Impact of crural repair with gastroesophageal junction stitching to left crus during sleeve gastrectomy in morbidly obese patients with hiatus hernia

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Background
The actual effect of laparoscopic sleeve gastrectomy (LSG) on patients having gastroesophageal reflux disease (GERD) symptoms is still controversial. Repair of accidently discovered hiatus hernia during LSG is commonly advocated by many authors; however, data are not enough on the outcomes of GERD symptoms in these patients. The aim of this study is to evaluate the effect of restoration of gastroesophageal junction complex as protective mechanism through concomitant hiatal hernia repair, proper dissection of 2–3 cm of intraabdominal esophagus, and stitching of gastroesophageal junction to left crus of diaphragm on GERD symptoms in morbidly obese patients undergoing LSG.
Patients and methods
This is an observational study including 40 patients who previously have had LSG with crural repair and stitching of gastroesophageal junction to left crus of diaphragm in the same operation. Patients were treated at Ain Shams University hospitals from January 2017 to January 2019.
Results
The mean age of the study population was 37±11 years (range, 20–55 years). The mean BMI of the morbidly obese patients was 43.95±2.58 (40–49). Symptoms of GERD were presented only in 28 (70%) patients collected by GERD-Health Related Quality of Life questionnaire, and hiatal hernia was diagnosed in them by preoperative upper endoscopy. The mean follow-up was 6 months during which remission of GERD symptoms occurred in 36 (90%) patients along with regression of esophagitis as diagnosed by upper endoscopy 6 months postoperatively.
Conclusion
Sleeve gastrectomy with concomitant crural repair and stitching of gastroesophageal junction to left crus of diaphragm is considered a feasible and safe technique providing good results in management of GERD symptoms for obese patients with reflux symptoms and hiatus hernia.

Keywords:
cruroplasty, gastroesophageal reflux disease, sleeve gastrectomy

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Introduction

Obesity is considered one of the independent risk factors for development of both gastroesophageal reflux disease (GERD) and hiatus hernia (HH). Approximately 50–70% of patients undergoing bariatric surgeries have symptomatic reflux. However, HH is diagnosed in only 37–50% of morbidly obese patients who undergo bariatric surgery either preoperatively or intraoperatively [1].

With the progress of bariatric surgery and being the only proven and effective long-term treatment for morbid obesity, the number of bariatric surgeries performed has increased significantly. Laparoscopic sleeve gastrectomy (LSG) is considered now as a standard stand-alone weight loss procedure. Being an easy and safe procedure with excellent short-term and intermediate-term results, the number of primary SG cases being performed is increasing dramatically [2].

Laparoscopic antireflux surgery (especially laparoscopic Nissan fundoplication) with hiatal hernia repair (HHR) is generally the best management for refractory or structural GERD. Meanwhile, in morbidly obese patients with HH and/or GERD symptoms, the feasibility and effect of doing the antireflux surgery along with a bariatric surgery is still under-observation as antireflux surgeries mainly depend upon the wrap formation using the gastric fundus which is removed or excluded in different

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bariatric surgeries. Laparoscopic Roux-en-Y bypass with or without crural closure is the best known operation to improve GERD and HH [3].

Some limitations of SG in morbidly obese patients with GERD is the development of postoperative high-pressure gastric tube along with loss of gastroesophageal junction complex (stapled), which is usually attributed to GERD symptoms. However, the incidence of de novo GERD and the effect of SG on patients with preexisting GERD remain controversial. Some authors have reported resolution of GERD following SG, whereas others noted a high incidence of de novo GERD and worsening of previously existing GERD-related symptoms following SG [3].

Few studies have addressed the effect of LSG with crural closure on GERD in morbidly obese patients having HH, and still the results of these studies are conflicting [4].

The aim of our study is to see the effect of HHR and stitching of gastroesophageal junction to left crus of diaphragm on GERD symptoms in morbidly obese patients with HH undergoing LSG.

