rate of bariatric surgery is ranging from 0.1 to 2.0 percent by Poulose et al in 2005 and the study published by Flum et al in the same year (38, 39). In our study, one case of mortality has occurred this represents a 1% mortality rate. This high mortality rate in our study can be explained by the relatively small size of the sample.

**Conclusion:**

LSG is a safe procedure with acceptable complication rates . It has definitely higher success rate regarding weight reduction and improvment / resolution of obesity associated co-morbidities like hypertention , DM,dyslipidemia, OSAS,infertility and skeletal pain

**Conflicts of interest:** no conflicts of interest.

**References**

1. World health organization (WHO) Obesity and Overweight. 2018. (Fact Sheet no. 311). https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight/ [Google Scholar].

2. Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement: Executive Summary. Crit Pathw Cardiol. 2005;4(4):198-203. [PubMed].

3. Isomaa B, Almgren P, Tuomi T, Forsen B, Lahti K, Nissen M. Cardiovascular morbidity and mortality associated with the metabolic syndrome. Diabetes Care. 2001;24(4):683-9. [PubMed].

4. Wolfe BM, Kvach E, Eckel RH. Treatment of Obesity: Weight Loss and Bariatric Surgery. Circ Res. 2016;118(11):1844–1855. DOI:10.1161/CIRCRESAHA.116.307591.

5. Zhao N, Tao K, Wang G, Xia Z. Global obesity research trends from 1999 to 2017: A bibliometric analysis. Medicine (Baltimore). 2019;98(4):e14132. DOI:10.1097/MD.0000000000014132.

6. Markar SR, Penna M, Karthikesalingam A, Hashemi M. The impact of hospital and surgeon volume on clinical outcome following bariatric surgery. Obes Surg. 2012;22(7):1126-34. [DOI] [PubMed].

7. Marceau P, Biron S, Bourque RA, Potvin M, Hould FS, Simard S. Biliopancreatic Diversion with a New Type of Gastrectomy. Obes Surg. 1993;3(1):29-35. [DOI] [PubMed].

8. Regan JP, Inabnet WB, Gagner M, Pomp A. Early experience with two-stage laparoscopic Roux-en-Y gastric bypass as an alternative in the super-super obese patient. Obes Surg. 2003;13(6):861-4. [DOI] [PubMed].

9. Hoyuela C. Five-year outcomes of laparoscopic sleeve gastrectomy as a primary procedure for morbid obesity: A prospective study. World J Gastrointest Surg. 2017;9(4):109–117. DOI:10.4240/wjgs.v9.i4.109].

10- Hurt RT, Kulisek C, Buchanan LA, McClave SA. The obesity epidemic: challenges, health initiatives, and implications for gastroenterologists. Gastroenterology & hepatology. 2010;6(12):780-92.

11- Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2005;384(9945):766-81.

12- Noria S, Grantcharov T. Biological effects of bariatric surgery on obesity-related comorbidities. Canadian Journal of Surgery. 2013;56(1):47-57.

13- Boza C., Salinas J., Salgado N., P\_erez G., Raddatz A., Funke R.Laparoscopic sleeve gastrectomy as a stand-alone procedure for morbid obesity: report of 1,000 cases and 3-year follow-up, Obes. Surg. 22 (2012) 866e871.

14. Parikh M, Gagner M, Heacock L, Strain G, Dakin G, Pomp A. Laparoscopic sleeve gastrectomy: does bougie size affect mean %EWL? Short-term outcomes. Surg Obes Relat Dis. 2008;4(4):528–33.

15. Gagner M. Leaks after sleeve gastrectomy are associated with smaller bougies: prevention and treatment strategies. Surg Laparosc Endosc Percutan Tech. 2010;20(3):166–9.

16. Bellanger DE, Greenway FL. Laparoscopic sleeve gastrectomy, 529 cases without a leak: short-term results and technical considerations. Obes Surg. 2011;21(2):146–50.

17. Skrekas G, Lapatsanis D, Stafyla V, Pampalambros A. One year after laparoscopic “tight” sleeve gastrectomy: technique and outcome. Obes Surg. 2008;18(7):810–3.

18-Wang X., Chang X., Gao L., et al: Effectiveness of laparoscopic sleeve gastrectomy for weight loss and obesity-associated co-morbidities: a 3-year outcome from Mainland Chinese patients. Surg Obes Relat Dis. 2016;12:1305-1311.

