



Seven-Year Outcomes of Laproscopic Sleeve Gastrectomy in Indian Patients with Different Classes of Obesity

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Abstract

Background

The aim of the study was to assess the long-term outcome in terms of weight loss and remission of comorbidities among the patients who had undergone LSG in an Indian setting.

Methods

This is a retrospective observational study of patients (BMI > 30 kg/m²) who underwent LSG having a minimum 6 months of follow-up data. Based on preoperative BMI, patients were grouped as class 1, 30 < BMI < 35 kg/m²; class 2, 35 < BMI < 40 kg/m²; and class 3, BMI > 40 kg/m². Data on BMI and %EWL between three classes and among genders at different follow-up points for 7 years were compared.

Result

Study included 95 patients (mean age of 33.7 ± 11 years), and the preoperative mean BMI was 40.2 ± 5.1 kg/m². At one year of surgery, 85.5% patients achieved > 50%EWL. The highest mean %EWL was found in class 1 (66.19%), followed by class 2 (56.73%) and class 3 (46.59%) at the sixth month follow-up. At the seventh year, %EWLs were 85.11% (class 1), 76.69% (class 2), and 62.98% (class 3) and the mean BMIs were 25.13 ± 3.09 kg/m² (class 1), 26.86 ± 2.12 kg/m² (class 2), and 31.07 ± 3.39 kg/m² (class 3) and were significantly different ($p < 0.05$). At the last follow-up, though, the males showed slight weight regain; however, there were no statistical differences between the genders ($p = 0.065$).

Conclusion

Outcome from LSG was better in patients with BMI < 40 kg/m² compared to the patients with BMI > 40 kg/m². Remission of obesity-related comorbidities was observed with LSG in all groups and gender did not influence the outcome significantly.

Keywords Obesity · Sleeve gastrectomy · Diabetes · BMI · Bariatric surgery

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Introduction

Bariatric surgery is gaining popularity as the most effective treatment for morbid obesity. Laparoscopic sleeve gastrectomy (LSG) was introduced as a preliminary bariatric procedure to achieve substantial weight loss, therefore lowering the rate of possible complications during the secondary procedures like duodenal switch or laparoscopic Roux-en-Y gastric bypass [1, 2]. Studies have shown favorable short-term and long-term outcomes in morbidly obese patients [3], and LSG continues to be practiced as a standard bariatric surgical procedure [4]. Technical simplicity, shorter operative time, maintenance of bowel integrity, and preservation of the pylorus are some of the advantages of LSG [5, 6]. In addition, patients who underwent LSG had fewer nutritional deficiencies compared to other procedures [7]. In patients who develop severe gastroesophageal reflux symptoms or those who regain weight, LSG can be later modified if required to a more complex procedure such RYGB or MGB [8–11].

LSG has been recommended as a single and effective intervention in obese adults who usually fail to reach real benefits from a structured weight loss program, as it can significantly improve the BMI by excess weight loss and/or resolve obesity-associated comorbidities [12]. Obesity among Indian population is increasing, giving rise to increased prevalence of associated comorbidities. Due to lifestyle and ethnic genetic susceptibility, the conventional weight loss management programs are less effective in these patients.

The excess weight loss from the surgery depends on the preoperative BMI status. Patients presenting with different classes of obesity (class I, II, and III) may respond differently to the surgery outcomes in terms of weight loss. Similarly, gender has shown to be associated with bariatric surgery with disparity in the outcome between genders [13]. A study by Blum et al. showed that female patients' response to bariatric surgery was better compared to the male patients [14]. Hence, our objectives were to compare (i) the BMI and % EWL among patients from three different groups based on BMI and (ii) between genders at different time points during the 7-year follow-up.

Materials and Methods

Patients

This is a retrospective observational single-center study conducted with the approval from the institutional ethical committee. Preoperative and postoperative follow-up data of all the patients who underwent LSG as a sole bariatric procedure for morbid obesity between the years 2007 and 2011 were reviewed from the hospital medical records. The inclusion criteria were patients of any gender with BMI > 30 kg/m² with

a minimum 6 months of follow-up data. Patients who underwent other additional bariatric surgery, with HIV, and other autoimmune diseases were excluded.

Surgery

Standard preoperative care and precautions were taken. The LSG was performed using the four-port technique. A 30-Fr bougie was passed under vision through the esophagus, stomach, and into the first portion of the duodenum. It was aligned along the lesser curvature of the stomach and used as a template to perform the vertical sleeve gastrectomy. An endoscopic linear cutting stapler was used to serially staple and transect the stomach staying just to the left and lateral to the bougie. The transected stomach, which includes the greater curvature, was completely freed and removed from the peritoneum through the umbilical port. Standard postoperative care was given. Fluid and food intakes were monitored and discharged with dietary instructions by a bariatric dietician.

