Five-year outcomes of laparoscopic sleeve gastrectomy in the treatment of morbid obesity: a retrospective analysis

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Background
Laparoscopic sleeve gastrectomy (LSG) is an emerging surgical technique that is gaining popularity among bariatric surgeons owing to its surgical simplicity with encouraging results.
Aim
A retrospective analysis of 5-year outcomes of LSG performed for treatment of morbid obesity was done regarding weight loss, improvement in comorbidities, complications, and quality of life.
Patient and methods
LSG was performed for the treatment of morbid obesity between May 2012 and January 2015 on 200 patients who completed 5-year follow-up postoperatively at the Gastrointestinal and Laparoscopic Surgery Unit, General Surgery Department, Tanta University, Egypt.
Results
The study population included 165 females and 35 males, with a mean age of 30.17 ±8.90 years. The mean preoperative BMI was 51.76±7.36 kg/m^2. The mean operative time was 90.83±29.43 min, and the mean postoperative hospital stay was 3.54 days. Conversion to open surgery occurred in one (0.5%) case. Early complications were encountered in 15 (7.5%) patients. Staple line leakage at the gastroesophageal junction was recorded in two (1%) cases detected by gastrografin study on the fifth postoperative day. Late complications included 20/199 (10.1%) patients. The mean postoperative excess body weight loss percent achieved was 59.47±15.20 at 1 year, 66.45±13.8 at 2 years, 70.09 ±14.3 at 3 years, 65.72±10.14 at 4 years, and 60.20±11.25 at 5 years, The mean BMI achieved was 35.40±5.81 at 1 year, 31.60±5.41 at 2 years, 28.20 ±7.25 at 3 years, 30.48±6.71 at 4 years, and 34.20±5.45 at 5 years.
Conclusion
LSG surgery is an easy, safe, and effective bariatric surgical procedure producing significant weight loss, resolution or improvement of comorbidities, and improvement of quality of life with low perioperative complications.

Keywords:
laparoscopic, obesity, sleeve gastrectomy

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Introduction

Obesity is a worldwide health problem in both developed and developing countries [1]. At present, bariatric surgery is the most effective method to achieve major, long-term weight loss, which has led to a sharp rise in number and interest of bariatric surgical procedures performed over the past 15 years [2].

Laparoscopic sleeve gastrectomy (LSG) has gained popularity whether as a primary, staged, or revisional operation for its proven safety and short-term efficacy [3].

LSG has been associated with several important advantages in terms of pylorus preservation (avoidance of dumping syndrome); preservation of intestinal continuity; does not involve any digestive anastomosis; no mesenteric defects are created, eliminating the risk of internal hernia; and no foreign material is used [4].

LSG results in stable and adequate weight loss with resolution/improvement in comorbidities in a high percentage of patients. It can be considered a definitive operation for morbid obesity [5].

Patients and methods

This retrospective study was carried out at the Gastrointestinal and Laparoscopic Surgery Unit, Department of General Surgery, Tanta University, to analyze the outcomes of LSG performed for the treatment of morbid obesity between May 2012 and January 2015 and included 200 patients who completed 5 years of follow-up postoperatively. Written informed consent was obtained from the patients. The study was approved by the Research Ethics Committee, Quality Assurance Unit, Faculty of Medicine, Tanta University.

Preoperative assessment and preparation

Data from all operated patients were routinely collected prospectively in a database. The hospital files of included patients have been reviewed, and the following data were collected.

Anthropometric measurements in the form of weight, height, BMI, waist circumference, hip circumference, and waist/hip ratio; laboratory investigations; imaging investigations; and evaluation of associated comorbidities.

Accurate assessment and optimization of associated uncontrolled comorbidities that may carry risk for anesthesia and surgery was done.

