

# Does the Repair of an Accidentally Discovered Hiatal Hernia and Gastropexy Affect the Incidence of De Novo Postoperative GERD Symptoms After Laparoscopic Sleeve Gastrectomy?

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**Background:** The relationship between laparoscopic sleeve gastrectomy (LSG) and gastroesophageal reflux disease (GERD) is intricate. Hiatal hernia repair or gastropexy can have an impact on postoperative GERD.

**Aim:** To assess the effect of the repair of an accidentally discovered HH and/or gastropexy on the development of de novo postoperative GERD symptoms after LSG.

**Methods:** This retrospective study included all obese patients who underwent LSG at our hospital from January 2018 to June 2022. The data retrieved from patients' files comprised demographic and clinical data, including BMI, GERD symptoms, and comorbidities. Hiatal hernias, surgical technique, gastropexy, duration, and intraoperative complications were recorded. Postoperative data included early and late postoperative complications, weight loss, de novo GERD, and medication use.

**Results:** The study included 253 patients, 89 males (35.2%) and 164 females (64.8%), with a mean age of 33.3±10.04 years. De novo GERD was detected in 94 individuals (37.15%). HH was accidentally found and repaired in 29 patients (11.5%). Only 10.3% of LSG and HH repair patients had de novo GERD symptoms, compared to 40.6% of non-HH patients. 149 patients (58.9%) had gastropexy with LSG. Postoperative de novo GERD symptoms were comparable for LSG with gastropexy (40.5%) and LSG alone (40.9%).

**Conclusion:** After one year, concurrent hiatal hernia repair and LSG seem to be safe and beneficial in lowering postoperative de novo GERD symptoms. The inclusion of gastropexy with LSG had no significant impact on postoperative de novo GERD. Both HH repair and gastropexy lengthened the operation but did not increase its complications.

**Keywords:** Obesity, Laparoscopic sleeve gastrectomy, Gastroesophageal reflux disease, GERD, Hiatal hernia, Gastropexy

## Introduction

Obesity is an alarmingly expanding global public health concern.<sup>1</sup> In the last three decades, the prevalence of obesity has doubled or tripled in a number of countries around the globe, likely due to urbanization, a sedentary lifestyle, and increased consumption of high-calorie processed foods.<sup>2</sup> Saudi Arabia has one of the highest obesity rates in the world, posing a significant health risk.<sup>3</sup> It is estimated that more than 70% of Saudi Arabians are overweight or obese.<sup>4</sup>

Gastroesophageal Reflux Disease (GERD) is a chronic gastrointestinal condition characterized by the regurgitation of stomach acid or bile into the esophagus, resulting in irritation and inflammation.<sup>5</sup> Heartburn, regurgitation, difficulty swallowing, chest pain, and wheezing are GERD symptoms. A weak lower esophageal sphincter, obesity, pregnancy,

smoking, and specific drugs can all contribute to it.<sup>6</sup> There is a significant correlation between obesity and GERD. Overweight or obese individuals are more likely to experience GERD symptoms.<sup>7,8</sup>

It has been demonstrated that laparoscopic sleeve gastrectomy (LSG) is an effective and sustainable treatment for obesity.<sup>9</sup> This results in weight loss and improvements in health conditions related to obesity, such as diabetes, elevated blood pressure, and sleep apnea.<sup>10,11</sup> Although LSG relieves symptoms in a substantial proportion of patients with preoperative GERD, it was reported that one-third of patients with de novo GERD symptoms developed after LSG.<sup>12</sup> LSG entails the removal of a significant portion of the stomach, leaving behind a reduced, tube-like stomach. This procedure can alter the anatomy and function of the digestive system, resulting in GERD. These symptoms can be mild or severe, and they can appear promptly following surgery or several months later.<sup>13</sup>

In order to prevent or reduce GERD in the postoperative period following LSG, it has been suggested that the remaining gastric reservoir can now be attached to the prepancreatic, gastrosplenic, or gastrocolic ligaments (gastropexy or omentopexy).<sup>14,15</sup> However, there are few studies in the literature that confirm this hypothesis.