Patients and methods

Study design

The present study is an observational study including 40 morbidly obese patients who had LSG along with crural repair for HH and stitching of gastroesophageal junction to left crus of diaphragm. Patients were recruited and treated at Ain Shams University hospitals from January 2017 to January 2019. The number of the patients was restricted because of both the patient and the ethical committee approval; however, all patients included received information about surgical technique, risks of the operation, and other options for treatment.

Inclusion criteria

Age ranging between 20 and 55 years and BMI between 40 and 49 were the inclusion criteria.

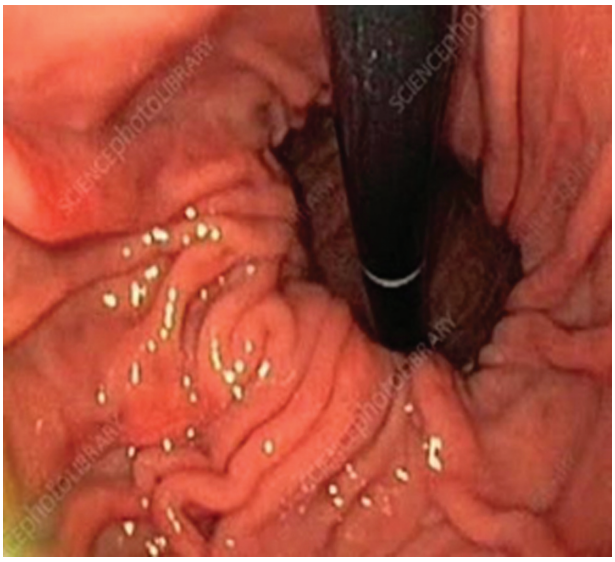
Exclusion criteria

Age less than 18 or more than 60 years, obese patients with major cardiac, respiratory, renal, or hepatic comorbidities interfering with anesthesia or laparoscopy, sweet eaters, and patients with previous upper gastrointestinal tract surgeries were the exclusion criteria.

Steps of the study

Preoperative patients were evaluated by full history and examination. Questions regarding psychological assessment of the patient, eating behavior, and GERD symptoms were assessed using GERD-Health Related Quality of Life (HRQL) questionnaire. Routine laboratory studies, pelvi-abdominal ultrasound, and upper gastrointestinal endoscopy to diagnose HH (for GERD symptomatic patients) were done (Fig. 1).

Figure 1



Upper endoscopy showing hiatus hernia and mild esophagitis.

GERD-HRQL
Questionnaire (GERD-HRQL)
Institution: patient ID: Date /
☐ On PPIs ☐ Off PPIs If off, for how long? days/ months

Scale:
0=no symptom.
1=symptoms noticeable but not bothersome.
2=symptoms noticeable and bothersome but not every day.
3=symptoms bothersome every day.
4=symptoms affect daily activity.
5=symptoms are incapacitating to do daily activities.

Please check the box to the right of each question which best describes your experience over the past 2 weeks

(1) How bad is the heartburn? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(2) Heartburn when lying down? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(3) Heartburn when standing up? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.

(4) Heartburn after meals? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(5) Does heartburn change your diet? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(6) Does heartburn wake you from sleep? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(7) Do you have difficulty swallowing? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(8) Do you have pain with swallowing? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(9) If you take medication, does this affect your daily life? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(10) How bad is the regurgitation? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(11) Regurgitation when lying down? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(12) Regurgitation when standing up? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(13) Regurgitation after meals? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(14) Does regurgitation change your diet? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(15) Does regurgitation wake you from sleep? ☐0 ☐1 ☐2 ☐ 3 ☐4 ☐5.
(16) How satisfied are you with your present condition?

☐ Satisfied ☐ Neutral ☐ Dissatisfied.

Administered by Monitored by

Date (mm/dd/yy) Date (mm/dd/yy)

GERD-HRQL Questionnaire – Instructions

Total score: calculated by summing the individual scores to questions 1–15.
(1) Greatest possible score (worst symptoms)=75.
(2) Lowest possible score (no symptoms)=0.

