

# Sleeve Gastrectomy with Crural Repair in Obese Patients with Gastroesophageal Reflux Disease and Hiatus Hernia; a Cohort Study

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**Introduction:** Hiatal hernia (HH) or gastroesophageal reflux disease (GERD) is increasingly acknowledged as a comorbidity associated with obesity. The most successful bariatric treatment for treating morbidly obese individuals with GERD and/or HH is still the Roux-en-Y gastric bypass. On the other hand, there is ongoing discussion on the appropriateness of laparoscopic sleeve gastrectomy (SG) for these individuals. Reporting our experience with 40 patients who had SG and HH repair (HHR) was our goal.

**Patients and methods:** The results of patients who had SG with crural repair to treat GERD symptoms or HH were analyzed across two centers. The Reflux index questionnaire (RSI), stopping antireflux medication, and radiographic or endoscopic signs of HH recurrence were all taken into consideration while evaluating the clinical result.

**Results:** RSI scores were significantly reduced postoperatively. There was significant resolution of GERD symptoms postoperatively ( $p=0.001$ ). There were no postoperative complications. Two of our patients required conversion to Roux en Y gastric bypass (RNYGB) to control persistent postoperative GERD.

**Conclusion:** LSG with cruroplasty is an effective and safe method for weight reduction and treatment of GERD caused by HH in morbid obese patients.

**Key words:** Gastroesophageal reflux disease, gastroesophageal junction, morbid obesity, hiatus hernia, laparoscopic sleeve gastrectomy.

## Introduction

Obesity increases the chance of paraesophageal hernias (PEHs) forming as well as their recurrence after they have been treated. Furthermore, a higher incidence of gastritis, gastroesophageal reflux symptoms, and hiatal hernias has been linked to morbid obesity ( $\text{BMI} \geq 40 \text{ kg/m}^2$ ).<sup>1</sup>

The most long-lasting therapy for obesity and associated comorbidities is thought to be surgical weight loss. A single, conclusive treatment for weight loss, laparoscopic sleeve gastrectomy (LSG) has gained appeal because to its minimal complication profile, ease of technique, and success rate. With a decreased chance of negative nutritional effects and surgical problems (Such as internal hernia and marginal ulceration), it also seems safe in the long run.<sup>2</sup>

Since GERD is known to cause esophagitis, Barrett's disease, and cancer, it's critical to create and improve methods that reduce the likelihood of reflux following surgery. It is safe to repair the HH concurrently with a sleeve gastrectomy, which may help reduce reflux symptoms.<sup>3</sup>

Diaphragmatic crura are sutured together anteriorly, or ideally posteriorly (simple cruroplasty), following reduction of the herniated stomach and abdominal esophagus in the peritoneal cavity.

A tension-free closure of the hiatal defect is essential for long-lasting paraesophageal hernia repair. By

adhering to the concepts of total esophagus and sac mobilization and preservation of crural integrity, primary crural repair can be accomplished. With the esophagus in a neutral, tension-free position inside the hiatus, two or three interrupted nonabsorbable sutures are used to approximate the crura.

This cohort study has been reported in line with the STROCSS guidelines.<sup>4</sup>

## Patients and methods

This was a cohort study which examined the results of individuals who had SG combined with crural surgery to treat HH or GERD symptoms. The study involved 40 morbid patients who were either endoscopically or imaging-diagnosed with GERD or a hiatus hernia, or who had an accidentally discovered hiatus hernia during LSG. It was carried out in the surgical departments of Helwan University Hospital and Ain Shams University Hospital between June 2022 and June 2023, with clinical follow-up at one month, three months, six months, and one year after surgery. In order to assess the clinical result, the Reflux Index Questionnaire (RSI), the cessation of anti-reflux medication, and radiographic or endoscopic signs of HH recurrence were taken into consideration.

**Inclusion criteria:** Morbid obese patients ( $\text{BMI} > 35$ ), more than 18 years old, patients diagnosed with HH by endoscopy or imaging and patients having HH accidentally discovered during LSG.

**Exclusion criteria:** Less than 18 years old, patients demanding other bariatric surgery than LSG, lower esophageal sphincter dysfunction proven by manometry, patients who underwent previous reflux surgery and Barrett's esophagus proven by endoscopy.

All patients who were asked to take part in the study completed an informed consent form, and the Research Ethics Committee (REC) for Human Subjects Research got ethics committee approval in accordance with the 2013 Declaration of Helsinki.

