

Laparoscopic Sleeve Gastrectomy with or without Hiatal Hernia Repair: Effect on Gastroesophageal Reflux Disease in Morbidly Obese Patients

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ABSTRACT

Background: Gastroesophageal reflux disease (GERD) is considered an obesity-related comorbidity. Hiatal hernia (HH) plays a role in the pathophysiology of GERD in the obese population. Roux-en-Y gastric bypass is considered the operation of choice when GERD is diagnosed in these population, the effect of laparoscopic sleeve gastrectomy (LSG) with hiatal hernia repair (HHR) on GERD still debated.

Objective: To compare the outcomes of performing LSG with concomitant HHR vs LSG alone in patients with GERD.

Patients and Methods: This was a retrospective analysis of maintained data of 241 patients undergoing LSG after refusing to undergo a bypass surgery in the Bariatric Surgery Department, Ain Shams University Hospital. The difference in outcomes between performing LSG with concomitant HHR and performing LSG alone was analyzed. The interest outcomes were postoperative GERD symptoms, development of de novo GERD, postoperative complications, resolution of comorbidities, and excess weight loss.

Results: Preoperatively, 129 patients (53.5%) had mild GERD symptoms while 33 patients (13.7%) had moderate GERD symptoms, and the rest of the patients were asymptomatic for GERD. Seventy-five patients (31.12%) were diagnosed with HH by endoscopy preoperatively out of which 11 patients were asymptomatic for GERD. Intraoperatively, 35 patients (14.5%) were diagnosed with HH 4-5 cm in diameter, 67 patients (27.8%) were diagnosed with HH smaller than 2 cm in diameter and 42 patients (17.4%) had only small depression or weakness among the intercrural fibers with no actual defect in the hiatus.

Conclusion: LSG with concomitant HHR provides adequate management of GERD and should be performed if HH diagnosis was made in obese population as it's feasible and safe.

Keywords: Laparoscopic sleeve gastrectomy, Gastroesophageal reflux disease, Hiatal Hernia repair.

INTRODUCTION

Gastroesophageal reflux disease (GERD) has a much higher prevalence in the obese and overweight population compared to its prevalence in non-obese individuals. It has also been demonstrated that obesity and overweight are independent predictors of GERD⁽¹⁾.

Studies demonstrated that elevated body mass index (BMI) is associated with the presence of GERD and is positively correlated to its severity, this effect is caused by loss of normal physiologic and anatomical anti-reflux mechanisms⁽²⁻⁴⁾.

This is explained by various changes such as associations with esophageal motility disorders, higher gastroesophageal pressure gradient, and the development of hiatal hernia (HH), which has a greater prevalence in the obese population compared to the non-obese⁽⁴⁻⁷⁾.

Moreover, obesity causes a high failure rate of anti-reflux surgery and an increased rate of hiatal hernia (HH) recurrence or occurrence^(8,9). On the other hand, bariatric surgery has been demonstrated to positively affect GERD symptoms while also having the advantage of weight reduction and a great positive effect on other obesity-related metabolic comorbidities such as diabetes mellitus (DM), hypertension (HTN), and dyslipidemia^(10,11). Presently, the most effective bariatric operation in obese patients with GERD is Roux-en-Y gastric bypass (RYGB)⁽¹²⁻¹⁵⁾.

Laparoscopic sleeve gastrectomy (LSG) has been gaining a lot of popularity in the bariatric surgery

communities that it has now become the most popular bariatric procedure mainly due to its results regarding excess weight loss (EWL) and resolution of metabolic comorbidities⁽¹⁶⁻¹⁹⁾. Nevertheless, data concerning the effect of LSG on GERD are sparse and mixed leading to controversy^(20,21).

Additionally, there's no solid consensus regarding the indication or contraindication of SG in morbidly obese patients diagnosed with HH⁽²²⁻²⁸⁾. The present study aims to analyze the difference in postoperative outcomes and effect on GERD symptoms between patients who underwent LSG only and patients who had LSG with concomitant hiatal hernia repair (HHR).

PATIENTS AND METHODS

This is a retrospective analysis of prospectively maintained data from the Bariatric Surgery Department of our institution; Ain Shams University Hospital, which is a tertiary hospital.