Data Collection

Preoperative data included patient demographics, weight, BMI, and comorbidities. The follow-up data included BMI, %EWL, complications, and status of comorbidities. The obesity-related comorbid conditions included type 2 diabetes mellitus (T2DM), hypertension (HTN), obstructive sleep apnea (OSA), and gastroesophageal reflux disease (GERD). The numbers were recorded and compared with the follow-up data to account for the % remission in the comorbid conditions post-LSG.

The patients were classified according to the preoperative BMI into three groups: class 1, patients with BMI 30–35 kg/m²; class 2, patients with 35 < BMI < 40 kg/m²; and class 3, patients with BMI > 40 kg/m².

The efficiency of bariatric surgery with respect to weight loss was assessed based on the %EWL; if the %EWL was 30–50%, surgery was considered inadequate, and a failure if %EWL was < 30%. Remission of comorbidities was assessed based on standard clinical evaluation used for each condition.

Statistical Analysis

The data is presented as the mean and SD or numbers and percentage. Normality of the data was tested with Shapiro-Wilks test. One-way ANOVA and independent *t* test were used to compare quantitative variables across the classes and among the genders, respectively, at different time points. Tests for significance of difference were two-sided, and *p* < 0.05 was considered to be statistically significant. All the statistical analyses were performed using SPSS version 22.0.

Table 1 Pre-op patient demographics (*n* = 95)

Female, <i>n</i> (%)	52 (54.73%)
Male, <i>n</i> (%)	43 (45.26%)
Age (mean ± SD)	33.7 ± 11.2 years
BMI (mean ± SD)	40.19 ± 5.01 kg/m ²
Patients with comorbidities*, <i>n</i> (%)	38 (40%)

*Type 2 diabetes mellitus, hypertension, obstructive sleep apnea, gastroesophageal reflux disease, and others (not related to obesity)

Results

Baseline Characteristics

We reviewed all the LSG cases performed during the study period, and a total of 95 cases matched the inclusion criteria. The study group consisted of 52 (54.7%) females and 43 (45.3%) males. The mean age of the study group was 33.7 ± 11.2 years with mean BMI of 40.2 ± 5.1 kg/m². Patient demographics, preoperative data, and comorbidities are presented in Table 1. The number of patients available during the follow-up period is presented in Fig. 1. Postoperatively, there were no complications and mortality.

Outcome Comparison Based on Preoperative BMI and %EWL

Changes in BMI, % EWL, and %BMIL during the 7-year period compared to preoperative data are given in Fig. 2a–c. At six months (*n* = 95), 53 (55.79%), and at one year (*n* = 90), 77 (85.55%) patients achieved > 50%EWL, respectively, indicating the successful outcome. Among the 13 patients who did not achieve > 50%EWL at 1 year after surgery, 5 patients could achieve > 50%EWL by the second year, and 10 patients by the third year after surgery. However, at the end of 7 years, only two patients out of these 13 could not achieve or maintain > 50% EWL.

