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Impact of concurrent hiatal hernia repair during laparoscopic sleeve gastrectomy on patient-reported gastroesophageal reflux symptoms: a state-wide analysis

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Original article

Impact of concurrent hiatal hernia repair during laparoscopic sleeve gastrectomy on patient-reported gastroesophageal reflux symptoms: a state-wide analysis

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Abstract

Background: Concurrent hiatal hernia repair (HHR) during laparoscopic sleeve gastrectomy (LSG) may improve gastroesophageal reflux disease (GERD) symptoms. However, patient-reported outcomes are limited, and the influence of surgeon technique remains unclear.

Objectives: To assess patient-reported GERD severity before and after LSG with and without concomitant HHR.

Setting: Teaching and non-teaching hospitals participating in a state-wide quality improvement collaborative.

Methods: Using a state-wide bariatric-specific data registry, all patients who underwent a primary LSG between 2015 and 2019 who completed a baseline and 1 year validated GERD health related quality of life (GERD-HRQL) survey were identified (n = 11,742). GERD severity at 1 year as well as 30-day risk-adjusted adverse events was compared between patients who underwent LSG with or without HHR. Results were also stratified by anterior versus posterior HHR.

Results: A total of 4015 patients underwent a LSG-HHR (34%). Compared to patients who underwent LSG without HHR, LSG-HHR patients were older (47.8 yr versus 44.6 yr; $P < .0001$), had a lower preoperative body mass index (BMI) (45.8 kg/m^2 versus 48 kg/m^2; $P < .0001$) and more likely to be female (85.2% versus 77.6%, $P < .0001$). Patients who underwent a posterior HHR (n = 3205) experienced higher rates of symptom improvement (69.5% versus 64.0%, $P = .0014$) and lower rates of new onset symptoms at 1 year (28.2% versus 30.2%, $P = .0500$). Patients who underwent an anterior HHR (n = 496) experienced higher rates of hemorrhage and readmissions with no significant difference in symptom improvement.

Conclusions: Concurrent posterior hiatal HHR at the time of sleeve gastrectomy can improve reflux symptoms. Patients undergoing anterior repair derive no benefit and should be avoided. (Surg Obes Relat Dis 2022; ■:1–7.)

Keywords: Laparoscopic sleeve gastrectomy; Gastroesophageal reflux disease; Hiatal hernia repair

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Obesity remains a global epidemic and current trends predict that the prevalence of obesity in the United States is projected to increase to nearly 50% of adults by 2030 [1]. Bariatric surgery has been shown to be the most effective and durable intervention for obesity and its comorbid conditions [1]. Laparoscopic sleeve gastrectomy (LSG) has become the most common procedure performed to date accounting for approximately 45%–80% of all bariatric procedures with data showing significant weight loss [2,3]. While very effective for weight loss, there remain concerns about potential complications related to the procedure, particularly gastroesophageal reflux disease (GERD). Initial randomized controlled trials and subsequent observational studies have demonstrated that up to 30% of patients developed de novo reflux or worsening GERD symptoms after LSG [4,5].

While some patients may be able to manage their symptoms with medications, for others the symptoms will be quite severe requiring additional interventions or surgical revision. Additionally, there have been studies showing development of serious GERD-related complications after LSG including esophagitis, Barrett's esophagus, and in rare cases progression to esophageal cancer [3–6]. Obesity increases the likelihood for the presence of a hiatal hernia as well as GERD symptoms [5–7]. While hiatal hernia repair (HHR) in the absence of GERD symptoms is not commonly advocated for in the general population, performing a HHR at the time of LSG has been advocated as a means of improving or preventing GERD after surgery even among asymptomatic patients [7–9]. Due to limited data on HHR closures, it is important to specifically examine posterior versus anterior HHR repair as they have differing outcomes and surgeon preferences. To date, data are limited to single center studies with small sample sizes and fails to focus on patient symptoms or technical approaches to HHR.