Preoperative laboratory tests included complete blood cell counts, kidney and liver functions, bleeding profiles, thyroid functions, and cortisol panels. All patients underwent a thorough clinical evaluation before to surgery. Every patient had a standard chest radiograph and cardiopulmonary work-up. To

prevent thrombo-embolism, low molecular weight heparin was administered 12 hours before surgery, and patients were kept in elastic stockings during their hospital stay and for two weeks after surgery.

Preoperative reflux symptoms index questionnaire (RSI questionnaire) (**Table 1**) was used for initial GERD symptoms assessment. Upper GI endoscopy with comment on the grade of reflux was performed for patients with reflux symptoms and score of 13 points or more using the RSI questionnaire.

Nine elements make up the RSI, a scoring instrument designed to evaluate different laryngo-pharyngeal reflux (LPR) symptoms. A maximum score of 45 indicates the most severe symptoms, with each item having a range from zero (no complaints) to five (severe complaints). An RSI score greater than 13 indicates LPR and is regarded as abnormal.

**Table 1: Reflux symptom index.<sup>(5)</sup>**

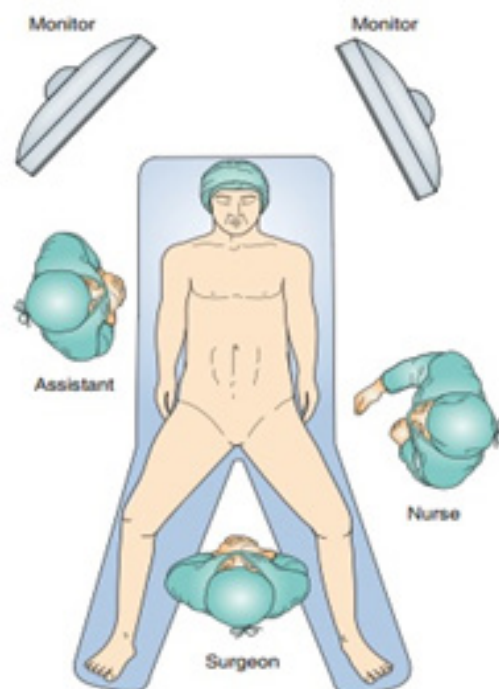
Within the last month, how did the following problems affect you?

0= no problem, 5= severe problem

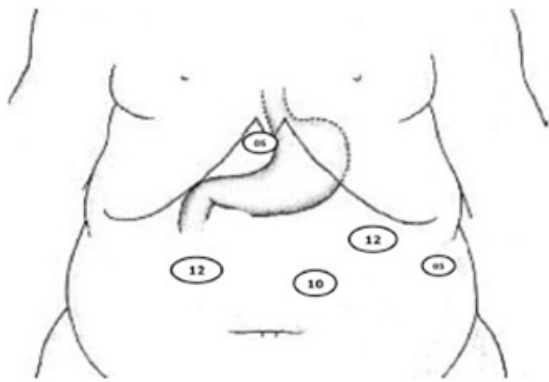
1. Hoarseness or a problem with voice	0 1 2 3 4 5
2. Clearing your throat	0 1 2 3 4 5
3. Excess throat mucous or postnasal drip	0 1 2 3 4 5
4. Difficulty swallowing food, liquid or pills	0 1 2 3 4 5
5. Coughing after you ate or lying down	0 1 2 3 4 5
6. Breathing difficulties or choking episodes	0 1 2 3 4 5
7. Troublesome or annoying cough	0 1 2 3 4 5
8. Sensations of something sticking in your throat or a lump in your throat	0 1 2 3 4 5
9. Heartburn, chest pain, indigestion or stomach acid coming up	0 1 2 3 4 5

## Operative technique

The same doctors performed all of the procedures using the same cruoroplasty surgical method. General anesthesia was used for all surgeries, and a prophylactic antibiotic (a 1 gm bottle of ceftriaxone) was administered along with endotracheal intubation in the French position (fig. 1). Pneumoperitoneum was created using a veress needle and a 10 mm supraumbilical port, and we employed five ports (fig. 2). A 5 mm port was positioned just beneath the xiphoid process to enter the fan liver retractor, and two additional 12 mm openings were positioned as working ports on the left and right-mid clavicular lines, respectively. For the helper, a second 5 mm port was positioned on the left anterior axillary line.