The condition of hiatal hernia (HH) is not uncommon among obese patients. It may be present in up to 40% of patients with morbid obesity.<sup>16</sup> If the hernia is large or causing symptoms such as reflux or difficulty swallowing, it may be necessary to repair it during the same surgical procedure. In addition to exacerbating reflux symptoms, hiatal hernia may also result in incomplete gastric fundus excision during laparoscopic sleeve gastrectomy.<sup>17</sup>

The relationship between HH and GERD is quite complicated. Although there seems to be a connection between hiatal hernia and GERD, neither condition appears to induce the other. Some individuals have GERD without a hiatal hernia, and others have a hiatal hernia without GERD.<sup>18</sup> In addition, the effect of LSG on the development of de novo GERD cannot be predicted.<sup>12</sup>

Therefore, the aim of the study was to assess the effect of the repair of an accidentally discovered hiatal hernia and/or gastropexy on the development of de novo postoperative GERD symptoms after laparoscopic sleeve gastrectomy.

## Patients and Methods

This is a retrospective study that included all obese patients (over the age of 18) who underwent LSG in our hospital during the period from January 2018 to June 2022.

The extracted information from the patients' files comprised demographic and clinical data, such as BMI, the presence of GERD symptoms, and any accompanying comorbidities. The operative data comprised the presence of hiatal hernias (detected by assessing the hiatus intraoperatively for any defect, laxity or dimpling), the surgical approach (The repair of hiatus hernia was performed by complete mobilization of the gastroesophageal junction, mediastinal mobilization of the esophagus, and a posterior cruroplasty), whether gastrectomy (GP) was performed or not (In our institution, we gastropexy was performed by suturing the staple line of the greater curvature of the gastric remnant to the pericolic, pancreatic fascia, and proximal part to the free edge of the gastrocolic ligament on 5 or 6 points with Prolene (3/0) sutures), the duration of the operation, and any complications that occurred during the procedure. The postoperative data encompassed both immediate and delayed postoperative complications, the emergence of newly developed symptoms of GERD, and the utilization of proton pump inhibitors (PPIs). The quantification of weight loss was measured using the alteration in body mass index, the percentage of excess weight loss (% EWL), and the percentage of total weight loss (% TWL).

The symptoms of GERD were used to detect GERD postoperatively and were classified clinically as follows: none; Grade 1: mild symptoms (heartburn and regurgitation occurring once or less per week) with no PPI use; grade 2: moderate symptoms (heartburn or regurgitation occurring a few times per week) and/or periodic PPI use; and grade 3: severe symptoms (regular heartburn, a chronic cough, regurgitation, a hoarse voice, and regurgitation of food) and/or frequent PPI use.<sup>19</sup>

The following were excluded from the study: patients under the age of 18, those with incomplete medical records for at least 1 year, and those with preoperative GERD symptoms or those who were receiving proton pump inhibitors (PPIs). At our institution, esophagogastroduodenoscopy (EGD) is performed pre- and post-LSG using a selective approach only for patients with GERD symptoms. All patients diagnosed with Barrett's esophagus or extensive esophagitis prior to LSG

by endoscopy were excluded from the study. Patients with a preoperative diagnosis of HH were also excluded from the study in order not to confuse the results.

According to the patients' data, patients were classified into 4 groups: Group A for patients with no HH and no GP, Group B for patients with HH and no PG, Group C for patients with GP and no HH, and Group D for patients with HH and GP. A comparison between the 4 groups regarding the development of de novo GERD symptoms as well as the grade of the GERD symptoms was conducted.

## Outcomes

### Primary Endpoints

- Determination of the impact of hiatal hernia repair along with LSG on the development of post-LSG de novo GERD symptoms by comparing the incidence of de novo GERD symptoms between patients who had hiatal hernia repair and those who did not.
- Determination of the impact of gastropexy along with LSG on the development of de novo GERD symptoms by comparing the incidence of GERD between patients who had gastropexy along with LSG and those who underwent LSG only.

### Secondary Endpoint

- Determination of the impact of hiatal hernia repair and/or gastropexy, along with LSG, on the development of operative and postoperative complications.