Operative technique

The surgery was performed through the right-sided position, in a supine position with legs adducted. The surgeon and the cameraman stood on the patient's right side, and the assistants stood on the patient's left side. The procedure was performed through five abdominal trocars. Insufflation was achieved after insertion of the first port optically guided by a 0° scope and then replaced by a 30° scope for optimum visualization. Devascularization of the greater curvature was started at the level of the middle of the body of the stomach, where the greater omentum is made of single layer and then extended cephalad through the short gastric vessels till the gastroesophageal junction (GEJ) exposing the left leaflet of right crus with complete mobilization of the posterior aspect of the fundus. This means that we start 1st stappling 4–6 cm from pylorus and firing after introduction of 36 french bougie to avoid tight sleeve. The sleeve was completed by sequential firings of the stapler going cephalad toward 1 cm lateral to the angle of His. Hiatal repair was performed when hiatal hernia is diagnosed preoperatively or intraoperatively. Methylene blue test was done routinely.

Operative data included operative time, any operative complications, or other surgical procedures performed together with bariatric surgery.

Early postoperative data included postoperative course, results of the contrast study, length of hospital stay, any complications, readmission, or intervention.

During the study period, included patients were recalled for assessment annually after surgery. The following data were collected:

(1) Anthropometric measurements: weight loss, change in mean BMI, and change in mean excess body weight loss percent (EBWL%).
(2) Improvement or resolution of obesity-associated morbidities. Resolution of comorbidities was defined as 'normalization of clinical and laboratory parameters without medications' and improvement as 'normalization of clinical and laboratory parameters with reduced dose of medication.'
(3) Development of complications and their management, including any readmission or intervention.
(4) Assessment of the patients' quality of life (QOL) using the bariatric analysis and reporting outcome system.

Statistical analysis

The results were collected, tabulated, and statistically analyzed using the SPSS statistical package, version 20 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were prepared. Categorical data were expressed as number and frequency (percent). Metric data were expressed as range, mean, and SD.

Results

The study population included 200 patients, comprising 165 (82.5%) females and 35 (17.5%) males. Their ages ranged between 18 and 53 years, with a mean of 30.17 ±8.90 years. Preoperative upper gastrointestinal endoscopy was done routinely for all patients, and it revealed that that 10 (5%) patients had small sliding hiatus hernia less than 2 cm, five (2.5%) patients with mild gastroesophageal reflux disease (GERD), 15 (7.5%) patients had gastritis (antral or pangastritis), and five (2.5%) patients with duodenitis and received medical treatment before surgery. In this study, 40 (20%) patients were hypertensive, 30 (15%) patients had type 2 diabetes mellitus, 53 (26.5%) patients had dyslipidemia, 42 (21%) patients had arthritis, 34 (17%) patients had obstructive sleep apnea, 26 (13%) patients had urinary symptoms such as stress incontinence, 22 (11%) patients

had skin symptoms, such as intertrigo; and 10 (5%) patients had gall bladder stones (Table 1).

Operative records

The mean operative time was 90.83±29.43 min. Associated procedures were laparoscopic cholecystectomy in 10 (5%) patients and hiatal repair in 10 (5%) cases.

Intraoperative complications

Intraoperative complications were recorded in 22 (11%) patients. Superficial liver tear caused by the liver retractor was encountered in 12 (6%) patients with bulky liver in super and super super obese patients, and the resulting bleeding was controlled by compression. Minimal bleeding from splenic capsule occurred in two (1%) patients and was controlled by compression as well. Staple line bleeding occurred in seven (3.5%) patients and was stopped by oversewing, and posterior subcardiac gastric perforation during introduction of the bougie by the anesthesiologist occurred in one (0.5%) patient, where the procedure was converted to open owing to difficulty in repairing it laparoscopically, which was repaired, and sleeve was completed.

Postoperative results

The mean postoperative hospital stay was 3.54 days. All patients in this study were subjected to oral gastrografin contrast study on the first postoperative day, and no leakage was detected in any of them (Fig. 1).

Table 1 Preoperative results

Preoperative results	*N*=200 [*n* (%)]
Sex	
Male	35 (17.5)
Female	165 (82.5)
Age	
Minimum–maximum	18.0–53.0
Mean	30.17±8.90
Preoperative endoscopic finding	
Normal	165 (82.5)
Small hiatal hernia	10 (5)
GERD	5 (2.5)
Gastritis of different degrees	15 (7.5)
Duodenitis	5 (2.5)
Associated comorbidities	
Hypertension	40 (20)
Type 2 DM	30 (15)
Dyslipidemia	53 (26.5)
Muscloskeletal	42 (21)
OSA	34 (17)
Urinary	26 (13)
Skin	22 (11)
Gall bladder stones	10 (5)

DM, diabetes mellitus; GERD, gastroesophageal reflux disease; OSA, obstructive sleep apnea.