**Fig 1: Intraoperative position.**



**Fig 2: Ports site position.**

Starting with the creation of the gastric sleeve, we dissected the larger curvature 4 cm from the pylorus to the cardio-esophageal junction, continuing until the gastric fundus was fully mobilized. A 40 Fr calibration tube (Bougie) was placed within the stomach after the stomach was dissected from the larger curvature using Harmonic Ethicon, (**Fig. 3**). The resection was completed using a linear stapler, beginning 4 cm from the pylorus and ending 1 cm from the angle of Hiss.

The hernia was then cut off from its mediastinal attachments and reduced to 3–4 cm of the esophagus within the abdomen using a harmonic scalpel and a mix of blunt and sharp dissection techniques.



**Fig 3: Intraoperative dissection.**

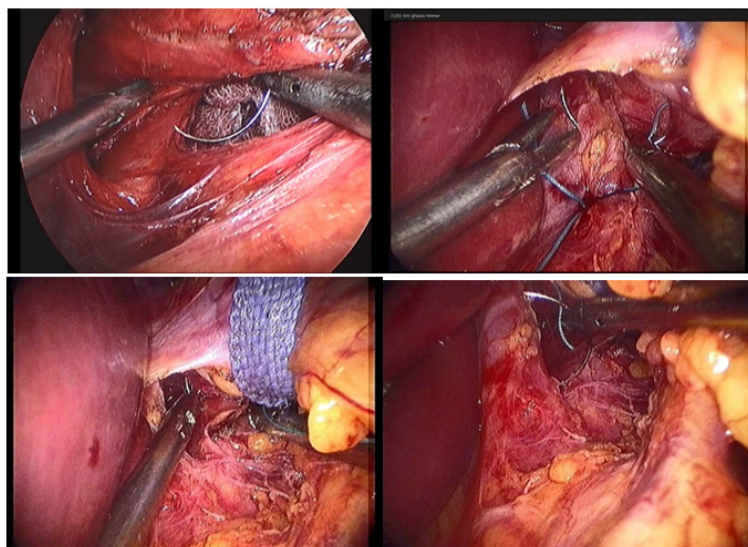
The integrity of the staple line was examined following the completion of the stomach transection. After injecting methylene blue into the stomach, the staple line was closely examined for leaks.

### Crural closure

After reviewing the hiatal defect, the assistant retracted the esophagus, elevating it to the left and ventrally. Then, two or three interrupted ethibond excel sutures were used to repair the defect. The sutures were calibrated on the 40-Fr bougie that

was placed in the esophagus, and they began as low as possible to reduce tension on each stitch. Anterior repair was added if the hiatal defect was still broad. It began at the intersection of the right and left crus and was completed as far anteriorly as feasible (Fig 4), allowing the 40-Fr bougie to freely move between the esophagus and the residual stomach to prevent tight crural closure.

Intra-abdominal drains were left draining the surgical bed following the operation.



**Fig 4: Crural repair.**

## Post operative follow up

Elastic stockings were utilized during the hospital stay to prevent thromboembolism, and a prophylactic dose of LMWH was administered 12 hours after surgery and maintained for two weeks. On the second day of the procedure and 12 hours after the procedure, third-generation cephalosporins were administered. On the second day of the procedure, a clear liquid sip was initiated. If there was less than 50 ml of serosanguinous fluid, intra-abdominal drains were removed after 24 hours. If not, they were left in place and removed at the first outpatient clinic (OPC) visit for patients with complex surgical cases, unusual operative bleeding, or a higher risk for postoperative bleeding. (ii) On the second postoperative day, all patients without

any complications were released after receiving instructions on diet and activities, and medications including multivitamins.

Following surgery, patients were followed up with weekly in OPC for the first month and then at 3, 6, and 12 months. Six months following the procedure, the patients had an Upper Gastro Intestinal endoscopy, and they were clinically monitored for weight reduction and reflux symptom resolution using the RSI questionnaire for a year.

## Results

This study included 40 patients; 29 females and 11 males with mean age of  $33.7 \pm 10.57$ . The BMI in our cases ranged from 35–59 (**Table 2**).

**Table 2: Demographic data and characteristics of the studied patients**

Total no. = 40		
Age	Mean $\pm$ SD	33.7 $\pm$ 10.57
	Range	18–65
Sex	Female	29 (72.5%)
	Male	11 (27.5%)
BMI	Mean $\pm$ SD	41.32 – 52.6 $\pm$ 6.31
	Range	35–59

**Table 3: Comparison between percentage of patients with GERD symptoms, GERD score and percentage of patients with UGI pre and post-surgery**

		Pre	Post	Test value	P-value	Sig.
GERD Symptoms	Negative	19 (47.5%)	28 (70.0%)	4.178*	0.040	S
	Positive	21 (52.5%)	12 (30.0%)			
Score	Median (IQR)	10 (3 – 17)	2 (0 – 4)	-4.531 $\neq$	0.001	HS
	Range	2 – 38	0 – 22			
Patients that underwent UGI	Negative	26 (65.0%)	34 (85.0%)	4.267*	0.038	S
	Positive	14 (35.0%)	6 (15.0%)			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant.