19-Franco JV, Ruiz PA, Palermo M, Gagner M. A review of studies comparing three laparoscopic procedures in bariatric surgery: sleeve gastrectomy, Roux-en-Y gastric bypass, and adjustable gastric banding. Obes Surg. 2011;21:1458–1468.

20-Lakdawala MA, Bhasker A, Mulchandani D, Goel S, Jain S. Comparison between the results of laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass in the Indian population: a retrospective 1-year study. Obes Surg. 2010;20:1–6.

21. Roger Noun et al. Laparoscopic Sleeve Gastrectomy for Mildly Obese Patients (Body Mass Index of 30 <35 kg/m2): Operative Outcome and Short-Term Results. 2012.

22.Han S, Kim W, Oh J. Results of Laparoscopic Sleeve Gastrectomy at 1 Year in Morbidly Obese Korean Patients. Obesity Surgery. 2005;15(10):1469-75.

23-Gill RS, Birch DW, Shi X, Sharma AM, Karmali S. Sleeve gastrectomy, and type 2 diabetes mellitus: a systematic review. Surgery for Obesity and Related Diseases. 2010;6(6):707-13.

24.uyuZabadi H, Daqour A, Hawari A, Hasouni J. Short-term outcomes of laparoscopic sleeve gastrectomy among obese patients in the northern west bank: a retrospective records review. BMC Research Notes. 2014;7(1):1-9.

25-Christou NV, Sampalis JS, Liberman M, Look D, Auger S, McLean A. Surgery Decreases Long-term Mortality, Morbidity, and Health Care Use in Morbidly Obese Patients. Annals of Surgery. 2004;240(3):416-9.

26-Almogy G, Crookes PF, Anthone GJ. Longitudinal Gastrectomy as a Treatment for the High-Risk Super-Obese Patient. Obesity Surgery. 2004;14(4):492-7.

27-Sammour T, Hill AG, Singh P, Ranasinghe A, Babor R, Rahman H. Laparoscopic Sleeve Gastrectomy as a Single-Stage Bariatric Procedure. Obesity Surgery. 2010;20(3):271-5.

28- Li K, et al. Comparative study on laparoscopic sleeve gastrectomy and laparoscopic gastric bypass for treatment of morbid obesity patients. Hepatogastroenterology. 2014;61(130):319–22.

29-Rawlins L, et al. Sleeve gastrectomy: 5-year outcomes of a single institution. Surg Obes Relat Dis. 2013;9(1):21–5.

30-Behrens C, Tang BQ, Amson BJ. Early results of a Canadian laparoscopic sleeve gastrectomy experience. Can J Surg. 2011;54(2):138–43.

31 - Zhang N, et al. Reduction in obesity-related comorbidities: is gastric bypass better than sleeve gastrectomy? Surg Endosc. 2013;27(4):1273–80.

32-Cottam D, Qureshi FG, Mattar SG, Sharma S, Holover S, Bonanomi G . Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high-risk patients with morbid obesity. Surgical Endoscopy. 2006;20(6):859-63.

33-Vuolo G., Voglino C., Tirone A., et al: Is sleeve gastrectomy a therapeutic procedure for all obese patients? International Journal of Surgery. 2016;30:48-55.

34-Armstrong J, O'Malley SP. Outcomes of sleeve gastrectomy for morbid obesity: A safe and effective procedure? International Journal of Surgery. 2010;8(1):69-71.

35-Dapri G, Cadière G, Himpens J. Reinforcing the Staple Line During Laparoscopic Sleeve Gastrectomy: Prospective Randomized Clinical Study Comparing Three Different Techniques. Obesity Surgery. 2010;20(4):462-7.

36-Sjöström L, Lindroos A-K, Peltonen M, Torgerson J, Bouchard C, Carlsson B. Lifestyle, Diabetes, and Cardiovascular Risk Factors 10 Years after Bariatric Surgery. The New England Journal of Medicine. 2004;351(26):2683-93.

37-Frezza EE, Reddy S, Gee LL, Wachtel MS. Complications after sleeve gastrectomy for morbid obesity. Obes Surg. 2009;19:684–7.

38-Poulose BK, Griffin MR, Moore DE, Zhu Y, Smalley W, Richards WO. Risk Factors for Post-Operative Mortality in Bariatric Surgery. Journal of Surgical Research. 2005;127(1):1-7.

39-Flum DR, Salem L, Elrod JA, Dellinger EP, Cheadle A, Chan L. Early mortality among Medicare beneficiaries undergoing bariatric surgical procedures. JAMA. 2005;294(15):393-8.