Early postoperative complications

Early complications were encountered in 15 (7.5%) patients, severe staple line bleeding occurred in one (0.5%) patient, which compromised the patient's hemodynamics in spite of intensive resuscitation by fluids and blood. The patient was managed by open surgical exploration at the same night in emergency hospital owing to unavailability of the laparoscope at this time, and a large hematoma was evacuated with oversewing the staple line. Staple line leakage at GEJ (Fig. 2) was recorded in two (1%) cases detected by gastrografin study on the fifth day postoperative, who were managed by keeping the intraabdominal drain, insertion of Mega stent (Taewoong Medical, Seoul, Korea) (Fig. 3), and total parenteral nutrition. One patient passed smoothly, and stent was removed 4 weeks later, and the other patient was diabetic and hypertensive, with BMI 58.7, and she was noncompliant to fasting. She developed chest infection and died because of it after 60 days. Small left subphrenic collection occurred in four (2%) patients, who were successfully managed conservatively by antibiotics, close observation, and repeated follow-up US. Moreover, eight (4%) patients experienced local wound complications (seroma and infection) and were managed successfully by conservative treatment in the form of antibiotics (according to culture and sensitivity test) and repeated daily dressing.

Change in excess body weight loss percent and BMI

In this study, the mean preoperative weight was 139.55 ±20.03 kg. The mean postoperative weight achieved was 95.75±17.09 kg at 1 year, 88.35±15.89 kg at 2 years, 82.36±14.30 kg at 3 years, 87.42±16.14 kg at 4 years, and 93.85±23.05 kg at 5 years.

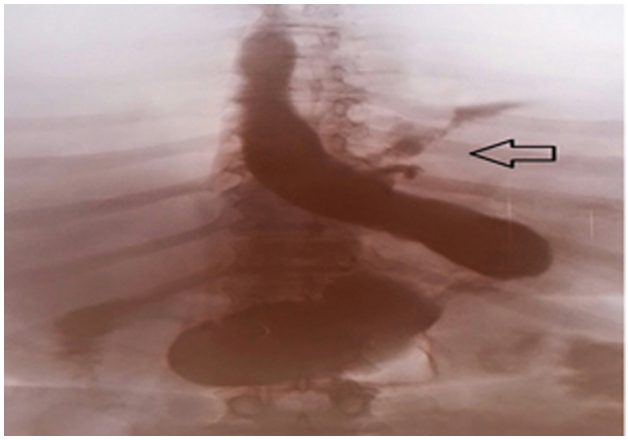
In this study, the mean postoperative EBWL% achieved was 59.47±15.20 at 1 year, 66.45±13.8 at 2 years, 70.09±14.3 at 3 years, 65.72±10.14 at 4 years, and 60.20±11.25 at 5 years.

The mean preoperative BMI was 51.76±7.36 kg/m^2. The mean BMI achieved was 35.40±5.81 at 1 year, 31.60±5.41 at 2 years, 28.20±7.25 at 3 years, 30.48 ±6.71 at 4 years, and 34.20±5.45 at 5 years. Regarding weight regain, it occurred in 40/199 (20.1%) patients at 5-year follow-up. Revisions to laparoscopic one anastomosis gastric bypass were done in 30 (15.07%) patients.

Figure 1

Gastrografin contrast study.

Figure 2



Leakage at GEJ. GEJ, gastroesophageal junction.

Effects of weight reduction

Bariatric analysis and recording outcome system

The system defines five outcome groups (failure, fair, good, very good, and excellent), based on a scoring table that adds or subtracts points while evaluating three main areas: percentage of excess weight loss, changes in medical conditions, and QOL (Table 2).