Patients

From August 2017 to October 2019, 262 patients were operated upon by LSG in our department. Out of those patients, 21 were lost during follow up and the rest were followed up for 2 years postoperatively. All patients with mild to moderate GERD symptoms undergoing LSG at the time of the study were included together with GERD asymptomatic patients, only patients with previous anti-reflux surgery, previous

HHR, or other previous bariatric procedures were excluded. All patients were counseled regarding all surgical options and were offered bypass surgery, which they refused for either high long-life financial burden or due to fear of long-term complications.

Those two groups of patients were all requesting LSG. They all had a preoperative workup formed of a complete history, clinical examination, routine laboratory tests, abdominal ultrasonography, esophagogastroduodenoscopy (EGD), psychological evaluation, and nutritional assessment. The GERD symptoms severity classification was done on a 3-class scale ranging from 1 (mild symptoms with no need for proton pump inhibitors [PPI] for their control), 2 (moderate symptoms controlled by periodic PPI intake), and 3 (severe symptoms with the need for continuous PPI intake for their control)⁽²⁷⁾.

Patients were followed up for 2 years regarding postoperative complications, BMI, GERD symptoms status, development of de novo GERD, and obesity-related comorbidity improvement. Patients' GERD symptoms were evaluated and assessed in every visit.

Our outcomes of interest are:

- Postoperative GERD symptoms resolution is classified as either: no improvement, partial resolution, or complete resolution of symptoms.
- The development of de novo GERD.
- Development of postoperative complications.
- Resolution of obesity-related comorbidities.
- Excess weight loss.

Surgical Technique:

All patients received venous thromboembolism prophylaxis in the form of mechanical and pharmacological prophylaxis, antibiotic prophylaxis was administered following our institution's protocols.

Under general anesthesia 4 trocars were introduced after the establishment of pneumoperitoneum with liver retraction. The fundus was fully mobilized and the hiatal area was carefully dissected aided by the complete mobilization of the fundus and visualization of the left diaphragmatic crus.

Then the sleeve was formed over a 40 French bougie, beginning 4-6 cm proximal to the pylorus using a linear cutting stapler and ending near the esophagogastric angle. Extreme care was taken to place the proximal staple line 2 cm lateral to the angle of His to give the gastroesophageal junction a wide berth. Hernial sac was then reduced to the abdominal cavity and accompanying pads of fat if present were excised and the hiatal defect larger than 2 cm was repaired always in a posterior approach using one or more interrupted nonabsorbable sutures between the diaphragmatic pillars as shown in **Fig. 1**.

Simple depression with no presence of an actual defect was left without any interference or repair. A Methylene blue dye test was performed on the table in

all cases using a nasogastric tube routinely at the end of the procedure.

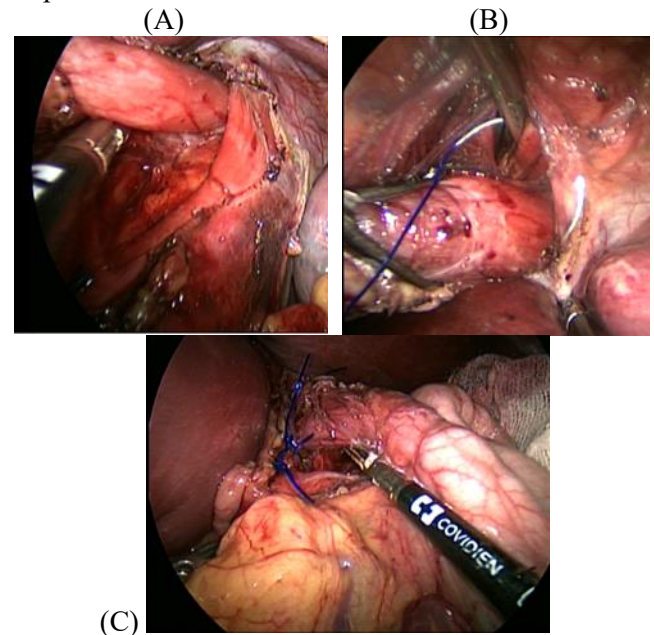


Fig. (1): A. Hiatal hernia defect, B. Repairing defect posteriorly, C. Stitches after closure of defect.

Ethical consent:

An approval of the study was obtained from Ain Shams University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The analysis was done using IBM SPSS 26 software (SPSS, Chicago, IL). Chi-square tests with exact significance were used to evaluate differences, independent samples t-tests were used also when appropriate. The mean values with standard deviations were calculated. Continuous data were expressed as mean \pm standard deviation, categorical data were expressed as frequencies and percentages. Statistical significance was set at $p < 0.05$.