Within this context, the goal of this study was to assess if concurrent HHR during LSG improved patient-reported GERD symptoms by comparing a matched cohort of patients who did not undergo concurrent HHR. To accomplish this, we performed a retrospective cohort study of patients who underwent a LSG between 2015–2019. In addition, our previous work looked at differences in HHR approaches (anterior versus posterior) [10,11] and through this study we sought to understand if differing approaches impacted patient reported GERD outcomes.

Methods

Patient data were collected through the Michigan Bariatric Surgery Collaborative (MBSC), a payor funded collaborative bariatric data registry, which has been described previously [12]. Centrally trained data-abstractors perform chart reviews to obtain preoperative patient level demographics, preoperative co-morbidities, procedural details, and 30-day postoperative events. In addition, patient specific data are obtained using baseline and annual surveys. The MBSC data followed patients longitudinally, and data and results provided included baseline (prior to their procedure) and follow up after 1 year. Data were not collected immediately after the patient's operation. Seventy surgeons from 38 bariatric surgery programs submitted data to a clinical registry which provide information ranging from patient demographics to outcomes of interest.

Data collected

Baseline characteristics were collected from the medical record and included age, sex, race, weight, body mass index (BMI), insurance coverage (Private insurance, Medicare, Medicaid, and no insurance), and co-morbidities (hypertension, hyperlipidemia, diabetes, insulin dependent diabetes, non-insulin dependent diabetes, psychological disorders, GERD, and sleep apnea). Postoperative outcomes included 30-day complication rates, which included (postoperative leaks, hemorrhage, emergency room visits, readmission rates, requirement of endoscopy, stricture/dilation, and conversion to bypass). Weight loss outcomes at 1 year were captured from annual patient surveys and are reported in total body weight loss (TBWL)%.

GERD severity scores were obtained by using the GERD Health Related Quality of Life (GERD-HRQL) questionnaire, which was completed at baseline and at 1 year after surgery among all patients in the study cohort. The GERD-HRQL is a validated instrument that provides a quantitative method of measuring symptom severity of GERD [12]. The survey consists of 10 scaled questions (each scored from 0–5); 0 indicating "No symptoms" and 5 indicating "Inability to do daily activities." [12] For our study, Question #1 (Q1): "How bad is your heartburn?" was used to record patient-reported GERD severity at baseline and 1 year postoperatively. The data from this question was used, rather than all 10 questions from the GERD-HRQL because Q1 is focused on heartburn specifically, rather than other symptoms such as pain which are heavily dependent on the operation performed. In addition, each patient is asked Q1 in the clinical space before and after surgery [11,12]. In addition, the patient survey included questions about discontinuation of antacid medications, need for upper endoscopy with dilation, as well as conversion to gastric bypass in the first year after LSG [13–17].

Data on operative details were obtained from chart review and included which LSG cases were performed with and without HHR as well as operative time. Type of HHR was obtained from a survey completed in 2020 by surgeons participating in the MBSC. The options for concurrent management of HHR included "anterior suture repair," "posterior suture repair without mesh," "posterior suture repair with biologic mesh," "posterior suture repair with synthetic mesh," "any of the above with addition of fundoplication,"

and "no repair." For the purpose of this analysis, we simplified these approaches into 2 categories, anterior and posterior hiatal hernia repairs. The MBSC data set has 4015 patients with a HHR, using surgeon level data we identified 3205 patients as getting a posterior repair, 496 with anterior repair, and 314 patients for whom we did not have corresponding surgeon data to indicate anterior or posterior HHR.

Statistical analysis

Our primary outcome was to compare baseline versus 1-year GERD-HRQL scores and evaluate whether symptoms improved, worsened, or remained unchanged following LSG, LSG with posterior HHR, and LSG with anterior HHR. In addition, we analyzed whether there was new onset of GERD and whether patients discontinued GERD medication use.

Secondary outcomes included operative time as well as 30-day risk adjusted complication rates, hospital length of stay, and opioid use to determine if concurrent HHR increased the likelihood for adverse events or pain. In addition, we included rates of endoscopy, dilation, and conversion to gastric bypass within 1-year after surgery.

