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RESEARCH ARTICLE

Symptomatic GERD after Sleeve Gastrectomy

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Abstract

Background: Laparoscopic sleeve gastrectomy (LSG) remains an effective standalone bariatric surgery. Some patients might experience gastroesophageal reflux (GERD) symptoms post LSG despite its beneficial outcome on weight loss and improving obesity morbidities. This study aims to determine the prevalence of post-LSG GERD symptoms and associated risk factors.

Subjects and methods: This study comprises LSG patients who underwent surgery between 2015 to 2020. We applied the GERD- Health-Related Quality of Life (GERD-HRQL) questionnaire to compute the prevalence of GERD symptoms before and after surgery. The answer was rated from 0 to 5 based on GERD symptoms severity.

Results: A total of 160 patients (mean age: 33.8 ± 11.15 years: 63% of female) were included. The mean preoperative and postoperative weights were 133.5 ± 28.21 Kg (BMI 44.86 kg/m2) and 83.32 ± 21.23 Kg, respectively, with the average excess weight loss (EWL) of 69.5% after LSG. The Wilcoxon Signed Ranks test has shown increased GERD symptoms in previous GERD free or mildly symptomatic patients.

Conclusion: LSG was significantly associated with the new onset of GERD symptoms and worsened the mild preoperative symptoms.

Keywords

Bariatric surgery, Laparoscopic Sleeve Gastrectomy (LSG), Gastroesophageal Reflux Disease (GERD), Obesity, Comorbidities, Body Mass Index (BMI)

Introduction

Obesity has been regarded as a significant risk factor for developing gastroesophageal reflux disease (GERD), accounting for more than 50% of people showing mild or severe symptoms [1]. It has been reported that obesity and its related comorbidities reduce the quality of life and life expectancy [2]. Also, it was estimated that the life expectancy of obese patients over BMI 40-45 kg/m^2 has reduced by an average of 8-10 years [3]. Obesity was prevalent in Saudi Arabia, ranging from 28.7 to 42.0%, with a body mass index (BMI) of 30 kg/m^2 [2,4]. The proportion of obese females was higher than males (33.5 versus 24.1%), with a total estimation of 3.6 million Saudi people aged ≥ 15 years [2,5,6].

GERD is defined as abnormal gastric contents refluxing into the esophagus due to the failure of an anti-reflux barrier. The troublesome symptoms associated with GERD are heartburn, dysphagia, laryngitis, chronic

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cough, and regurgitation. Prolonged acid exposure within the esophagus leads to complications such as Barrett's esophagus and peptic esophageal stricture. The etiology of GERD among obese patients is due to an increase in intra-abdominal pressure combined with more frequent episodes of transient relaxation of the lower esophageal sphincter (LES) [7]. Multiple factors have been identified after LSG, which include reduced esophageal clearance, presence of residual hiatal defect with intrathoracic migration of the sleeve, tight sleeve, medio-gastric sub-stenosis, excessive antrum resection, cranioplasty failures, and a high-fat-containing diet [8].

Bariatric surgery (BS) has been considered a long-term solution for the management of obesity. However, all bariatric surgeries differ in outcomes, risks, and complications. Several surgical approaches are available today for promoting weight loss, like gastric bypass surgery, sleeve gastrectomy, and gastric banding. Laparoscopic sleeve gastrectomy (LSG) is a standalone procedure that is mainly a restrictive surgical approach initially established for highly obese patients with a BMI ≥ 60 kg/m^2 [9].

LSG reduces gastric capacity, leading to smaller meal sizes and earlier satiety, resulting in weight loss. LSG has gained popularity worldwide in managing obesity, especially in people with a BMI between 40-45 kg/m^2, due to its excellent resolution of comorbidities [5,10,11]. LSG also has beneficial effects such as reduced postoperative dumping syndrome, malabsorption, and marginal ulcers with an improved quality of life than malabsorptive procedures such as gastric bypass [12]. However, several studies reported that symptomatic GERD occurred in 7.8-20% of obese patients within 12-24 months after the LSG procedure [13-15]. Similarly, the incidence of symptomatic GERD after LSG was reported to be between 6.5 to 17.5% of patients at the second and third international consensus summits [16,17]. Enhanced reflux symptoms have been noticed in the first year after sleeve gastrectomy (SG), followed by a gradual reduction up to the third year [18]. Therefore, it is crucial to understand the relationship between the SG procedure and GERD.