To assess changes in QOL after treatment, this method incorporates a specifically designed patient questionnaire that addresses self-esteem and four daily activities. Complications and reoperative surgery deduct points, thus avoiding the controversy of considering reoperations as failures. Overall, 17.5% of patients were recorded as fair outcome, 42.5% were good, 32.5% were very good, and 7.5% patients were excellent. There were no cases of failure, where more than seven points represents an excellent result, five to seven points a very good result, three to five points a good result, and one to three points a fair result. A final score of one point or less signifies a failure of the treatment.

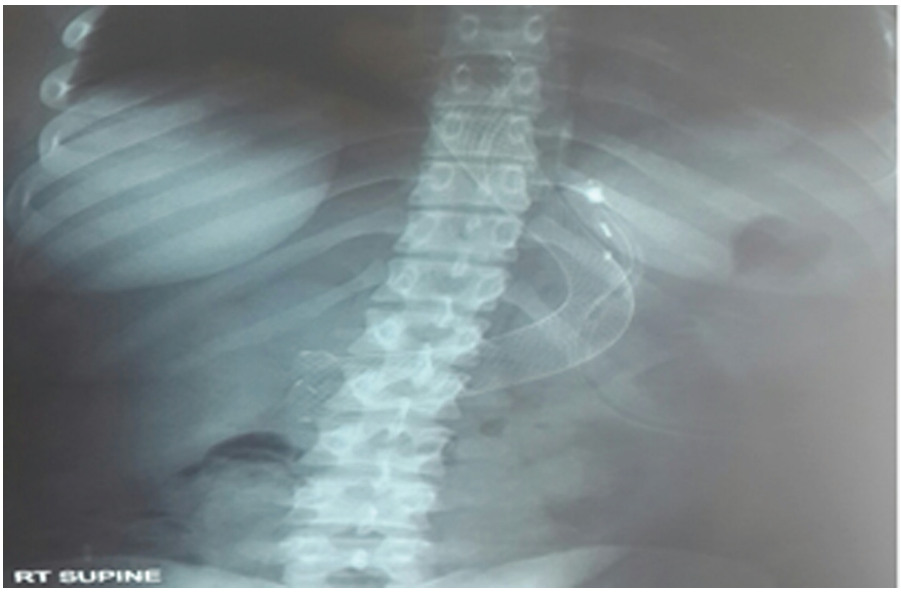
Late postoperative complications

Late complications were encountered in 20/199 (10.1%) patients after exclusion of one patient who died. Of 189 patients, 11 (5.8%) developed gall stones at the first year postoperatively; four of them presented with biliary pain and the others were discovered by ultrasound (US) examination, and they were managed by laparoscopic cholecystectomy. Nutritional sequelae developed in six (3.1%) patients, in the form of anemia in three (1.5%) patients and hypocalcemia in three (1.5%) patients, who were treated medically. Incisional hernia occurred 6 months postoperatively in one (0.5%) patient, who was explored for control of staple line bleeding. The patient was managed surgically by onlay mesh repair 18 months postoperatively and passed smoothly without significant sequelae. Port site hernia occurred 2 months postoperatively in two (1%) patients at the left 5–12 port site where the resected stomach was retrieved and managed surgically by onlay mesh repair 15 months postoperatively and passed smoothly without significant sequelae.

Discussion

The aim of this study was to analyze 5-year outcomes of LSG performed for treatment of morbid obesity

Figure 3



Mega stent.

Table 2 Effects of weight reduction

Obesity-related morbidities	*n* (%)
HTN	39 (100)
Resolved	17 (43.6)
Improved	13 (33.3)
No change	9 (23.1)
DM	29 (100)
Resolved	12 (41.4)
Improved	5 (17.2)
No change	12 (41.4)
Dyslipidemia	53 (100)
Resolved	20 (37.7)
Improved	15 (28.3)
No change	18 (34)
Muscloskeletal	41 (100)
Resolved	20 (48.8)
Improved	8 (19.5)
No change	13 (31.7)
OSA	33 (100)
Resolved	17 (51.5)
Improved	8 (24.25)
No change	8 (24.25)
Urinary	26 (100)
Resolved	12 (46.2)
Improved	10 (38.5)
No change	4 (15.3)
Skin	22 (100)
Resolved	10 (45.4)
Improved	6 (27.3)
No change	6 (27.3)

DM, diabetes mellitus; HTN, hypertension; OSA, obstructive sleep apnea.

regarding weight loss, improvement in comorbidities, complications, and QOL. This study included 200 morbidly obese patients who completed 5 years of follow-up postoperatively and accepted to participate and signed an informed consent.