Heartburn score: calculated by summing the individual scores to questions 1–6.
(1) Worst heartburn symptoms=30.
(2) No heartburn symptoms=0.
(3) Scores of less than or equal to 12 with each individual question not exceeding 2 indicate heartburn elimination [5,6].

Regurgitation score: calculated by summing the individual scores to questions 10–15.
(1) Worst regurgitation symptoms=30.
(2) No regurgitation symptoms=0.
(3) Scores of less than or equal to 12 with each individual question not exceeding 2 indicate regurgitation elimination.

Surgery

All the patients had LSG along with crural repair and stitching of the gastroesophageal junction to left crus in the same sitting under general anesthesia and under complete aseptic conditions, and operative time was recorded.

Steps of operation

Anesthesia

Operations were carried out under general anesthesia, with endotracheal intubation. Patients had a liquid diet 24 h before surgery and a minimum of 6–8 h of nothing by mouth (NPO) before surgery. Intravenous prophylactic antibiotic and subcutaneous low-molecular-weight heparin (Clexan) were given during the anesthesia induction.

Surgical technique

The patient was positioned in reverse Trendelenburg, in a split leg position, with both arms placed in abduction. Elastic and intermittent compressing stockings were applied. The surgeon stood between the patient's legs and the first assistant holding camera to the patient's right side. The patient was secured to the operating table. The abdomen was insufflated with visiport. A five-trocar technique was used. The first 12-mm visiport trocar was placed in the left mid-clavicular line 2 cm from the costal margin. One 5-mm trocar was placed just below the xiphoid process, another 5 mm port at anterior axillary line and one in the right mid-clavicular line. The camera port was 12-mm port as it was used also for stapling about 20 cm from xiphisternum in the midline or slightly to the patient's left. The liver was retracted by 5-mm instrument through the upper port. The greater omentum was transected with an energy device (Harmonic Ace; Ethicon Endosurgery, Cincinnati, Ohio, USA) starting 2–4 cm from the pylorus till reaching the fundus which was completely mobilized after transecting the short gastric vessels until the left crus was completely identified. The gastro-hepatic ligament was transected, and dissection of the right crus was done elevating and dissecting about 2–3 cm of the esophagus, and attention not to injure posterior vagus was given during posterior dissection (Fig. 2).

After identifying the HH till confluence of both crura, closure of it was done using 2/0 Ethibond for crural repair guided by 40-Fr bougie inserted by anesthesiologist through the mouth down to duodenum (Fig. 3a,b). Repair of the crura was guided by the bougie size and direction to avoid postoperative dysphagia that might happen from tight closure. SG was done then by stapling of the stomach using an Echelon stapler (Ethicon Endosurgery). We always start our transection using

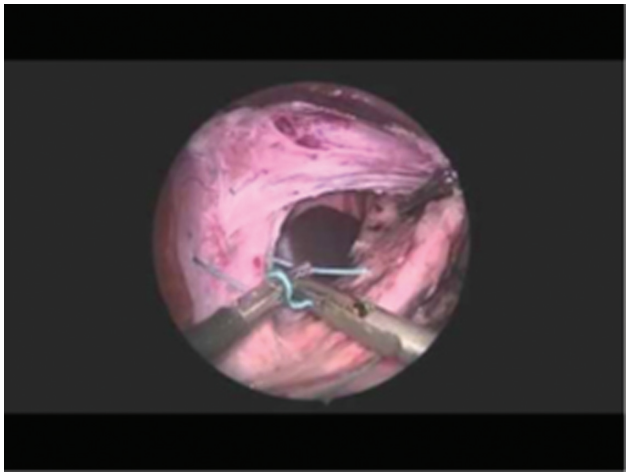
either a green or black cartridge, followed by four to five cartridges according to stomach length (Fig. 4). The gastroesophageal junction was kept in an intraabdominal location by taking a loose stitch between it and the left crus of the diaphragm (Fig. 5a–d).