LSG can increase the risk of postoperative development of "de novo" GERD and Barrett's esophagus despite its excellent outcome in weight loss [19,20]. Gagner, et al. [16] used a questionnaire-based survey and examined 14,776 sleeve gastrectomies. They reported that 6.5% of patients after LSG suffered from de novo GERD [16]. Similarly, the International Sleeve Expert 2011 analyzed the outcomes of 12,799 sleeve gastrectomy's and reported a higher postoperative rate of de novo GERD of 12.11 ± 8.97% [21]. This study aims to evaluate the incidence of de novo GERD in obese patients who underwent LSG and the impact of surgery on their pre-existing GERD symptoms.

Subjects and Methods

Subjects

From 2015 to 2020, 537 obese individuals who underwent LSG were included in this cohort research. A total of 377 patients were excluded from our analysis for the following reasons: previous stomach or esophageal surgery (including bariatric or non-bariatric surgical procedures), endoscopic sleeve gastroplasty, positive response to *Helicobacter pylori* detected by histopathology, and patients who were lost to follow-up or could not be contacted by phone. Before or during surgery, all patients identified with a hiatus hernia were also excluded from participation. Patients with obesity and GERD who had not responded to medical therapy were also excluded from the study. As a result, the research only included 160 patients who met eligibility requirements. Patients receiving LSG for morbid obesity of all sexes were included. The institutional review board had approved the research protocols. The options for LSG and Roux-en-y gastric bypass were discussed with those patients who have successfully managed their GERD with or without acid suppression drugs. The possibility of increasing GERD symptoms due to LSG surgery was thoroughly discussed with the patients.

Surgery

The procedure is carried out regularly. An intraoperative 36-Fr calibration tube has been used for all surgeries, which have all been performed laparoscopically. All patients followed our post-operative diet and exercise protocols, with an average hospital stay of 36 hours.

GERD questionnaire

This study focused on detecting "de novo" GERD symptoms after LSG. In order to identify acid reflux symptoms, patients were asked to complete a clinical questionnaire, either in person or over telephonic conversations. Each patient was evaluated for demographic and clinical variables, including age, sex, smoking history, socioeconomic position, and urea breath test results. Also, preoperative BMI and average excess weight loss percentage (EWL%), duration of hospital stay, comorbidities, and information on prior gastrointestinal procedures were all included in the gathered data set. The GERD questionnaire (GERDq) was used to evaluate the severity and frequency of GERD symptoms after LSG. The questionnaire was filled out before surgery and reapplied after 18 months post-surgery. As shown in Table 1, GERDq includes six questions that assess the effect of GERD symptoms on patients and their overall quality of life. The questionnaire was accessible in both English and Arabic. This questionnaire determines the frequency of heartburn, regurgitation, pain in the upper stomach, nausea, and difficulty in night sleep due to heartburn/regurgitation and suggests additional medications for

Table 1: Determination of GERD after LSG based on GERDq (English version).

Please answer the following questions by ticking the appropriate box in front of each question	How many times does this occur per week?			
	0 day	1 day	2-3 days	4-7 days
How often did you have a burning sensation behind your breastbone (heartburn)?				
How often did your stomach contents (liquid or food) move upward to your throat or mouth (regurgitation)?				
How often did you have pain in the center of the upper stomach?				
How often did you have nausea?				
How often did you have difficulty getting a good night's sleep due to your heartburn and/or regurgitation?				
How often did you take additional medication for your heartburn and/or regurgitation, other than what the physician told you to take (such as Tums, Rolaids, and Maalox)?				