The patients' age in our study ranged between 18 and 53 years, with mean of 30.17±8.90 years. This recorded age is quite similar to ElShora [6], and Abo Ryia [7], where the mean age was 33.2±10.2 years.

Regarding sex distribution in our study, females constituted the majority of our patients [165/200 (82.5)]. This sex incidence was matched with that reported by El-Mahdi [8] (78.7%).

The operative time ranged between 60 and 130 min, with a mean of 90.83±29.43 min, which is similar to the mean operative time reported by Shi *et al*. [9], of 100.4 min, ranged from 49 to 143 min.

Intraoperative complications were recorded in 22 (11%) patients. Staple line bleeding in seven (3.5%) patients was stopped by oversewing, and posterior subcardiac gastric perforation during introduction of the bougie by the anesthesiologist occurred in one (0.5%) patient, where the procedure was converted to open owing to difficulty to repair it laparoscopically.

Compared with other series of LSG, the overall conversion rate was 1.96%, with 100 operations laparoscopically completed and two converted to open reported by Zacharoulis *et al*. [10]. The first converted case was owing to dense adhesions from multiple previous laparotomies, and the second was owing to hemorrhage from the short gastric vessels.

Conversion to open technique was required in 2 (0.6%) patients due to massive hepatomegaly reported by Basso *et al*. 2011 [11].

Staple line leakage at the GEJ is by far the most dangerous and the most challenging postoperative complication after LSG, and it is considered as the nightmare for bariatric surgeons.

Early complications were encountered in 15 (7.5%) patients, severe staple line bleeding occurred in one (0.5%) patient that compromised the patient's hemodynamics in spite of intensive resuscitation by fluids and blood. The patient was managed by open surgical exploration at the same night owing to unavailability of the laparoscope at this time. Staple line leakage at GEJ was recorded in two (1%) cases, detected by gastrografin study on the fifth day postoperative, who were managed by keeping the intraabdominal drain, insertion of Mega stent (Taewoong Medical), and total parenteral nutrition. One patient passed smoothly and stent was removed 4 weeks later and the other patient was diabetic and hypertensive with BMI 58.7, and she was noncompliant to fasting. She developed chest infection and died because of it after 60 days.

Chopra *et al*., 2012 [5] reported leakage at GEJ in four (2.16%) of their patients. Two leaks were detected early on 1st day postoperative and were successfully repaired laparoscopically by suturing. The other two leaks were detected at 6 and 19 postoperative day.

Regarding mortality rate in our study, it occurred in one (0.5%) patient after 2 months postoperative owing to severe chest infection. The patient had leakage at GEJ. This is quite similar to that reported by Plamper *et al*. [12] that Clavien–Dindo grade V (30-day mortality) occurred in one (0.8%) patient of LSG.

Pech *et al*. [13] reported that mortality rate is 2%. One patient died during hospital stay 73 days after operation, owing to SIRS and ARDS. The second patient died several months after LSG, in fact of his cardiac situation without any relation to operation.

The mean postoperative hospital stay was 3.54 days, which is quite similar to that reported by Magee *et al*. [14], with a mean of 3 days, ranged between 2 and 7 days.

Late complications were encountered in 20/199 (10.1%) patients. Of 189 patients, 11 (5.8%) developed gall stones at the first year postoperatively; four of them presented with biliary pain and the others were discovered by US examination, and they were managed by laparoscopic cholecystectomy.

Obesity and rapid weight loss are known risk factors for gall stones formation, and some centers routinely perform prophylactic cholecystectomy with bariatric procedures to prevent complications of cholelithiasis, whereas other centers prefer to do cholecystectomy only for those having gall stones [15]. Our center adopts the second policy. Hence, we do preoperative abdominal US examination routinely for all of our patients to detect cases with asymptomatic gall stones. Laparoscopic cholecystectomy was done in 10 (5%) patients because of having gall stones whether symptomatic or not.