Full data about hospital stay and short-term complications (as hemorrhage, leakage, hyperemesis, deep venous thrombosis, and wound infection) were analyzed, and regular follow up of weight, percent of excess weight loss, and diet regulation (at 1 week, 1 month, and then 3 and 6 months) for sleeve operation was done.

Symptoms of GERD were monitored postoperatively at 3 and 6 months.

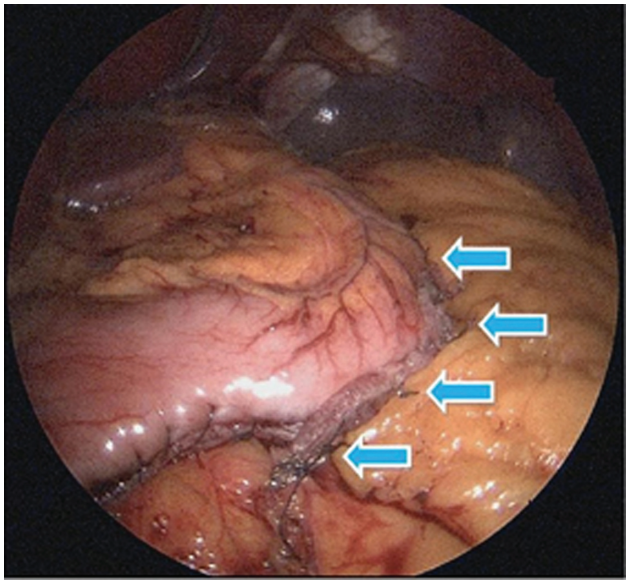
Postoperative follow-up: patients were discharged at the first or the second postoperative day, with oral clear fluids advised for 10 days. Overall, 30 ml of oral clear fluids was given every hour in the early morning and if patient tolerating, clear fluids in the evening. Then soft diet was allowed for next 10 days of surgery. Elastic compression stockings (for 24 h postoperatively) were used, and subcutaneous low-molecular-weight heparin injection (daily dose of 40 U) was administered until discharge because of a relatively high rate of DVT and pulmonary embolism for those patients. Low-molecular-weight heparin was currently prescribed up until 1 week postoperatively. In addition, a proton pump inhibitor (omeprazole 40 mg/day) was

Figure 2



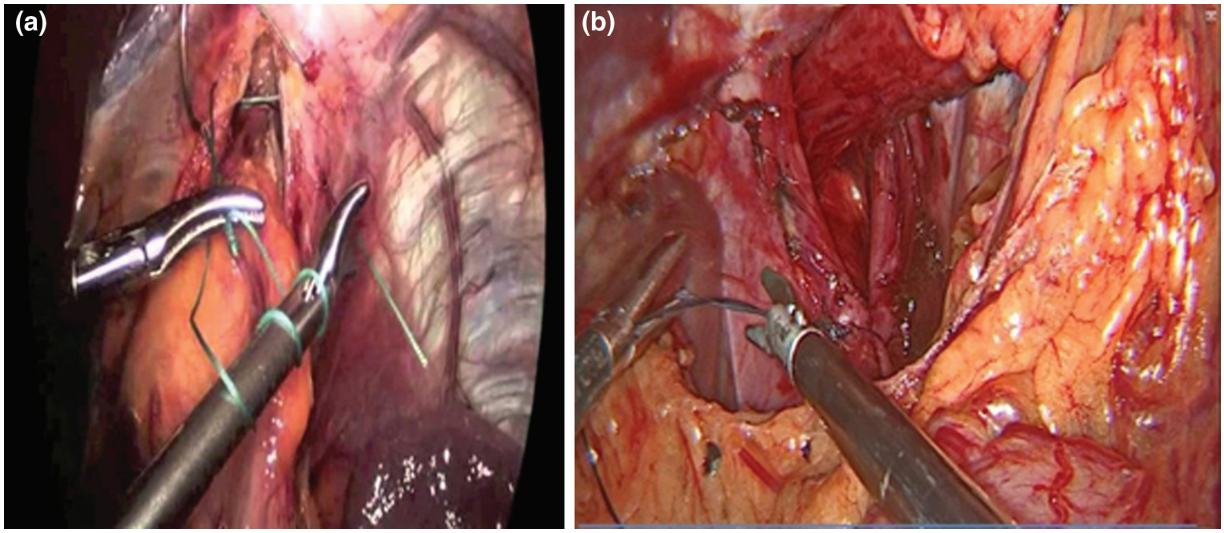
Dissect the hernial sac and repair of the crura of the diaphragm.