\*: Chi-square test;  $\neq$ : Wilcoxon Ranks test.

## Preoperative data

21 patients had positive GERD symptoms where 14 of them underwent UGI endoscopy as they had a score more than 13 points on RSI questionnaire 10 of them had grade A esophagitis while 4 of them had grade B esophagitis. 7 of the patients had small HH less than 2 cm while 4 of them had large HH greater than 2 cm, none of the patients had positive H. Pylori by endoscopy. None of the patients in our study had Barrett's esophagus by endoscopy.

## Follow up data.

In the follow up period postoperatively 12 patients had GERD symptoms, 6 of them underwent follow up UGI endoscopy, 3 of them had positive findings as 2 had grade A esophagitis and the other had grade B esophagitis and recurrent hiatus hernia. None of the patients had H. Pylori infection postoperatively, and none of the patients had symptoms of dysphagia using the Eckardt symptom score (ESS) (**Table 4**).

**Table 4: ESS**

Score	Dysphagia	Regurgitation	Retrosternal pain	Weight loss (Kg)
0	None	None	None	None
1	Occasional	Occasional	Occasional	<5
2	Daily	Daily	Daily	5-10
3	Each meal	Each meal	Each meal	<10

The 12 patients who had postoperative GERD symptoms and were initially given medical treatment, 10 patients had resolution of symptoms while 2 of them required conversion to roux en y gastric bypass (RNYGB).

Our study patients had highly significant decrease in the RSI score postoperatively with p value of 0.001, significant decrease in postoperative GERD symptoms with p value of 0.04 and significant postoperative negative UGI findings with p value of 0.038 as shown in **Table 3**.

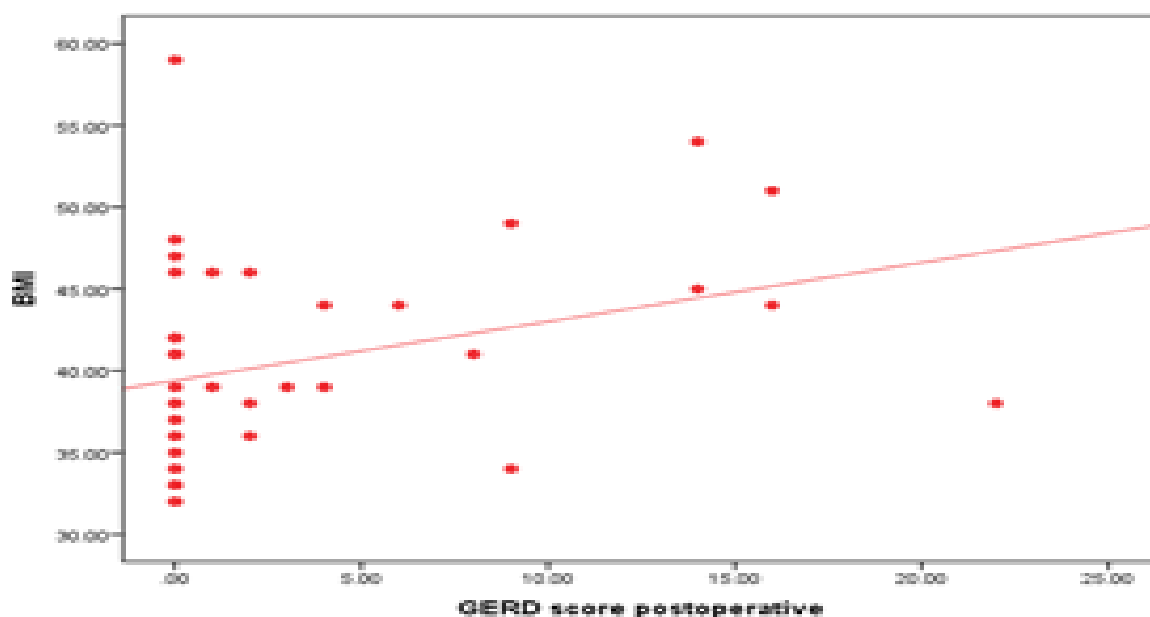
**Table 5: Correlation between each of age and BMI with GERD score pre and postoperative among all the studied patients**

	Age		BMI	
	r	p-value	r	p-value
GERD score preoperative	-0.052	0.75	0.256	0.111
GERD score postoperative	-0.092	0.572	0.373*	0.018

Spearman correlation coefficients.