In this study, the mean preoperative weight was 139.55 ±20.03 kg. The mean postoperative EBWL% achieved was 59.47±15.20 at 1 year, 66.45±13.8 at 2 years, 70.09 ±14.3 at 3 years, 65.72±10.14 at 4 years, and 60.20 ±11.25 at 5 years, The mean preoperative BMI was 51.76±7.36 kg/m^2. The mean BMI achieved was 35.40 ±5.81 at 1 year, 31.60±5.41 at 2 years, 28.20±7.25 at 3 years, 30.48±6.71 at 4 years, and 34.20±5.45 at 5 years.

In a systematic review of literature on LSG including 12 129 patients, Fischer *et al*. [16], reported that the maximum % EWL occurred 24 months postoperatively with a mean EWL of 64.3% (minimum 46.1%, maximum 75.0%). However, the mean EWL at 48 months was 60.9% (56.3–66.0%). They reported that reoperations were necessary in 6.8% (range, 0.7–25%) of cases receiving LSG as a stand-alone procedure because of regaining weight. This highlighted the importance of long-term follow-up.

After bariatric surgery, one of the main concerns is weight regain. In our study, it occurred in 40/199 (20.1%) patients at 5-year follow-up. The weight regain in LSG is attributed to dilatation of the sleeve after some time which confirmed in our study by follow-up endoscope in 30/199 (15.07%) patients, leading to more food intake, which is quite similar to the results reported by Jammu and Sharma [17], with 14.2% after LSG, and Kular *et al*. [18], who reported 13 (12.5%) patients with weight regain in LSG group. Revisions to laparoscopic one anastomosis gastric bypass were done in 30 (15%) patients.

In this study, resolution/improvement of hypertension in our study was seen in 76.9% of cases. Our results of LSG were found in agreement with that reported by Ramalingam and Anton [19] (71.4%) and Sánchez-Santos *et al*. [20] (63.2%).

In this study, resolution/improvement of type 2 diabetes mellitus was reported in 58.6%. Our results coincided with that reported by Jammu and Sharma [17], where 56.5% of patients who underwent LSG achieved diabetes remission.Resolution/improvement of dyslipidemia was reported in 66% of patients. Our results are quite similar to that reported by Kular *et al*. [18], where 72% showed improvement after LSG.

Resolution/improvement of degenerated joint diseases in our study was seen in 68.3%. Our results did not match with Kansou *et al*. [21], who reported improvement in 87.1% after LSG. This may be explained by the higher numbers of super and super super obese patients included in our study.

Resolution/improvement of obstructive sleep apnea in our study was seen in 75.7%. Our results coincide with that reported by Kansou *et al*. [21], who reported 75.9% showed improvement after LSG.

Resolution/improvement of urinary problems in our study was 84.7%. Our results of LSG are quite similar to that reported by Srinivasa *et al*. [22], with 90%.

Regarding postoperative endoscopic follow-up examination, it was done in 199 patients. Pathological findings were reported in 60 (30.15%) patients; gastritis of different degrees in 22 (11.05%) patients; wide proximal half of sleeve in 30 (15.07%) patients; small sliding hiatal hernia in five (2.51%) patients, three of them being de novo; and GERD in three (1.5%) patients, two of them being de novo GERD.

LSG may cause de novo GERD or may improve or aggravate existing reflux. There is no consensus about mechanisms responsible for the existing reflux outcome, the development of de novo GERD and also about the effects of LSG in LES function. However, most surgeons agree that LSG can be effectively and safely performed when bariatric surgery is indicated with the exception of Barrett's esophagus and severe GERD. Additionally, there is no universally accepted policy for simultaneous hiatal repair and LSG, although most surgeons agree when hiatal hernia is diagnosed pre- or intra-operatively, that posterior hiatus repair is necessary [23].

Conclusion

LSG surgery is an easy, safe, and effective bariatric surgical procedure, producing significant weight loss, resolution or improvement of comorbidities, and improvement of QOL, with low perioperative complications. LSG requires a very cooperative patient following accurate dietary recommendations to achieve its planned aims.

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Conflicts of interest

There are no conflicts of interest.

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