Table 2: General characteristic of symptomatic GERD patient who underwent LSG.

Parameters	Classification	Frequency	Percentage	Mean ± SD
Age	11-20	16	10.0	33.8 ± 1.15
	21-30	52	32.5	
	31-40	54	33.8	
	41-50	23	14.4	
	> 50	15	9.4	
Gender	Female	102	63.8	NA
	Male	58	36.3	
Smoking status	No Smoking	154	96.3	NA
	Smoking	6	3.8	
Pre-BMI	<= 40	54	33.8	44.86 ± 7.58
	<= 45	40	25.0	
	<= 50	28	17.5	
	> 50	38	23.8	
Post-surgery complications	False	160	100.0	NA
Pre-existing GERD	False	141	88.1	NA
	True	19	11.9	

heartburn/ regurgitation. The GERD probability and its influence on quality of life were assessed by scoring the derived response. Probability quality is categorized into four groups from the total scores obtained from GERDq. When the GERDq score is between 0, 1-2, 3-7, and 8-10, the QoL is represented as 0, 50, 79, and 89%, respectively. This study also demonstrated the probability and impact of GERD on daily activities.

GERDq symptom scores

GERDq < 8: low probability for GERD, GERDq ≥ 8 and ≤ 3 on questions 5 and 6 (impact questions): GERD with low impact on daily life, GERDq8 and3 in questions 5 and 6 (impact questions): GERD with a high impact on daily life.

Statistics analysis

Statistical analysis was performed using Windows SPSS version 25 [22]. Data are expressed as means and standard deviations for continuous variables and numbers or percentages for categorical variables. Comparison among the variables was performed using the Chi-square test or Wilcoxon Signed-Ranks Test as an appropriate test for continuous variables and the Chi-square test for categorical variables. A p-value of < 0.05 was considered statistically significant to reject the null hypothesis.

Results

Basal characteristics of symptomatic GERD patients who underwent LSG

In the current study, 537 obese individuals who underwent LSG surgery over the last 5 years (2015-2020) were considered to study the associated postoperative risk factor and symptoms of GERD. Just 160 patients satisfied our study inclusion criteria, and their characteristic features are summarized in Table 2. The average age of the participants was 33.8 ± 11.15 years. In patients with LSG, GERD symptoms were

Table 3: Estimation of the likelihood of pre-and post-existing GERD symptoms in LSG.

Parameters	Category	How many times does this occur per week? (% GER likelihood)				Total	Chi-square	df	p-value
		0	50	79	89				
Pre-existing GERD symptoms on LSG	No pre-existing GERD	141	0	0	0	141	0.161	2	0.0016
	Pre-existing GERD	0	0	19	0	19			
	Total	141	0	19	0	160			
Post-existing GERD symptoms on LSG	No post-existing GERD	0	100	26	15	141	2.655	2	0.265
	post-existing GERD	0	10	6	3	19			
	Total	0	110	32	18	160			

Table 4: Determination of the association between pre-and post-existing GERD with LSG.

Pre- and post-existing GERD with LSG		N	Mean Rank	Z	Sig.
Pre-post	Negative Ranks	144[a]	78.92	-10.259[b]	0.0001
	Positive ranks	10[b]	57.00		
	Ties	6[c]			
	Total	160			

Note: [a](pre) < post; [b](pre) > post; [c](pre) = post.

Table 5: Effect of patient age, sex, and smoking history on GERD symptoms.