RESULTS

Two hundred and forty one candidates for LSG (mean BMI 45.61 ± 4.33 kg/m²) were operated on and were followed up for 2 years after surgery. The mean age of the group was (38.59 ± 11.16 years) and 63.9% of the group were females. A total of 162 patients (67.2%) complained of GERD symptoms preoperatively. GERD severity classification is demonstrated in **Table 1**.

All patients underwent EGD and 75 patients (31.12%) were diagnosed with HH by endoscopy preoperatively out of which 11 patients were asymptomatic for GERD. Intraoperatively, 35 patients (14.5%) were diagnosed with HH 4-5 cm in diameter,

67 patients (27.8%) were diagnosed with HH smaller than 2 cm in diameter and 42 patients (17.4%) had only small depression or weakness among the intercrural fibers with no actual defect in the hiatus. All patients diagnosed with actual HH and defect successfully underwent concomitant LSG and HHR for a total of 77 patients. The mean operative time for LSG+HHR was 63.84±13.74 minutes. The rest of the patient population (165 patients) underwent standard LSG.

Table (1): Preoperative GERD severity classification status

Symptoms	Patients (n)
No preoperative GERD	211
1 : Mild (mild symptoms with no need for PPI for their control)	129
2 : Moderate (moderate symptoms controlled by periodic PPI intake)	33
3 : Severe (severe symptoms controlled by continuous PPI intake)	0

Proton Pump Inhibitor (PPI).

The two patient groups were compared regarding postoperative GERD outcomes, the development of de novo GERD, development of postoperative complications, resolution of obesity-

related comorbidities, and weight loss after surgery. Both patient groups had no fatality recorded.

Postoperative GERD

Regarding postoperative GERD outcome, 112 patients underwent LSG with concomitant HHR as they had HH and preoperative GERD symptoms. 81 (73%) patients had complete resolution of symptoms, 18 (16%) had partial improvement and 12 (11%) had persistent symptoms. Compared to 17 (33.3%) patients having a complete resolution, 21 (41.7%) patients with partial resolution, and 12 (24%) patients with persistence of symptoms in the group who underwent LSG only due to absence of hiatal hernia defect intraoperatively. for a total of 99 (88.9%) of patients undergoing LSG with HHR reporting improvement compared to 38 (75%) in patients undergoing LSG only. The difference was significant p=0.001.

Development of de novo GERD

In the patient group which underwent LSG+HHR out of the patients not complaining of preoperative GERD, 6 patients (7.6%) developed de novo GERD compared to 14 patients (17.7%) in the group of LSG only, the difference was not significant p=0.063.

The timing of the development of de novo GERD is demonstrated in **Table 2**.

Table (2): De novo GERD Development

	De novo GERD			
	After 3 months (%)	After 6 months (%)	After 9 months (%)	After 12 months (%)
Sleeve gastrectomy only	3 (3.8%)	8 (10.1%)	2 (2.5%)	1 (1.3%)
Sleeve gastrectomy + HH repair	2 (2.5%)	2 (2.5%)	1 (1.3%)	1 (1.3%)

Postoperative Complications

Out of the patients who underwent LSG and HHR, 7 patients (8.1%) developed postoperative complications, compared to 11 patients (8.5%) in the other group, the difference was not significant p=0.92. The postoperative complications are demonstrated in **Table 3**.

Table (3): Postoperative Complications

	Sleeve gastrectomy only	Sleeve gastrectomy + HH repair	
	(%)	n	(%)
Bleeding managed by conservative management	(2.3%)	3	(2.7%)
Vomiting managed by conservative management	(0.0%)	2	(1.8%)
Respiratory tract infection	(2.3%)	2	(1.8%)
Haematemesis managed conservatively	(0.8%)	0	(0.0%)
Wound infection	(1.5%)	2	(1.8%)
Bleeding managed by re-operation and reinforcement of staple line	(0.8%)	0	(0.0%)
Leaking managed by stent and pigtail insertion	(0.8%)	0	(0.0%)

Resolution of Comorbidities

Forty patients (35.7%) had obesity-related comorbidities in the LSG+HHR group, compared to 59 patients (45.7%) in the other group, the difference was not statistically significant p=0.08. (Fig. 2).