## Statistical Analysis

The data was collected and entered into the personal computer. We used the Statistical Package for Social Sciences (SPSS/version 24.0) software for statistical analysis.

We applied the following statistical tests: We used the arithmetic mean, standard deviation, and a comparison between more than two populations when the data was normally distributed. We used an ANOVA test and a post hoc test to determine if there was a significant difference between the groups. We used the Chi square test for categorized parameters and then compared the two groups to identify any significant differences between them. The level of significance was 0.05.

## Results

The study included 253 patients, 89 males (35.2%) and 164 females (64.8%), with a mean age of  $33.3 \pm 10.04$  years (range: 18–64). The total number of patients who underwent GP was 149 (58.9%), while HH was accidentally discovered and repaired in 29 patients. (11.5%). Group A included 93 patients (36.8%), group B included 11 patients (4.3%), group C included 131 patients (51.8%), and group D included 18 patients (7.1%). No statistically significant differences were found among the four groups in terms of age, gender, presence of chronic diseases, %EWL category, and follow-up duration. Age groups ranging from 20 to 40 were more prevalent in groups A, C, and D, whereas group B had a higher prevalence of those aged beyond 40 years. The prevalence of female gender was higher in groups A, B, and C, but both genders were equally represented in group D. The demographic and clinical fundamentals of the studied cohort in relation to gastropexy and HH are shown in [Table 1](#).

Each step added to the LSG, HH repair, and/or gastropexy resulted in a significant increase in the operative time, with the maximum increase in group D, in which patients were subjected to both HH repair and gastropexy. Group A (no HH repair, no gastropexy) had the shortest surgical time with a mean of  $54.3 \pm 17.2$  minutes, while Group D (HH repair plus gastropexy) had the longest operative time with a mean of  $82.1 \pm 20.8$  minutes. [Table 2](#) demonstrates the operative time of all groups.

There was a significant difference between the BMI at baseline for all patients in all groups and both the BMI after 6 months ( $p < 0.001$ ) and the BMI after one year ( $p < 0.001$ ). However, there was no significant difference between the BMI at six months and one year. Group D showed higher %TWL, %EWL, and weight loss. However, we observed no

**Table 1** Basic Demographic and Clinical Data of the Studied Group

	Group A (No HH Repair, No Gastropexy) “n=93”		Group B (HH Repair and no Gastropexy) “n=11”		Group C (Gastropexy and No HH Repair) “n=131”		Group D (HH Repair and Gastropexy) “n=18”		P value
	No	%	No	%	No	%	No	%	
<b>Age group</b>									
<25 yrs	19	20.4	2	18.2	35	26.7	6	33.3	0.466
25–40 yrs	46	49.5	4	36.4	62	47.3	10	55.6	
> 40	28	30.1	5	45.5	34	26.0	2	11.1	
Range (years)	18.0–64.0		20.0–44.0		18.0–58.0		18.0–49.0		
Mean±S.D.	34.9±10.4		34.3±8.6		32.4±9.9		30.1±9.2		
<b>Gender</b>									
Male	28	30.1	5	45.5	47	35.9	9	50.0	0.345
Female	65	69.9	6	54.5	84	61.1	9	50.0	
<b>Chronic diseases</b>									
No	67	72.0	5	45.5	95	72.5	5	27.8	0.277
Yes	26	28.0	6	54.5	36	27.5	13	72.2	
DM	8	8.6	2	18.2	15	11.5	5	27.8	
HTN	12	12.9	1	9.1	5	3.8	4	22.2	
Hypothyroidism	4	4.3	3	27.3	12	9.2	2	11.1	
Asthma	3	3.2	1	9.1	3	2.3	2	11.1	
Hyperlipidemia	2	2.2	0	0.0	2	1.5	1	5.6	
<b>%EWL category</b>									
<50%	13	14.0	1	9.1	17	13.0	2	11.1	0.856
50–75%	40	43.0	6	54.5	57	43.5	6	33.3	
75–100%	33	35.5	2	18.2	47	35.9	7	38.9	
>100%	7	7.5	2	18.2	10	7.6	3	16.7	
<b>Follow-up period (months)</b>									
Range	12–29		13–28		12–28		12–27		0.254
Mean±S.D.	18.6±4.8		19.5±4.55		19.3±5.08		18.4±6.03		

**Abbreviation:** HH, Hiatal hernia.

statistically significant difference among the four groups in terms of these parameters. [Tables 3](#) and [4](#) demonstrate the comparison of the different studied groups regarding the BMI of the patients and the different weight categories.