Patient characteristics were summarized using frequency distributions for binary/categorical variables and means for continuous variables. To determine whether there were any differences between patients who had concurrent hiatal hernia repairs and those who did not, significance testing was performed using Chi-square tests for categorical variables and independent samples *t* tests were used to compare the cohorts on continuous variables. We compared risk and reliability adjusted outcomes using multiple logistic and linear regression analyses; adjusting for baseline patient characteristics, co-morbidities, and surgical program where the operation took place.

Results

Our study cohort included 11,742 patients who underwent LSG between 2015–2019 and who also completed a baseline and 1-year GERD-HRQL. Among this cohort, we found that 4015 (34.2%) patients underwent LSG with concurrent HHR. Baseline patient characteristics, demographics, and preoperative co-morbidities are provided in Table 1. Patients undergoing LSG-HHR were more likely to be female, were older (47.8 years versus 44.6 years, $P < .0001$), and had a higher rate of GERD as a documented preoperative diagnosis (60.2% versus 47.7%, $P < .0001$) despite a lower BMI (45.8 kg/m^2 versus 48 kg/m^2, $P < .0001$) prior to surgery to

Table 1
Patient characteristics of our studied cohort

Patient characteristics	No HH repair		HH repair		Unadjusted
	n	%	n	%	*P* value
Total patients	7727		4015		
Female	5998	77.6	3421	85.2	<.0001
Male	1729	23.4	594	14.8	
Race-White	5815	77.0	3035	76.8	.7797
Race-Black	1052	13.9	594	15.0	.1164
Race-other	682	9.0	323	8.2	.1261
Hispanic ethnicity	423	5.5	183	4.6	.0347
Private insurance	6165	79.8	3130	78.0	.0215
Medicare	807	10.4	484	12.1	.009
Medicaid	444	5.8	180	4.5	.0037
Self-pay/no insurance	311	4	221	5.5	.0003
	n	Mean (SD)	n	Mean (SD)	*P* value
Age	7727	44.6 (11.5)	4015	47.8 (11.6)	<.0001
Baseline weight (lbs)	7727	298.4 (62.3)	4015	279.0 (53.5)	<.0001
Preoperative BMI (kg/m^2)	7727	48.0 (8.4)	4015	45.8 (7.2)	<.0001
% Total weight loss	7631	29.2 (10.0)	3964	29.1 (9.2)	.7341
1 yr BMI (kg/m^2)	7631	33.8 (7.1)	3964	32.3 (6.1)	<.0001
Co-morbidities	n	%	n	%	*P* value
Hypertension	3806	49.3	1943	48.4	.3812
Hyperlipidemia	3369	43.6	1817	45.3	.0884
Diabetes	2349	30.4	1095	27.3	.0004
Insulin dependent diabetes mellitus	610	26.0	214	19.5	<.0001
Non-insulin dependent diabetes mellitus	1739	74.0	881	80.5	
Psychological disorder	4375	56.6	2349	58.5	.0516
GERD	3682	47.7	2418	60.2	<.0001
Sleep apnea	3658	47.3	1831	45.6	.0760

HH repair = hiatal hernia repair; SD = standard deviation; BMI = body mass index; GERD = gastroesophageal reflux disease.

when compared to patients who underwent LSG without HHR.

Primary outcomes

GERD outcomes by technique are reported in Figure 1 and Table 2. Patients undergoing a posterior repair had a statistically significant higher rate of improved GERD scores (28.8% LSG without HHR versus 30.8% anterior - HHR versus 39.7% posterior - HHR, $P < .0001$), lower rate of worsening symptoms (24.6% versus 27.6% versus 20.5%, $P < .0001$) as well as the lowest rate of new onset GERD (16.8% versus 17.1% versus 12.3%, $P < .0001$) (Fig. 1). In addition, patients undergoing a posterior repair had a higher rate of preoperative proton-pump inhibitor (PPI) medication use (26.5% versus 27.8% versus 38.5%, $P < .0001$), but no significant change in PPI discontinuation at 1 year (63.2%, 65.9%, 62.9%; $P = .7781$) despite similar weight loss between groups. Changes in GERD score was greatest among patients undergoing posterior HHR both when symptoms improved (-1.65 versus −1.71 versus −1.83, $P < .0001$) and least when patients experienced symptoms that worsened (1.81 versus 1.80 versus 1.67, $P < .0001$). Finally, the percentage of TBWL was similar among all groups (29.3% versus 30.4% versus 29.1%, $P = .3521$).