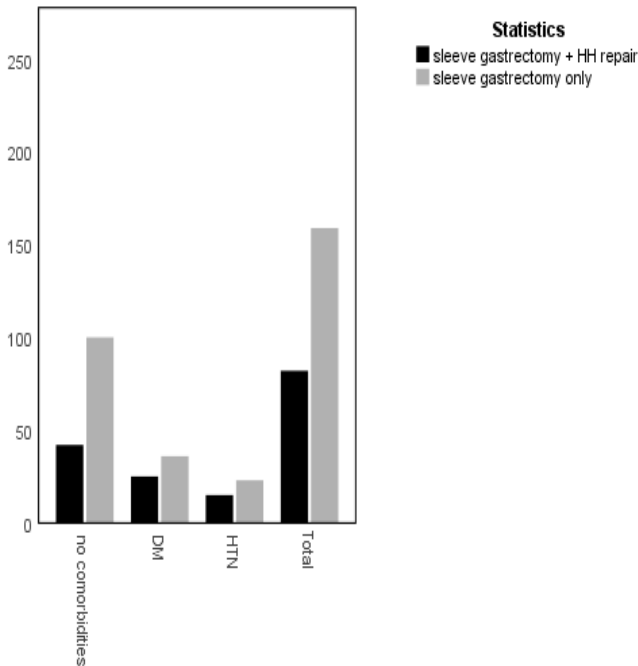


Fig. (2): Preoperative Comorbidities.

In the LSG+HHR repair group, 6 patients (15%) had no improvement in their comorbidity postoperatively, 18 patients (45%) had partial resolution and 16 (40%) had complete resolution, compared to 7 patients (11.9%), 21 patients (35.6%) and 31 (52.5%) patients respectively in the LSG only group. The difference was not statistically significant p=0.47 (Table 4).

Table (4): Resolution of Comorbidities

	Resolution of Comorbidities		
	No improvement (%)	Partial Resolution (%)	Complete Resolution (%)
Sleeve gastrectomy only	7 (11.9%)	21 (35.6%)	31 (52.5%)
Sleeve gastrectomy + HH repair	6 (15.0%)	18 (45.0%)	16 (40.0%)

BMI means for both groups at each follow-up table were demonstrated in Table 5.

Table (5): BMI Follow Up

Type of operation done		BMI 3 m	BMI 6 m	BMI 1y	BMI 2y
Sleeve gastrectomy only	Mean	32.55	28.48	24.70	24.20
	Std. Deviation	3.010	2.604	1.977	1.841
Sleeve gastrectomy + HH repair	Mean	34.76	30.38	26.72	24.32
	Std. Deviation	4.218	3.838	3.364	1.602

Excess weight loss

Postoperative weight loss was calculated as excess weight loss (EWL) % = (weight preoperatively - weight at maximum follow up)/excess body weight *100. the LSG+HHR group had a mean EWL of 106.16% ±11.69%, compared to 107.92% ±15.38% in the LSG only group after 2 years follow up, the difference was not statistically significant p=0.36.

DISCUSSION

RYGB is recognized as the superior solution to GERD in the obese population rather than anti-reflux surgeries. This higher efficacy, in addition to the EWL, is mostly due to the role obesity plays in the pathophysiology of GERD in this population, as it has been demonstrated that obesity affects the function of the natural anti-reflux mechanisms by way of increased intraabdominal pressure causing delayed gastric emptying, increase in the gastroesophageal pressure gradient and a higher chance of developing HH caused by anatomical alterations in the crural complex (10,11,29). RYGB is assumed to have the best outcomes when it comes to patients diagnosed with GERD and/or HH in the obese population. This is possibly due to the very small gastric pouch leading to decreased acid secretion and the Y limb maintaining fixation of the gastric content preventing new herniation or recurrence of an old one (12,13).

LSG and its effect on GERD are still highly debated, with limited evidence, some surgeons maintain that it worsens the symptoms, even considering the preoperative diagnosis of GERD or HH a contraindication to LSG (25).

The effect of LSG on GERD is multifaceted. Some studies have shown improvement in GERD symptoms after LSG with factors as weight loss, decreased acid production, and restoration of the angle of His playing a role (22-24,26). Others have demonstrated worsening of symptoms or even development of de novo GERD postoperatively with multiple possible causes as the development of HH, decreased gastric emptying, lower compliance of the gastric sleeve, decreased pressure in the lower esophageal sphincter (LES), and resection of the sling fibers (33-35).

Similar controversy surrounds the presence of HH and the effect of concomitant HHR with LSG on preoperative GERD symptoms and development of de novo GERD, some investigators had improved outcomes of GERD after the concomitant repair while not being associated with increased mortality or morbidity(27). Other investigators found no improvement in outcomes with doing concomitant HHR rather than LSG alone(28).