Regarding postoperative de novo GERD, 94 patients (37.15%) had newly developed GERD symptoms, the majority of which (58.5%) were mild in severity. Proton pump inhibitors were prescribed to 35.1% of them, and the results were satisfactory for all of them. Descriptive statistics of postoperative de novo GERD among the studied group are shown in [Table 5](#).

Postoperative de novo GERD symptoms of patients with HH repair occurred in 9.1% in group B and 11.1% in group D; that was significantly less compared to 40.9% in group A and 40.5% in group C, whose patients had no HH. Furthermore, all patients who developed de novo GERD after HH repair had mild symptoms. This was found to be significant.

Postoperative de novo GERD symptoms were observed in 36.9% of patients who underwent gastropexy as part of the LSG procedure. Out of 131 patients who underwent gastropexy with no HH repair in Group C, de novo GERD symptoms were found in 40.5%, compared to 40.9% in patients with no gastropexy in Group A. This difference was found to be insignificant. In addition, there was no significant difference between patients with and without gastropexy in the distribution of the severity of postoperative de novo GERD symptoms. A comparison between the four groups regarding the development of postoperative de novo GERD symptoms and their severity is shown in [Table 6](#).

**Table 2** Comparison Between Different Studied Groups Regarding Operative Time (Min)

Operative Duration (min).	Group A (No HH Repair, No Gastropexy) "n=93"	Group B (HH Repair and No Gastropexy) "n=11"	Group C (Gastropexy and No HH Repair) "n=131"	Group D (HH Repair and Gastropexy) "n=18"
Range	39–128	62–133	48–128	65–136
Mean±S.D.	54.3±17.2	76.9±23.1	65.3±16.5	82.1±20.8
ANOVA	18.10			
P value	0.001*			
P1		0.001*	0.001*	0.001*
P2			0.034	0.44
P3				0.0026*

**Notes:** P1 comparison between No Hiatal hernia No gastropexy and other groups. P2 comparison between Positive HH and no gastropexy and other groups. P3 comparison between No HH and Positive gastropexy group and Positive HH and Positive gastropexy group. \*p<0.5 is significant.

**Abbreviation:** HH, Hiatal hernia.

**Table 3** Comparison Between Different Studied Group Regarding Body Mass Index All Over the Period of Follow Up

	Group A (No HH Repair, No Gastropexy) "n=93"	Group B (HH Repair and No Gastropexy) "n=11"	Group C (Gastropexy and No HH Repair) "n=131"	Group D (HH Repair and Gastropexy) "n=18"	ANOVA Test Pii value
<b>BMI base line</b>					
Range	35.10–64.80	35.70–53.50	35.10–64.50	38.10–63.60	1.233
Mean±SD	43.6±6.0	43.8±5.4	43.7±6.2	46.6±7.7	0.298
<b>BMI after 6 months</b>					
Range	19.80–40.10	18.00–36.10	19.30–56.50	19.40–37.20	0.079
Mean±SD	27.7±4.1	27.8±5.0	28.0±4.7	28.2±5.0	0.971
<b>BMI after 1 year</b>					
Range	20.70–49.10	18.24–36.72	19.47–56.46	20.80–37.20	0.194
Mean±SD	29.2±5.3	28.7±5.4	28.9±4.8	28.4±5.1	0.900
<b>ANOVA</b>	27.8	30.9	28.6	35.5	
<b>Pii value</b>	0.001*	0.001*	0.001*	0.001*	
<b>P1</b>	0.001*	0.001*	0.001*	0.001*	
<b>P2</b>	0.001*	0.002*	0.001*	0.001*	
<b>P3</b>	0.107	0.246	0.543	0.429	

**Notes:** Pii comparison between the different studied groups at the same period of follow up. Pii comparison between the interval times in the same group. P1 comparison between BMI at base line with BMI after 6 months. P2 comparison between BMI at base line with BMI after 12 months. P3 comparison between BMI after 6 months and BMI after 12 months. \*p<0.5 is significant.