Secondary outcomes

Operative time (48.9 min (LSG without HHR) versus 43.2 min (anterior HHR), $P < .0001$) and length of stay (1.75 days versus 1.64 days, $P = .0018$) were shorter among patients undergoing anterior HHR, when compared to no HHR. (Table 3) However, patients experienced higher rates of hemorrhage (0.8% versus 1.1%, $P = .0066$) and readmission (1.0% versus 2.2%, $P = .012$) with concurrent anterior HHR. Patients undergoing posterior HHR experienced longer operative times (69.9 min versus 79.2 min, $P < .0001$) and no difference in hospital LOS when compared to patients undergoing LSG alone (1.54 days versus 1.56 days, $P = .2401$) (Table 4). In addition, postoperative adverse events were similar between the 2 groups, with no significant additional risk when undergoing concurrent posterior HHR during LSG.

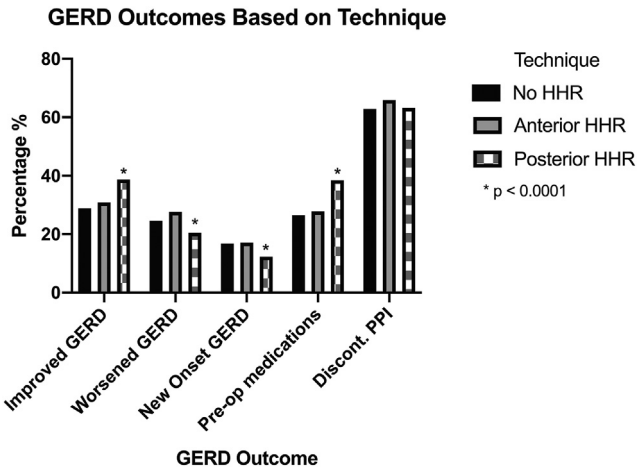

Fig. 1. Gastroesophageal reflux disease (GERD) outcomes based on laparoscopic sleeve gastrectomy (LSG) alone, LSG with anterior hiatal hernia repair, and LSG with posterior hiatal hernia repair. Worsened GERD is defined as a GERD Health Related Quality of Life (GERD-HRQL) score that is higher postoperatively (e.g., patients having worsening heartburn) compared to a lower score indicating improved or better heartburn symptoms. Y-axis represents percentage of patients who reported each outcome. X-axis represents the several GERD outcomes our study analyzed. GERD = gastroesophageal reflux disease; HHR = hiatal hernia repair; PPI = proton-pump inhibitor.

Discussion

This is the first and largest study to examine changes in GERD symptoms after LSG in patients undergoing concurrent HHR either by anterior or posterior repair by using a validated patient reported GERD-HRQL score and a state-wide bariatric specific data registry. Our results demonstrated that one third of patients undergoing LSG also underwent a concurrent HHR, and we found that GERD symptoms improved with concurrent HHR but only when a posterior HHR was performed. In addition, patients were less likely to develop new onset GERD after concurrent posterior HHR, when compared to no repair. Conversely, patients undergoing an anterior repair derived no benefit and had significantly higher rates of adverse events including hemorrhage and an increased risk of readmission. Patients who underwent LSG without HHR, compared to those who underwent LSG-HHR, had a greater improvement in GERD-HRQL Q1 scores and had greater total body percentage weight loss 1 year after their operation. Given these results, we believe that patients should be counseled about concurrent HHR during LSG and that a posterior HHR should be the only technique performed. Concurrent HHR at the time of sleeve gastrectomy can improve reflux symptoms, however technique matters.