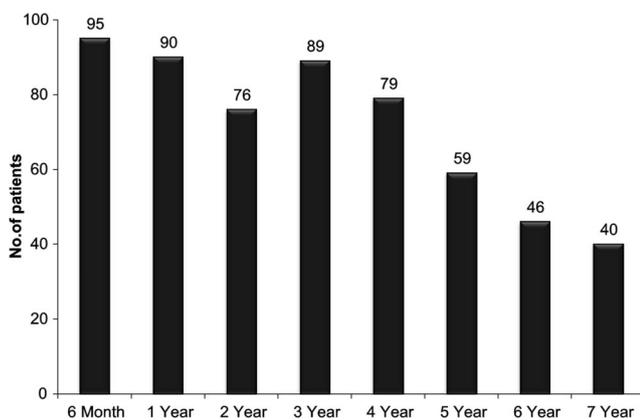


Fig. 1 Number of patients available in the follow-up period for 7 years

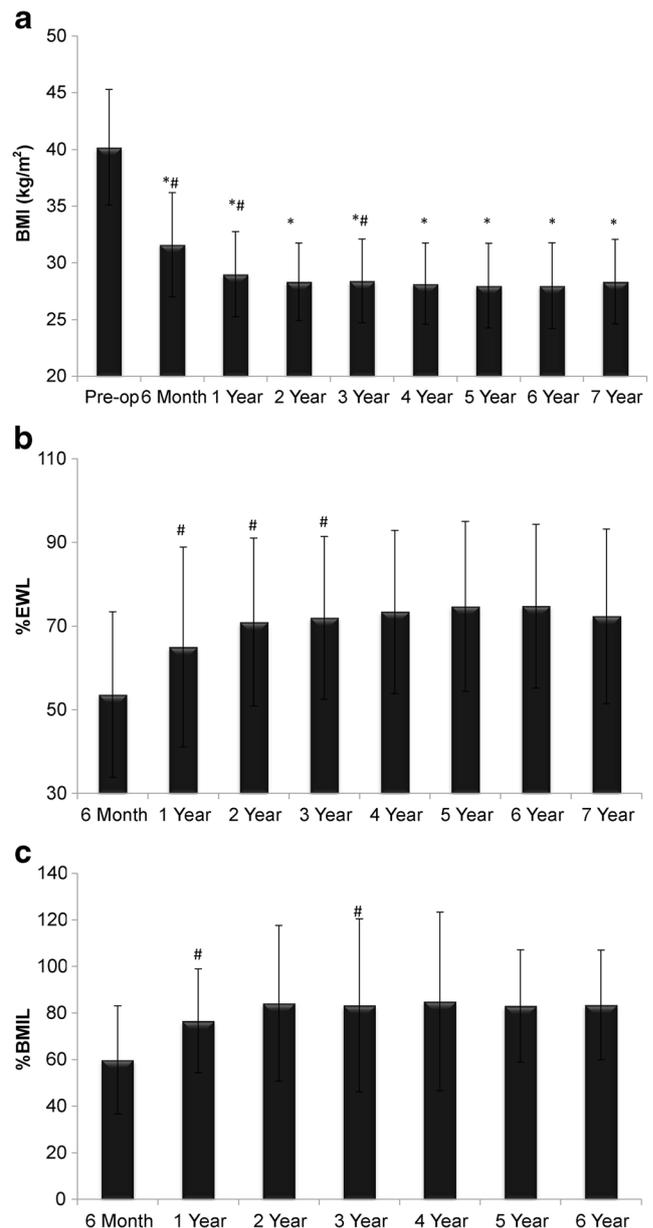


Fig. 2 a Pre- and postoperative mean BMI in the study group; *significant difference from the preoperative BMI and #significant difference from the previous follow-up (*p* < 0.05). b %EWL and c %BMIL among the patients; #significant difference from the previous follow-up (*p* < 0.05)

Comparison of outcome among the patients in three groups based on BMI is shown in Fig. 3a. The mean BMI of class 1 (*n* = 16) was 33.69 ± 1.21 kg/m², class 2 (*n* = 35) was 37.62 ± 1.64 kg/m², and class 3 (*n* = 44) was 44.61 ± 3.65 kg/m². There was a significant decrease in BMI (*p* < 0.05) from preoperative to 6 months and 1 year in class 1 and class 2, and there were no further significant changes in the BMI till the seventh year. In class 1 and class 2, the mean BMI at the end of the seventh year were 25.13 ± 3.09 kg/m² and 26.86 ± 2.12 kg/m², respectively.