**Abbreviation:** HH, Hiatal hernia.

Regarding the postoperative complications, they were encountered among 4 patients (1.54%). One female patient (group A) developed a gastric leak 10 days postoperatively and was treated successfully with a gastric stent. Another male patient (Group C) had bleeding during the first postoperative day and was reoperated. The bleeding was found to be from the stapler line, which was successfully secured. Two patients (groups A and D) had mild superficial wound infections and were treated successfully by conservative treatment. No deaths were reported among the 4 groups. Neither HH repair nor gastropexy had an influence on the incidence of postoperative complications.

**Table 4** Comparison Between Different Studied Group Regarding Different Weight Category

	Group A (No HH Repair, No Gastropexy) "n=93"	Group B (HH Repair and No Gastropexy) "n=11"	Group C (Gastropexy and No HH Repair) "n=131"	Group D (HH Repair and Gastropexy) "n=18"	ANOVA Test P value
<b>%TWL</b>					
Range	12.00–57.00	17.90–62.90	5.40–58.20	18.20–56.60	1.604
Mean±SD	32.6±9.8	33.8±14.0	33.3±10.6	38.5±10.0	0.189
<b>%EWL</b>					
Range	26.10–118.60	38.70–119.50	8.80–124.90	45.90–113.70	0.586
Mean±SD	71.1±20.4	71.2±24.9	72.0±20.8	78.2±19.3	0.625
<b>Least Wt. post op</b>					
Range	55.00–120.00	60.00–102.00	54.00–122.00	60.00–95.00	0.686
Mean±SD	70.8±10.1	75.2±14.7	71.2±10.3	72.8±10.3	0.561
<b>Weight loss</b>					
Range	12.00–86.00	16.00–107.00	7.00–92.00	16.00–82.00	2.168
Mean±SD	37.2±15.1	42.9±26.0	38.8±17.8	48.1±18.4	0.092

**Abbreviation:** HH, Hiatal hernia.

**Table 5** Descriptive Statistics of Postoperative de Novo GERD

	Number	Percent
<b>De novo postoperative GERD symptoms (n=253)</b>	94	37.15
<b>Grade of postoperative GERD symptoms (n=94)</b>		
Mild	55	58.5
Moderate	26	27.7
Severe	13	13.8
<b>Medication used for postoperative GERD (n=94)</b>	33	35.1

**Table 6** Comparison Between the Different Studied Groups Regarding Post Operative GERD and Its Degree

De Novo Postoperative GERD	Group A (No HH Repair, No Gastropexy) "n=93"		Group B (HH Repair and No Gastropexy) "n=11"		Group C (Gastropexy and No HH Repair) "n=131"		Group D (HH Repair and Gastropexy) "n=18"	
	No	%	No	%	No	%	No	%
No	55	59.1	10	90.9	78	59.5	16	88.9
Yes	38	40.9	1	9.1	53	40.5	2	11.1
<b>X<sup>2</sup></b>	10.098							
<b>P value</b>	0.0177*							
P1			0.046*		0.963		0.036*	
P2					0.047*		0.74	
P3							0.037*	
<b>Grade of GERD</b>								
Mild	27	71.1	1	100.0	30	56.6	2	100.0
Moderate	9	23.7	0	0.0	18	34.0	0	0.0
Severe	2	5.3	0	0.0	5	9.4	0	0.0

(Continued)

Table 6 (Continued).