Figure 4



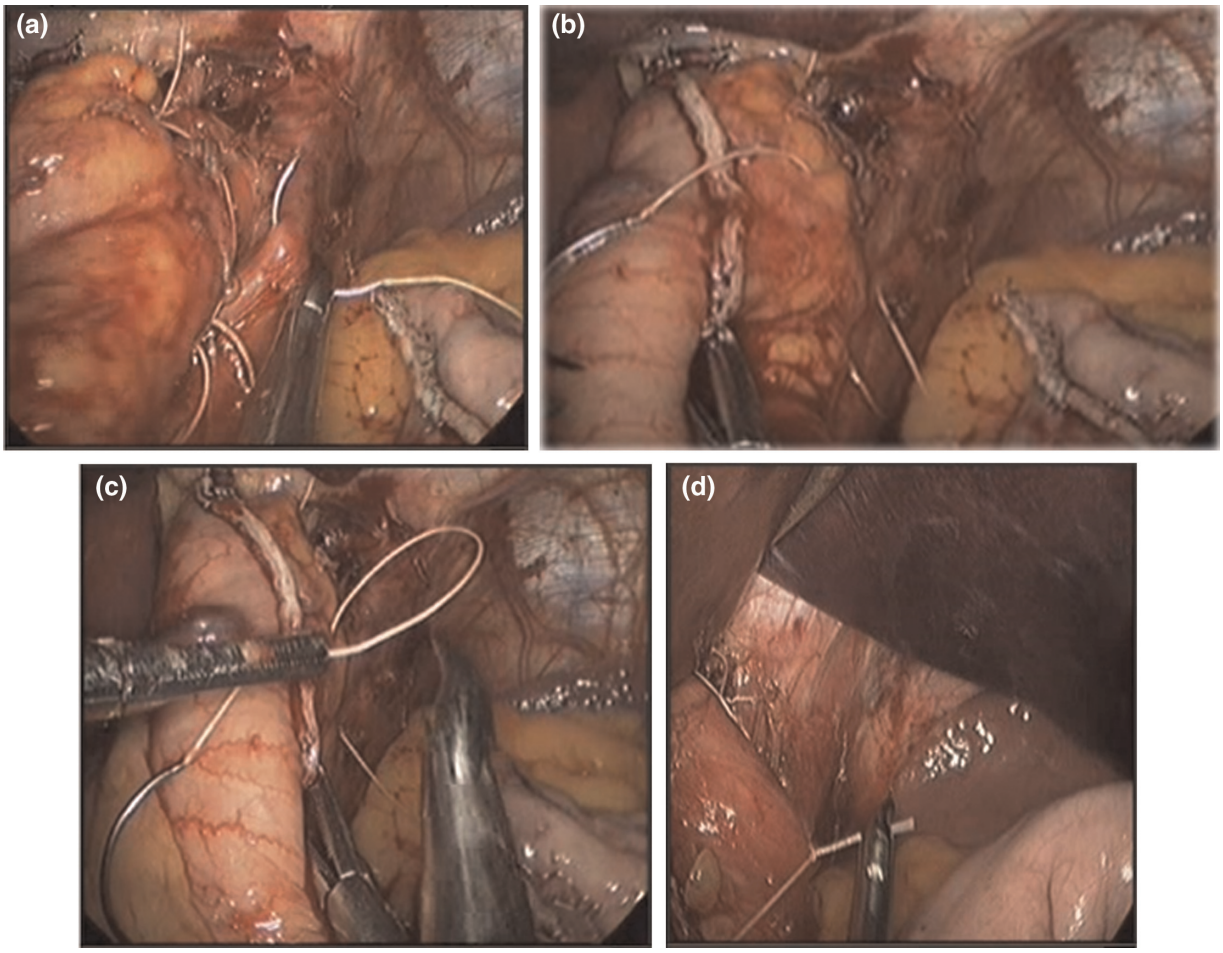
Sleeve gastrectomy done after crura repair.