Existing literature on GERD outcomes after LSG without HHR or with concomitant HHR supports our findings. A study that looked at 165 patients who underwent LSG versus LSG-HHR showed that baseline GERD symptoms were more prevalent in the LSG-HHR group while also showing that there was no significant difference in new onset of GERD symptoms between the 2 groups [17]. Our study however, found that there was an increased improvement in GERD symptoms in those who underwent LSG-HHR. HHR modifies normal physiology and anti-reflux mechanism, and by addressing and correcting HHR during LSG, this mechanism may be restored and account for the increased improvement in GERD symptoms. This difference in findings may be due to a more representative patient population size and use of a standardized measurement tool. Additionally, studies demonstrated that LSG has been reported to lead to remission of GERD symptoms in 53% of

Table 2
Gastroesophageal reflux disease (GERD) outcomes between laparoscopic sleeve gastrectomy (LSG) alone, LSG with anterior hiatal hernia repair (HHR), and LSG with posterior hiatal hernia repair

GERD outcomes	No HH repair	Anterior repair	Posterior repair	Adjusted *P* value
GERD improvement	28.8%	30.8%	39.7%	<.0001
GERD score at baseline, Mean (SD)	2.02 (0.97)	2.11 (0.97)	2.20 (1.03)	<.0001
GERD score at 1 yr, Mean (SD)	0.37 (.69)	0.40 (.67)	0.37 (.67)	.8266
Change in GERD score, Mean (SD)	−1.65 (.83)	−1.71 (.82)	−1.83 (.93)	<.0001
GERD worsened	24.6%	27.6%	20.5%	<.0001
GERD score at baseline, Mean (SD)	.50 (.84)	.61 (.90)	.63 (.90)	.0014
GERD score at 1 yr, Mean (SD)	2.30 (1.17)	2.40 (1.26)	2.30 (1.14)	.4446
Change in GERD score, Mean (SD)	1.81 (.98)	1.80 (.99)	1.67 (.91)	.0171
New onset gERD	16.8%	17.1%	12.3%	<.0001
GERD score at 1 yr	1.94 (1.05)	1.87 (1.03)	1.81 (.98)	.1068
Discontinuation of GERD medications				
On PPI medications prior to surgery	26.5%	27.8%	38.5%	<.0001
Discontinued PPI medications at 1 yr	62.9%	65.9%	63.2%	.7781
Weight loss at 1 yr	86.7% (36.0)	83.6% (30.3)	80.4% (30.8)	<.0001
Total body weight loss%	29.3% (9.6)	30.4% (8.6)	29.1% (8.8)	.3521
BMI at 1 yr (kg/m^2)	33.4 (6.9)	31.1 (5.9)	31.8 (5.8)	<.0001

HH repair = hiatal hernia repair; GERD = gastroesophageal reflux disease; SD = standard deviation; BMI = body mass index; PPI = proton-pump inhibitor.

patients at 5 years and that in the presence of HHR, LSG improved GERD symptoms or reduced the need for medication in one third of patients with pre-existing GERD [18,19].

Another study examined 58 patients from a single center who underwent LSG versus LSG-HHR and found that 15.6% of asymptomatic patients developed de novo GERD symptoms, similar to our findings of >10% of patients developing new onset of GERD [20]. It has been shown that LSG is now the most common bariatric operation worldwide and the effects of LSG technique on GERD outcomes matter. Previous studies have shown that 83% of surgeons believe that identification of hiatal hernias intraoperatively is appropriate and if found, should be dissected posteriorly [21]. However, there is poor consensus on what constitutes a hiatal hernia that requires repair [22]. Similarly, the technique of LSG is just as important. Felinska et al. showed that if appropriate attention was given to technical details then GERD could be successfully avoided in 64 out of 66 patients with LSG [23]. Other studies have shown that narrowing the mid portion of a sleeve at the angular notch was associated with higher rates of GERD following LSG, with lower rates of GERD symptoms when the sleeve is widest at the antrum [24]. These results redemonstrate the important of attention to technique when constructing the sleeve [23,24].