De Novo Postoperative GERD	Group A (No HH Repair, No Gastropexy) "n=93"		Group B (HH Repair and No Gastropexy) "n=11"		Group C (Gastropexy and No HH Repair) "n=131"		Group D (HH Repair and Gastropexy) "n=18"	
	No	%	No	%	No	%	No	%
<b>X<sup>2</sup></b>	8.25							
<b>P value</b>	0.041*							
P1			0.047*		0.821		0.013*	
P2					0.039*		0.881	
P3							0.027*	

**Notes:** P1 comparison between No Hiatal hernia No gastropexy and other groups. P2 comparison between Positive HH and no gastropexy and other groups. P3 comparison between No HH and Positive gastropexy group and Positive HH and Positive gastropexy group. \*p<0.5 is significant.

**Abbreviation:** HH, Hiatal hernia.

## Discussion

LSG has demonstrated favorable outcomes for certain related comorbidities.<sup>10</sup> However, the connection between LSG and postoperative GERD is still not completely comprehended and necessitates additional research. The literature contains conflicting findings about the association between LSG and GERD. Some studies have indicated a beneficial effect of LSG on GERD symptoms, while others have documented a deteriorating effect.<sup>20–22</sup>

In this study, we used GERD symptoms to assess the patients postoperatively. Twenty-four hour pH monitoring and EGD are considered the most accurate methods for detecting gastric reflux and gastroesophageal reflux disease (GERD).<sup>23</sup> Nevertheless, because of the scarcity and high cost of 24-hour pH monitoring and/or EGD in several hospitals, the diagnosis often relies solely on symptoms and endoscopy.<sup>24</sup> Unfortunately, we did not conduct pre- and postoperative EGD as a standard procedure. Postoperative EGD was only carried out in a tiny portion of patients who experienced severe symptoms of reflux or vomiting. We do not believe that any selective approach can solve the dilemma of who deserves 24-hour pH monitoring and/or EGD. Almost all the institutions that implement the selective approach, including our institution, certainly miss patients with asymptomatic GERD. Furthermore, the presence of symptoms is not a dependable sign of more severe acid reflux or endoscopic mucosal alterations, as many of these conditions can occur without any symptoms.<sup>25,26</sup> However, common reporting criteria for assessing outcomes following bariatric surgery recognize the use of medicine and any changes in medication as markers for gastroesophageal reflux disease (GERD).<sup>26</sup> We think that making a standard EGD post-LSG is not an easy task due to many factors. The availability and the cost may be important obstacles in many institutions. In addition, until now, the accurate schedule for making the EGD has not been clear: when to start, when to repeat, and when to stop. We think that more studies may be required to answer these questions.

Our study revealed that 37.2% of the patients developed de novo GERD symptoms following LSG, mainly characterized by mild to moderate intensity. Proton pump inhibitors were found to be effective in all patients who received them. The Fourth International Consensus Summit on SG in 2012 reported that GERD was the most commonly observed complication following LSG.<sup>27</sup> Genco et al<sup>28</sup> suggested that the presence or absence of symptoms of GERD following LSG may be linked to the effectiveness of the “anti-reflux barrier”. This barrier relies on the correct alignment of various anatomical structures, such as the crura of the diaphragm, the fibers of the gastric sling, the functional sphincter in the lower esophagus, and the ligaments connecting the diaphragm to the esophagus and cardia. Based on the proposal of Genco et al,<sup>28</sup> we can predict a different response for de novo GERD development after LSG between patients who had HH and those without HH.

Several factors may be linked to a higher risk of developing GERD following LSG. The factors contributing to this include reduced gastric compliance, elevated intraluminal pressure, excision or dilatation of the gastric fundus, low pressure in the esophageal sphincter, the general form of the sleeve, narrowing at the point where the vertical and



horizontal parts of the sleeve meet, and sleeve torsion. Furthermore, the presence of a persistent hiatal hernia is considered one of the most important factors affecting postoperative GERD.<sup>29</sup>

Dalboh et al<sup>12</sup> described a decline in regurgitation symptoms following LSG. Popescu et al<sup>29</sup> reported in their study that the improvement was greater in morbidly obese patients. This may be attributed to the reduction of the intra-abdominal pressure and its positive impact on the GERD. In addition, it was suggested that there is an acceleration of the gastric emptying after LSG, which may be the cause of the relief of the GERD symptoms postoperatively.<sup>30</sup>