Figure 3



(a) Repair of the crura of the diaphragm with sutures (anterior stitch). (b) Posterior repair of the crura.

Figure 5



(a) Stitching left crus to 1 cm below gastroesophageal junction. (b) Loose stitch of stomach below gastroesophageal junction and left crus. (c) Tension free stitch keeping small distance between stomach and left crus. (d) The gastroesophageal junction is fixed in intraabdominal position.

Figure 6

Postoperative upper endoscopy showing no hiatus hernia.

used for 6–8 weeks to reduce early symptoms of reflux that may develop.

Outpatient clinic visits were scheduled at 1 week, 1 month, 3 months, and 6 months postoperatively, and follow-up for the GERD symptoms as heartburn, dysphagia, regurgitation and chest pain was monitored using the same questionnaire used preoperatively.

Gastrointestinal endoscopy was done 6 months postoperatively to assess the efficacy of crural repair of HH and effect on GERD grade either progression or regression (Fig. 6).

Statistical analysis

Data were collected, revised, coded, and entered to the Statistical Package for Social Science (IBM SPSS), version 23 (Armonk, NY: IBM Corp.). The quantitative data were presented as mean, SDs, and ranges. Moreover, qualitative variables were presented as number and percentages.

The comparison between groups regarding qualitative data was done by using χ^2 test and/or Fisher exact test when the expected count in any cell found less than 5.

The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the *P* value was considered significant as follows: *P* value more than 0.05: nonsignificant, *P* value less than 0.05: significant, and *P* value less than 0.01: highly significant.

Results

Results are demonstrated in Tables 1–5 including demographic data of patients,BMI,operative time, comorbid conditions and their improvements after operation, also effect of operation on improvement on GERD symptoms and oesophagitis is demonstrated.

Discussion

Gagner *et al*. [8] reported that as for SG, it can promote the development or worsening of GERD symptoms, so that the preoperative diagnosis of GERD and/or HH might represent a contraindication to SG [7].

In contrary, a study by Himpens *et al*. [9] showed that the 'de novo' appearance of GERD occurred in 21.8% of patients 1 year after surgery. However, 3 years later, GERD was present in only 3.1% because of the restoration of the angle of His. Furthermore, 75% of patients affected by reflux symptoms before surgery noted its disappearance 1 and 3 years after surgery [9]. In our study, symptomatic GERD was present in 28 (70%) patients, and HH was diagnosed in all patients either preoperatively or intraoperatively. The mean follow-up was 6 months, and GERD remission occurred in 36 (90%) patients, confirmed by upper gastrointestinal endoscopy. In the remaining four (10%) patients, antireflux medications were continued, with complete control of symptoms after ~4 months.