Parameters	Category	How many times does this occur per week? (% GER likelihood)				Total	Chi-square	df	p-value
		0	50	79	89				
Age	11-20	0	11	3	2	16	3.911	4	0.418
	21-30	0	39	6	7	52			
	31-40	0	37	11	6	54			
	41-50	0	14	7	2	23			
	> 50	0	9	5	1	15			
	Total	0	110	32	18	160			
Gender	F	0	67	22	13	102	1.289	2	0.525
	M	0	43	10	5	58			
	Total	0	110	32	18	160			
Smoking status	Non-smoking	0	105	31	18	154	0.929	2	0.629
	Smoking	0	5	1	0	6			
	Total	0	110	32	18	160			

more prevalent in 21-30 years and 31-40 years and less prevalent in the younger population (11-20 years) and the elderly population over 50. Comparatively, female patients were 2 times higher than men. Among the selected individuals, 96.3% did not have the habit of smoking. The pre-body mass index of less than or equal to 40 was documented in 33.8% of the patients, and around 23.8% had more than 50 BMI. The mean preoperative and postoperative weights were 133.5 ± 28.21 Kg (BMI 44.86 kg/m^2) and 83.32 ± 21.23 Kg, respectively, as depicted in Table 1, with EWL of 69.5% after LSG.

Association of pre-and post-existing GERD with LSG

It was perceived that more than (88.1%) of our patients reported no pre-existing GERD symptoms, while the rest reported actual GERD symptoms (Table 2). The individual with preexisting GERD had a percentage likelihood of only 79 per week. The chance of developing the condition in patients with no pre-existing GERD symptoms has increased to 50% or more after the procedure, as stated in Table 3. Patients who had no prior history of GERD were dramatically affected by LSG. More than 70.9% of patients without preexisting GERD

showed 50 times GER per week after LSG. The Wilcoxon Signed-Ranks test assessed the correlation between GERD symptoms before and after LSG. A significant correlation was noticed among patients who developed GERD symptoms after LSG (p = 0.0001) (Table 4). Table 5 shows the age, gender, and smoking on developing GERD symptoms. Post LSG, GERD occurred in all age groups without discrimination of sex. However, the frequency of symptom appearance varied between different age groups and sex. Age and sex were perceived to have no significant influence on the development of GERD symptoms (p-value of 0.418 and 0.525, respectively). Similarly, the GERD symptom was observed in all patients, irrespective of their smoking habit. There was no correlation between smoking and the development of symptoms of GERD in our patients.

Discussion

In the present era, global morbid obesity rates are rising, including in Saudi Arabia [2,4]. Therefore, a simple surgical procedure with minimal technical complications is essential to achieve weight reduction with an acceptable, fast, and long-lasting influence on one's health [5,23].

Over recent years, laparoscopic sleeve gastrectomy (LSG) has become increasingly popular as an obesity therapy because of a significant reduction in the mortality and morbidity rates of the obese population [24-27]. LSG effectively controls obesity-related comorbid diseases, such as hypertension, obstructive sleep apnea, and diabetes mellitus, and maintains long-term weight loss successfully [2,28]. The LSG procedure has been shown to have more advantages than gastric bypass, where the latter causes diarrhea, dumping syndrome, and malabsorptive surgery [29,30]. Unlike vertical gastroplasty or laparoscopic adjustable gastric band, the LSG technique does not entail the introduction of a foreign body. However, there has always been some concern that LSG could cause or exacerbate the symptoms of GERD [31]. There has been a dearth of satisfactory research into the long-term effects of LSG on GERD.

Obesity induces symptoms of GERD reflux by reducing esophageal sphincter pressure (LES), esophageal motility disorders, increased intragastric pressure, gastroesophageal pressure gradient, and increased anatomical abnormalities such as hiatal hernia [32,33]. GERDq is an accurate, validated, and easy diagnostic tool for GERD with the advantages of being patient-centered, highly predictive, and has been shown to reduce health care costs without losing efficacy [34,35]. Our study demonstrated that pre-operative and post-operative weight was 133.5 ± 28.21 and 83.32 ± 21.23 Kg, respectively, and EWL of 69.5% in patients of an average age of 33.8 ± 1.15 years. In the first year after sleeve gastrectomy, the average EWL was 60 to 70% [17]. Studies by D'Hondt, et al. [36], Gadiot, et al. [37] and Sieber, et al. [38], each with a 5-year follow-up found a 37.2-59.0% excess decline in BMI. The weight reduction achieved after LSG was observed from the first to the second year; however, after the second year of treatment, weight gain was noticed [36-38].