Unique to our study was the analysis of discontinued GERD medications after LSG, LSG-posterior HHR, and LSG-anterior HHR as no study has previously examined this relationship. Our study adds novel results to the existing literature on GERD outcomes after LSG versus LSG-HHR, by providing a population scaled analysis while other studies focused on single center, smaller populations of patients. Secondly, our study focused on further stratifying patients based on surgeon technique (i.e., anterior versus posterior HHR approaches). By stratifying patients, our results show that posterior HHR has several advantages over the anterior approach - mainly the lower incidence of secondary complications with the most concerning being hemorrhage and readmission to the hospital postoperatively in LSG- anterior HHR groups. In addition, several studies

Table 3
Laparoscopic sleeve gastrectomy (LSG) with anterior hiatal hernia repair (HHR)—operative analysis and adverse events

LSG + posterior HHR outcomes	No HHR repair (n = 423)	Anterior HHR (n = 496)	*P* value
	Mean (SD)	Mean (SD)	
Operating room time (mins.)	48.9 (18.9)	43.2 (15.2)	<.0001
Length of stay (d)	1.75 (.55)	1.64 (.58)	.0018
Complications			
Leak	0%	0%	-
Hemorrhage	.8%	1.1%	.0066
Emergency room visit	2.8%	1.9%	.4207
Readmission	1%	2.2%	.012
Endoscopy with dilation	.5%	0%	.1253
Conversion to Gastric bypass	0%	0%	-

HHR = hiatal hernia repair; SD = standard deviation.

Table 4
Laparoscopic sleeve gastrectomy (LSG) with posterior hiatal hernia repair (HHR)—operative analysis and adverse events

LSG+anterior HHR outcomes	No HHR repair (n = 6349)	Posterior HHR (n = 3205)	*P* value
	Mean (SD)	Mean (SD)	
Operating room time (mins.)	69.9 (26.3)	79.2 (32.4)	<.0001
Length of stay (d)	1.56 (1.1)	1.54 (.9)	.2401
Complications			
Leak	.2%	.3%	.9842
Hemorrhage	1%	.8%	.3784
Emergency department visit	7.4%	8.4%	.7102
Readmission	2.4%	2.7%	.3787
Endoscopy with dilation	0,02%	.03%	.446
Conversion to gastric bypass	.02%	.03%	.6166

HHR = hiatal hernia repair; SD = standard deviation.

were deficient in either using a validated survey to capture patient reported GERD outcomes or did not have adequate follow up of patients.

Our study has several limitations. First, our data only included approximately 40% of all patients (those who completed both a baseline and 1 year follow up) in the MBSC database. Patients who either witnessed improved or worsening symptoms may have been more motivated to complete the postoperative survey, introducing to our study selection bias. In addition, the MBSC data only included GERD-HRQL data after 1 year postoperatively. This is a limitation because some patients may have experienced improved or worsening symptoms after 1 year, which was not accounted for in this study and should be examined further. Thirdly, our MBSC data did not have a standardized PPI protocol per every site and therefore PPI discontinuation and practices were dependent on surgeon preference, and that no significant changes in PPI discontinuation after 1 year has to do with patient factors including BMI, comorbidities, postsurgical course, and clinician preference. Fourthly, our MBSC data does not allow for further stratification of defect sizes, appearance of crura, and use of mesh at a patient level. Additionally, analysis of surgical HHR technique was limited as case videos were not available to create common themes/analysis for surgeons in each group. Future studies would benefit from this collected data. Finally, the gold standard for diagnosis of GERD is through pH monitoring. Our study lacked objective data such as endoscopy, or pH studies that may further describe patient symptoms. By using the GERD-HRQL, our approach was to use a non-invasive measure to evaluate patient outcomes rather than use invasive resources. Using a validated survey and clinically relevant patient reported outcomes through the MSBC data registry can help inform surgeons and patients about the risk and benefits of LSG, and LSG without HHR (as well as understanding the different techniques). Our work also provides evidence that there is some benefit to LSG with concomitant HHR repair, where other studies have indicated that results are inconclusive.

Conclusion

Our study demonstrated that posterior HHR had the highest rates of improved GERD symptoms and lowest reported rate of new onset of GERD. Anterior repair had no clear major benefit but resulted in more complications including hemorrhage and higher rates of readmission. Given the differences between anterior and posterior repair, surgeons performing LSG and concomitant HHR should preferably use the posterior approach in the future.

Disclosures

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