We aimed to prove that HHR is not just about crura approximation but the key to HHR is esophageal dissection and mobilization to restore intraabdominal esophagus. The gastroesophageal junction is a complex anatomic structure that is closely linked to proper functioning of the antacid barrier. Effacement of angle of His, loss of diaphragmatic support, and migration of intraabdominal esophagus into negative pressure chest area are some factors that contribute to disruption of the gastroesophageal junction anatomy and function as antacid barrier. So, we aimed at restoration of most of these protective mechanisms to ensure proper

Table 1 Demographic data

	Total *N*=40
Age	
Mean±SD	37.55±11.77
Range	20–55
Sex [*n* (%)]	
Female	30 (75.0)
Male	10 (25.0)
Weight	
Mean±SD	110.35±10.84
Range	88–128
Height	
Mean±SD	158.10±6.98
Range	145–171
BMI	
Mean±SD	43.95±2.58
Range	40–49
Operative time (min)	
Mean±SD	39.95±7.92
Range	30–55
Postoperative stay (days)	
Mean±SD	1.95±0.76
Range	1–3

Table 2 Comorbid conditions

	Total *N*=40 [*n* (%)]
Baseline GERD	
No	12 (30.0)
A (esophagitis)	18 (45.0)
B (esophagitis)	10 (25.0)
Sleep apnea	
No	24 (60.0)
Yes	16 (40.0)
HTN	
No	30 (75.0)
Yes	10 (25.0)
Dyslipidemia	
No	14 (35.0)
Yes	26 (65.0)
Asthma	
No	36 (90.0)
Yes	4 (10.0)
DM	
No	16 (40.0)
Yes	24 (60.0)
DM treatment	
Oral	10 (41.7)
Insulin	10 (41.7)
Both	4 (16.7)
Alcohol	
No	38 (95.0)
Yes	2 (5.0)
Smoking	
No	26 (65.0)
Yes	14 (35.0)

DM, diabetes mellitus; HTN, hypertension; GERD, gastroesophageal reflux disease.

Table 3 Preoperative data

Preoperative	Total *N*=40 [*n* (%)]
Size of hiatus hernia (cm)	
4	22 (55.0)
2	18 (45.0)
Esophagitis	
No	10 (25.0)
Yes	30 (75.0)
Gastritis	
No	30 (75.0)
Yes	10 (25.0)

Table 4 Comparison between preoperative data and 6 months postoperatively

	Preoperative [*n* (%)]	6 months postoperative [*n* (%)]	*P* value	Significance
Size of hiatus hernia (cm)				
4	22 (55.0)	0	0.000	HS
2	18 (45.0)	0		
Esophagitis				
No	10 (25.0)	30 (75.0)	0.002	HS
Yes	30 (75.0)	10 (25.0)		
Gastritis				
No	30 (75.0)	40 (100.0)	0.017	S
Yes	10 (25.0)			
GERD symptoms				
Yes	28 (70)	4 (10)		
No	12 (30)	36 (90)		

GERD, gastroesophageal reflux disease.*P* value more than 0.05: nonsignificant; *P* value less than 0.05: significant; *P* value less than 0.01: highly significant.

HHR and improvement of GERD symptoms postoperatively.

Some authors proved that 'de novo' GERD symptoms developed in 22.9% of their patients undergoing SG alone compared with 0% of patients undergoing SG plus HHR [2]. In our study, GERD symptoms were markedly improved confirmed by 6-month upper gastrointestinal endoscopy (90%). We tried to increase the antireflux measures by repairing of HH and keeping the gastroesophageal junction in intraabdominal position using a single stich between it and left crus of the diaphragm.

Further studies and regular long-term follow-ups are required to give proper idea about the effectiveness of our technique on improvement of GERD symptoms.

Table 5 Postoperative gastroesophageal reflux disease symptoms

Postoperative GERD symptoms	Total *N*=40
No	36 (90.0)
Mild	4 (10.0)

GERD, gastroesophageal reflux disease.

Conclusion

Sleeve gastrectomy with crural repair and stitching the gastroesophageal junction to the left crus of diaphragm is feasible and safe and provides good management of GERD in obese patients with reflux symptoms and HH. Moreover, small hiatal defects could be missed at preoperative endoscopy and/or upper gastrointestinal contrast study. Thus, a careful examination of the crura is always recommended intraoperatively.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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