In the present study, we found GERD symptoms to be significantly more prevalent in patients diagnosed with HH (53.7%) compared to other patients complaining of GERD with no HH detected on endoscopy (45%), this is possibly due to the effect that HH might have an effect on the anatomical anti-reflux

mechanisms, lower esophageal sphincter (LES) pressure, increased acid exposure during transient LES relaxation, and increased distance between the LES and diaphragmatic crura⁽³³⁾.

In this study, only 75 patients (67%) of patients undergoing HHR with LSG were diagnosed with HH preoperatively using EGD, which questions the reliability of EGD in making an accurate diagnosis of HH in obese patients, intraoperatively the presence of a visible indentation on the diaphragm above the esophageal opening indicated careful and thorough examination of the crural area for defects and herniation.

Comparing the GERD outcomes of both groups in our study revealed a statistically significant difference between both groups regarding the resolution of symptoms with (73%) experiencing complete resolution of their symptoms, (16%) partial resolution, and (11%) persistence after the LSG+HHR, compared to (33.3%), (41.7%) and (24%) respectively after LSG alone. These results suggest that repairing existing HH while performing SG is positively affecting the GERD symptoms experienced by the patients, possibly due to restoration of the normal anatomical barrier of the diaphragmatic crura, reducing the gastroesophageal pressure gradient, and replacement of the gastroesophageal junction intraabdominally in addition to the weight loss courtesy of the LSG. Furthermore, fewer patients (7.6%) developed de novo GERD in the group who underwent LSG and HHR compared to LSG only (17.7%) but that difference was not statistically significant. These results are in line with other studies in the literature such as those produced by **Soricelli et al.**⁽²⁷⁾, **Dakour et al.**⁽³⁴⁾, and **Rodriguez et al.**⁽³⁵⁾.

To demonstrate any effect that the concomitant repair might have on the efficacy of LSG regarding EWL, the EWL means at the maximum follow up period of 2 years were calculated and analyzed for both groups, the mean EWL in the concomitant repair group vs the LSG only group was 106.16% ±11.69% and 107.92% ±15.38% respectively, with the difference not being statistically significant, denoting that performing the repair did not change the efficacy of the operation regarding its weight loss goals.

Obesity-related comorbidities were present in (48.7%) of the patients undergoing LSG and HHR compared to (37.1%) of the patients undergoing LSG only with differences not reaching statistical significance. The improvement of the comorbidities in those patients was similar in both groups with (40%) of patients reporting complete resolution, (45%) reporting partial control, and (15%) reporting no improvement on the preoperative status vs (52.5%), (35.6%) and (11.9%) respectively, the difference between the groups was not statistically significant suggesting that the concomitant repair did not affect this outcome.

The rate of developing postoperative complications was similar in both groups, in the group undergoing LSG and HHR (8.1%) of patients developed complications compared to (8.5%) in the group

undergoing LSG alone, the difference was not statistically significant denoting that performing the concomitant repair had no detrimental role in this regard.

This study's value lies in showing what effect performing concomitant HHR with LSG might have on decreasing postoperative GERD symptoms compared to LSG alone, the patients in both groups had similar baseline characteristics giving this retrospective analysis some added value.

Limitations of the study

The limitations of our study involve being a retrospective study and not using standardized questionnaires to evaluate GERD symptoms. More prospective investigations and randomized trials are required on this subject, preferably on multiple patient ethnicities to reach a more solid conclusion on the indications of performing concomitant HHR with LSG if HH is present in obese patients.

CONCLUSION

Performing LSG with concomitant HHR is feasible in the obese population. The concomitant repair led to better outcomes regarding postoperative GERD symptoms with (88.9%) of those patients reporting improved symptoms. Regarding other outcomes such as developing de novo GERD, postoperative complications, resolution of postoperative comorbidities, and excess weight loss there was no difference between the concomitant repair and performing LSG alone. Only (40.2%) of patients with HH were diagnosed preoperatively, HH prevalence in the obese population could be underestimated based on these results, warranting a careful intraoperative examination of the crural area in LSG. The diagnosis of HH should not lead to excluding LSG as a bariatric solution in the morbidly obese population, as HHR with LSG is safe and feasible and leads to improved outcomes in GERD symptoms. Nevertheless, further prospective randomized investigations with longer follow-up periods are needed.

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