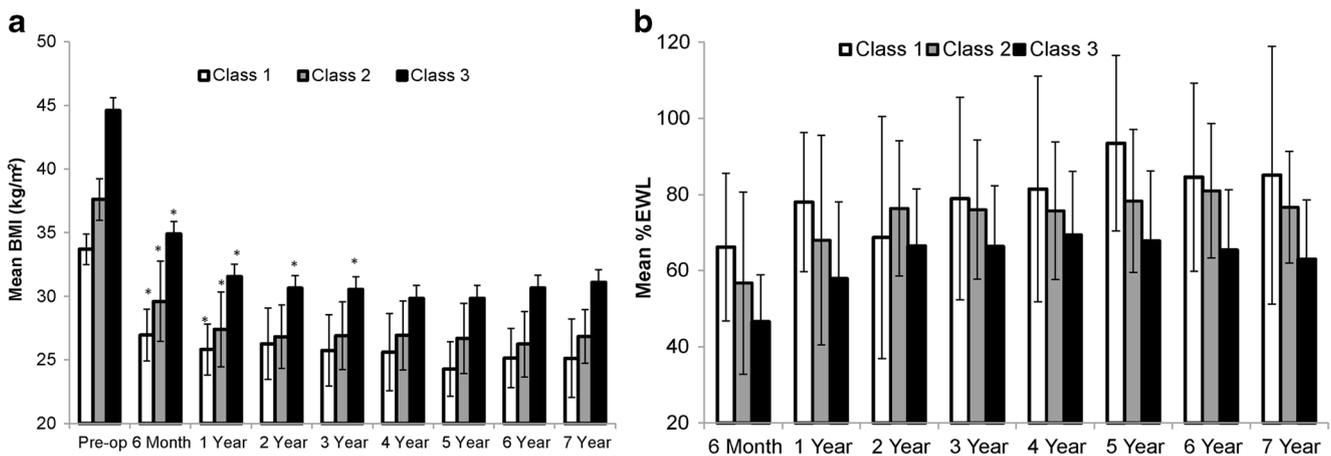


Fig. 3 Distribution of **a** mean BMI and **b** %EWL among the patients with different classes of obesity

In class 3, 24 (54.5%) patients were continued to be obese at 1-year postsurgery. However, decrease in BMI was observed in class 3 group till the third year, and at the end of the seventh year, the mean BMI was 31.07 ± 3.39 kg/m². The BMI in class 3 was significantly higher than class 1 and 2 throughout the follow-up period ($p < 0.001$).

Similar results in %EWL were observed among the classes (Fig. 3b). The mean %EWL among the three classes was significantly different ($p < 0.001$). The highest %EWL was found in class 1 (66.19%), followed by class 2 (56.73%) and class 3 (46.59%) at the sixth month follow-up. During the subsequent follow-ups %EWL was gradual and at the seventh year, %EWLs were 85.11% (class 1), 76.69% (class 2), and 62.98% (class 3).

Outcome Comparison Based on Gender

The preoperative BMI between the female and male was not significantly different ($p > 0.5$) (Fig. 4a). Postoperatively, the females showed consistent improvement in the reduction of

BMI throughout the follow-up period compared to the males, and the mean BMI at 7-years of the females was 27.12 ± 2.61 kg/m² and males was 29.49 ± 4.47 kg/m². Maximum %EWL was observed in the female cohort during the sixth year (78.64%), and in male cohort, it was during the fourth year (76.23%). A significant difference in the %EWL between the genders was observed in the sixth year ($p = 0.03$) (Fig. 4b). The male cohort after 6 years had weight regain; however, it was not statistically significant.

Comorbidities

Within two years of surgery, complete remission of obesity-related comorbidities (T2DM, HTN, OSA, and GERD) was achieved. The data on remission of all the comorbidities at different follow-up time points is given in Table 2. In the study cohort, 38 (40%) patients presented with comorbidities preoperatively. At 6-month follow-up, complete remission of T2DM and HTN was observed. Patients with OSA and GERD showed gradual improvement and attained complete

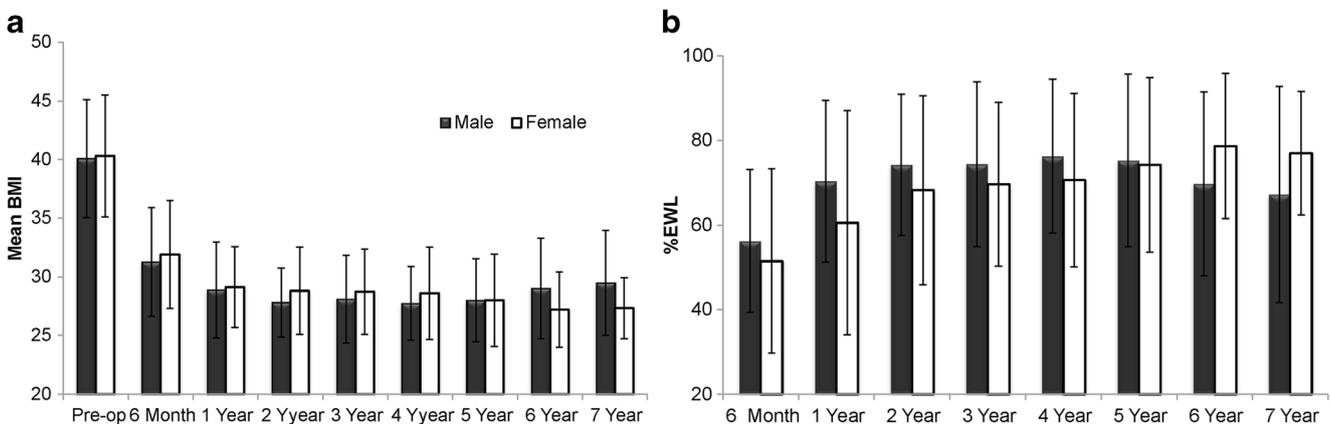


Fig. 4 Distribution of **a** mean BMI and **b** %EWL among the genders. The differences between the genders in mean BMI or %EWL were not significant