The incidence of hiatal hernias rises with advancing age. Around 55% to 60% of adults aged 50 and above have a hiatal hernia.<sup>31</sup> Hiatal hernias are prevalent in people who are candidates for bariatric surgery, with a prevalence of 20%–50% among those with extreme obesity.<sup>16,32</sup> These hernias result in GERD that may elevate the risk for further procedures.<sup>33</sup> Consequently, most surgeons find it safe and reasonable to repair hiatal hernias at the same time as bariatric surgery.<sup>34,35</sup> On the other hand, there are still opponents who question the effectiveness of repairing a hiatus hernia simultaneously with LSG or the specific procedure for closure.<sup>27,36,37</sup> In the literature, there is limited scientific research on patients who underwent both bariatric procedures and HH repair.<sup>34,38,39</sup>

The incidence of asymptomatic HH is not well documented in the literature, which may be attributed to the fact that those people will not seek medical advice. In our study, HH was accidentally discovered in 11.5% of our patients. Zuercher et al<sup>40</sup> identified intraoperative HH in 45 out of 559 patients (8.1%) during their bariatric surgery. The incidence of accidental detection of hiatal hernia during laparoscopic sleeve gastrectomy is little described in the scientific literature. Several studies have documented the effects of managing the simultaneous procedures of laparoscopic sleeve gastrectomy (LSG) and hiatal hernia (HH) correction in patients diagnosed before surgery.<sup>34,38,39</sup> Nevertheless, the accidentally discovered HH during LSG may be different. Genger et al,<sup>27</sup> in their survey of sleeve gastrectomy surgeons, reported that only a considerable 31% of surgeons actively sought a hiatal hernia (HH) if it was indicated on preoperative investigations or if there was a history of GERD.

In this study, postoperative de novo GERD symptoms occurred in 10.3% of patients after HH repair, which was significantly less compared to 40.6% of patients with no HH, with a better outcome in terms of severity of the GERD symptoms as all patients had mild symptoms. These results stress the important role of concomitant HH repair for those who have HH accidentally discovered along with LSG. However, the surgeons must be prepared for such a situation if they employ a selective strategy when conducting the preoperative EGD.

In the literature, there is a paucity of studies addressing the results of the repair of an accidentally discovered HH with LSG. However, several studies reported their experience with HH repair along with LSG. Angrisani et al<sup>41</sup> found a reduction in GERD symptoms in patients who underwent hiatal hernia repair, emphasizing the potential impact of surgical techniques on GERD outcomes. In contrast to our findings, Dakour Aridi et al<sup>19</sup> did not find hiatal hernia repair to significantly impact the incidence of GERD post-surgery.

Gastropexy is a relatively new step after sleeve gastrectomy that is gaining popularity due to its effective outcomes in terms of reducing early postoperative dyspeptic symptoms.<sup>42</sup> The lack of ligament attachments along the greater curvature of the stomach might lead to a vulnerability of the remaining gastric tube to twist and form a coil, resulting in symptoms of blockage. In order to prevent the twisting or coiling of the pouch, doctors advise securing it to the larger omentum or the nearby ligaments to ensure its stability. Therefore, the concept of incorporating the gastropexy procedure into the laparoscopic sleeve gastrectomy (LSG) was conceived.<sup>43</sup> Nevertheless, gastropexy is not a routine procedure in LSG. Gastropexy is a contentious technical aspect that is debated for its effectiveness in lowering postoperative dyspeptic symptoms and GERD, as well as other problems such as leakages, functional stenosis, or intrathoracic migration of the staple line.<sup>14</sup>

In this study, 149 patients (58.9%) had gastropexy after their LSG. It was the surgeon's preference to perform gastric fixation or not along with LSG. However, the technique of fixation was the same, with 3 to 4 interrupted Vicryl (3/0) sutures starting from the proximal to the distal, fixing the stomach to the gastrocolic and gastrosplenic ligaments. We stress the importance of the first and last stitches: the first upper stitch, which prevents the gastric remnant from moving above the diaphragm and stops the stomach from migrating into the thorax, and the distal stitch, located at the incisura angularis, which hypothetically prevents a kink and functional stenosis at this point. The importance of these two stitches was also mentioned in some studies.<sup>42,44</sup>