In our study group higher incidence of postoperative GERD symptoms and higher RSI score were directly related to increased BMI preoperatively as shown in

**Fig. 5** while the age of the patients had insignificant effect regarding GERD symptoms postoperatively (**Table 5**).

**Fig 5: Correlation between BMI and GERD score postoperative among all the studied patients.**

## Discussion

An important independent risk factor for both hiatal hernia (HH) and gastroesophageal reflux disease (GERD) is obesity. As body mass index (BMI) rises, so does the incidence of HH. The typical surgical procedure for HH is fundoplication and hiatal hernia repair (HHR). However, individuals who are morbidly obese and have a BMI of more than 35 kg/m<sup>2</sup> have much greater recurrence rates.<sup>6</sup>

Although many bariatric surgeons endorse LSG, there is a dearth of information in the literature about the results of GERD symptoms in obese patients with or without HH after sleeve gastrectomy. The purpose of this study was to assess the impact of concurrent cruroplasty on GERD remission and HH recurrence in these individuals.

The mean age of the 40 patients in this research was 33.7±10.57, with 29 females and 11 men. In our patients, the BMI was between 35 and 59.

During this study, we used RSI questionnaire for evaluation of our patients preoperatively and postoperatively as we found few studies using this questionnaire as the majority of studies used GERD Q questionnaire. And the reason for choosing RSI questionnaire was due to its reliability and we think it is simpler and easier to be fulfilled by patients.

Cruroplasty is one of the surgical techniques that have been studied to avoid post-operative de-novo GERD following LSG. This technique primarily relies on narrowing the esophageal hiatus, however expert opinions vary. While some surgeons believe this approach is beneficial in avoiding reflux, particularly when paired with absorbable mesh, others do not.<sup>7-8</sup>

A comprehensive study by Samakar et al.<sup>9</sup> suggested that the LSG could be a risk factor for either de-novo reflux production or reflux worsening. Despite introducing the possibility that cruroplasty may prevent GERD, it did not suggest adding the operation to LSG.

Furthermore, HH repair during LSG has the potential to disrupt the gastric sleeve's blood supply, increasing the likelihood of postoperative leakage.<sup>10</sup> No instances of postoperative leaking were noted in our investigation.

According to Felinska et al.,<sup>11</sup> LSG is a substantial risk factor for the development of postoperative reflux, whose incidence varies between 8% and 30% depending on the duration of follow-up.

Seventy percent of the participants in our research who had reflux problems resolved following LSG and cruroplasty did so.

Chen et al.<sup>12</sup> in their study said that the incidence of post surgical GERD remission in patients who had concurrent SG and HH surgery ranged from 21.3 to

95.0% while study by Soricelli et al.<sup>13</sup> showed 73%.

Two individuals (5%) in our research required conversion to RNYGB due to severe GERD symptoms. This is consistent with the findings of a research by Boru et al.<sup>14</sup> in which 96 patients were randomly assigned to have LSG with simple cruroplasty or LSG with cruroplasty and buttressing. Six patients in the group that had simple cruroplasty required repeat procedures of posterior crural repair and total of 12 patients (14%) needed sleeve revision and conversion to RNYGB for persistent GERD.

Alaa et al.<sup>15</sup> stated in their study that De novo GERD symptoms developed in 22.9% of the patients undergoing SG alone compared with 0% of patients undergoing SG plus HHR with no need for sleeve revision.

## Limitations

The sample size was insufficient, and the follow-up period was restricted to 12 months following surgery. This study was carried out at two medical facilities (Helwan University and Ain Shams University) hospitals. Furthermore, this was a cohort study, there was no financing available, and the expense of follow-up endoscopies prevented some of our patients from having them.

## Conclusion

Along with improving GERD symptoms and severity, LSG combined with cruroplasty provides positive weight reduction outcomes.

Therefore, to assess the long-term effects of LSG with cruroplasty on the alleviation of GERD symptoms, the recurrence of hiatal hernias, and the rates of complications, bigger sample randomized controlled trials studies with longer follow-up periods are required.

## Declaration of interest

The authors report no conflicts of interest.

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