Table 2 Remission of comorbidities after bariatric surgery in patients. The patients in the follow-up had complete remission one year after surgery

Comorbidity	Pre-op*, <i>n</i> (%)	6 months	1 year	2–5 years	6–7 years
Type 2 diabetes mellitus	10 (26.3%)	–	–	–	–
Hypertension	10 (26.3%)	–	–	–	–
Obstructive sleep apnea	18 (47.4%)	28.9%	2.6%	–	–
Gastroesophageal reflux disease	4 (10.5%)	10.5%	2.6%	–	–
Others (not related to obesity)	23 (60.5%)	13.2%	13.2%	13.2%	10.5%

**n* = 38; a few patients were with two or more comorbidities

remission by the second year follow-up. Improvement and (or) remission was also observed in comorbidities not associated with obesity.

Discussion

The purpose of this study was to evaluate the long-term follow-up results of LSG in morbidly obese patients in terms of weight loss by using %EWL and BMI changes as well the status of obesity-related comorbidities. Patients belonging to class 1 and class 2 obesity responded early to the surgery in gaining near to normal BMI with significant %EWL. Similarly, significant weight loss was also achieved in the class 3 patients. Among class 3 patients, 79.55% could achieve >50%EWL at one year after surgery and many of them maintained weight loss during subsequent follow-ups. Weight regain in long-term postbariatric surgery is a common observation in many centers [15, 16]. Maximum loss in weight was seen within six months of surgery and which followed a slow and steady decrease in weight in most of the patients. The initial loss in weight is also dependent on the preoperative excess weight.

Most of the patients who were lost to follow-up had attained >50% EWL and sustained weight loss maintaining a BMI below 30 kg/m². Some of the patients were not available for all the consecutive follow-ups. Some patients who had drastic weight loss by six months missed the follow-up at one year. Fifteen out of 19 patients who were lost to follow-up in the second year had third year follow-up, and among them, 13 were available for the seventh year follow-up. Among the 55 patients who were lost to follow-up in the seventh year, 39 patients had >50% EWL (range 50–109.3%) at fourth year follow-up. The patients who were lost to follow-up were mostly those who could attain significant weight loss and were able to sustain it in the subsequent years.

Very few studies have looked into the gender-based response in terms of weight loss postbariatric surgery. Our study population had almost equal number of male and female patients. A slight weight regain was observed among males after four years of surgery. These cases can be monitored

temporally for long durations to estimate the actual differences. Various factors may influence the differences in the long-term weight maintenance between the genders.

Remission in the obesity-related comorbidities was associated with weight loss after the LSG. The major anticipated outcomes from LSG are either weight loss or remission of comorbidities or both. All the patients with T2DM and hypertension achieved remission at six months after surgery. Gradual decrease in OSA and GERD were also seen in patients who had achieved significant weight loss. The compliance of patients with comorbidities was higher compared to the overall cohort. Remission of GERD after LSG is often a controversial subject. However, studies from different centers have reported favorable outcomes in the remission of GERD postsurgery [17–19]. Interestingly, in this study, all the patients with GERD had follow-up till seventh year.

Earlier studies have shown the success rate of LSG to be in 60% patients and to be more favorable for non-superobese patients [20, 21]. Postsurgery response of the obese patients depends on the maintenance of diet and lifestyle modifications suggested by the experts. Compliance with the general guidelines to be followed is often difficult to some patient groups, and hence, strict follow-up monitoring is needed to achieve the expected goals. Further, obesity is a multifactorial condition influenced not only by lifestyle but also genetics and plays a major role in some cases. Patients having genetic association may not respond to the surgery as effectively as the others. Hence, in future, while planning for bariatric/metabolic surgery, it is ideal to study the genes associated with obesity.

Conclusion

Gastric bypass surgery/sleeve gastrectomy is practiced in India in many centers since the last decade; however, data regarding the long-term outcomes of LSG are meagerly reported from India. Longer follow-up periods are necessary to elucidate the effectiveness of LSG regarding sustainable weight loss outcomes and remission of the associated comorbidities. This long-term follow-up study indicated that LSG is highly effective in terms of weight loss as a stand-alone procedure,

especially in patients with preoperative BMI lower than 40 kg/m². For patients whose BMI more than 40 kg/m², alternate procedures such as MGB or RYGB can be considered.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Statement of Human and Animal Rights This study was performed in accordance with the principles of Declaration of Helsinki and was approved by the institutional ethical committee.

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