In our study, there was no significant impact of adding gastropexy after LSG on the development of de novo GERD symptoms compared to LSG alone. Flølo et. al<sup>26</sup> found similar outcomes, indicating that adding gastropexy to LSG did not have any impact on preventing the use of anti-reflux medication, the need for additional surgeries due to GERD symptoms not being adequately controlled by medication, or the self-reported occurrence of epigastric pain or heartburn over a 7-year follow-up period. Afaneh et. al<sup>25</sup> conducted a small randomized trial comprising 60 patients from the United States. Both the patients and the interviewer were kept uninformed of the surgical procedure until the 1-year follow-up period. The investigators found no statistically significant variations in the GERD impact scale throughout the follow-up period.

Conversely, Sala et. al<sup>42</sup> found a notably greater number of patients who experienced new-onset reflux symptoms six months after undergoing LSG, as opposed to patients who underwent LSG with gastropexy. The evaluation of post-operative reflux was based only on symptoms and prolonged use of proton pump inhibitor medicines. Abou-Ashour HS<sup>14</sup> concluded in his study that patients who underwent gastropexy during laparoscopic sleeve gastrectomy (LSG) experienced a more favorable postoperative recovery. In addition, they demonstrated a substantial decrease in the need for antiemetic medications and a much-decreased occurrence of postoperative nausea, vomiting, symptoms of GERD, and stomach torsion compared to individuals who did not receive gastropexy.

There are obvious variations in the outcomes between different studies addressing GERD after LSG and gastropexy. This may be attributed to several factors. The surgical technique may represent an explanation for the varied and contradictory results among the different studies. Alternative methods of gastropexy were described. One may assume that the type and length of fixation play a role in the outcome. Also, the ways of assessing GERD using variable terms were observed as follows: some studies used patient symptoms or anti-reflux medication use; others used standardized patient-reported outcome measures. Furthermore, there was no uniform timepoint for assessment. One study<sup>25</sup> had a small sample size, which may affect the validity of the results, as implementing the study on a larger sample size may result in different outcomes.

We could not find any extra risk for those who performed LSG alone compared to those who had LSG combined with HH repair and/or GP. Nevertheless, there was significantly longer surgery for those who underwent HH repair, which could be justified on the basis of better postoperative GERD outcomes.

Lewis et al<sup>34</sup> stated that concurrent sleeve gastrectomy and HH repair were associated with an increased risk of some subsequent operative and nonoperative interventions. However, Hefler et al<sup>38</sup> found that the occurrence of significant problems for bariatric surgery with simultaneous HH repair is comparable to that of bariatric surgery alone. According to Janik et al,<sup>39</sup> sleeve gastrectomy with hiatal hernia correction is relatively safe in the short term and does not pose an increased risk of mortality. Nevertheless, this supplementary technique marginally elevates the likelihood of readmission and postoperative intervention, as well as morbidity. The duration of our study's follow-up period was at least one year (mean 19.3±4.1 months), which could be classified as short-term follow-up. An expanded period of observation may be necessary to assess the long-term effects of accidental HH repair. Sala et al<sup>42</sup> reported that adding GP to the LSG did not increase the risk of complications or postoperative morbidity.

## Limitations

Being a single-center study with short-term follow-up may be the limitations of this study.

## Conclusions

After one year, concurrent hiatal hernia repair and LSG seem to be safe and beneficial in lowering postoperative de novo GERD symptoms. The inclusion of gastropexy with LSG had no significant impact on postoperative de novo GERD. Both HH repair and gastropexy lengthened the operation but did not increase its complications.

## Ethical Approval

The study protocol has been approved by the Research Ethics Committee at King Khalid University (HAPO-06-B-001) with the number ECM#2023-2603. Given that this is a retrospective study, informed consent was not required. The study adhered to the ethical guidelines outlined in the Declaration of Helsinki. Furthermore, various approaches were employed

to disguise the identities of the patients. No personal information, such as names, addresses, or any other identifying details, was documented.

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## Disclosure

All authors declare no conflicts of interest in this work.

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