Controversy persists about the effects of LSG on GERD. Based on the recent BOLD database retrospective investigation, 44.5% of the 4832 patients reported developing GERD after LSG. Preexisting GERD symptoms persisted in most patients with LSG (84.1%), and only 15.9% had remission after LSG procedures. However, 8.6% of patients reported fresh GERD symptoms after LSG [39]. To support these findings, Stenard, et al. [40] examined 13 studies among 5953 individuals, which showed a negative impact of LSG on GERD symptoms. However, in the same review, when 12 trials were analyzed in 1863 patients, LSG had a favorable influence on GERD symptoms [40]. GERD and SLE have been shown to be associated by Oor, et al. [41] in a comprehensive review and meta-analysis of 33 studies. This meta-analysis concluded that the precise impact of LSG on the prevalence of GERD remains unresolved because of substantial heterogeneity across studies and paradoxical results of objective esophageal function testing. Several experts urged physicians to pay close attention to the signs of pre-operative GERD while selecting the best bariatric surgery procedure [41].

In our research, GERD symptoms are not affected by characteristics such as the patient's age, gender, smoking history, and obesity, as opposed to the results of Albanopoulo, et al. [23]. On the contrary, Coupaye, et al. [42] demonstrated that smokers were more likely to develop GERD. Our study demonstrated a strong correlation between GERD with LSGs. Similarly, several studies evaluated an increase in GERD prevalence ranging from 2.1 to 34.9% [43-48]. Arias, et al. [43] A single-center retrospective study reported 2.1% GERD after LSG with 26 months of follow-up. On a similar line, Braghetto, et al. [46] found a prevalence of 27.5% after LSG from a single institutional investigation.

In a single-center retrospective analysis, several reports looked for a correlation between LSG and symptoms of GERD [31,45]. After an average follow-up of 32 weeks, Howard, et al. [45] found a 14% increase in GERD symptoms after LSG. Also, there was a significant weight reduction in 176 individuals studied by Carter, et al. [31]. In the same study, the authors classified GERD symptoms into two groups: Early and late (i.e., symptoms observed before and after 30 days). The prevalence of GERD in the early and late post-LSG period was 14.4% and 12.6% [44]. A single-center retrospective investigation found a triphasic response of GERD to LSG. An increase in GERD after LSG was followed by a decline in the third year and an increase in the sixth year of treatment [44].

Tai, et al. [48] have examined symptoms of GERD after LSG for obese patients with an average pre-operative BMI of 36.3 kg/m^2 and reported an increased risk of developing symptoms by 34.9%, the highest increase in the prevalence of GERD recorded. The angle of His has been suggested as a possible cause of the increased occurrence of GERD symptoms after LSG [49]. However, it was found to increase gastric pressure and reduce gastric compliance, dilation of the neo-fundus lead to mild stomach stenosis, gastric stasis, increased gastric acid production, hypotension of LES, hiatal hernia, decreased plasma ghrelin levels, delayed gastric emptying, intestinal hypomotility, and dysmotility [47,50,51].

According to certain studies, the prevalence of GERD decreased from 2.8 to 20% due to LSG [52-54]. Few reports of single prospective research suggested a decline in GERD symptoms by 5 and 20% [55,56]. Retrospective studies by Rawlins, et al. [57] and Chopra, et al. [58] LSG reduced the prevalence of GERD by 4.1 and 0.5%, respectively. The reduced incidence of GERD can be attributed to increased gastric emptying, reduced abdominal fat, restoration of His angle, reduced wall tension, and decreased acid production after LSG treatment [59,60]. Our study found a significant association of LSG with new-onset or worsening GERD symptoms.

Conclusion

GERD with heart burning and regurgitation is common in patients with LSG. There are multifactorial variables, including post and pre-operative conditions, that could influence new-onset or even deteriorate the prevalent condition. Currently, the impact of LSG on GERD is still up for debate. Although several studies that examined LSG-induced GERD differed, there was still considerable variation in the findings. The study showed a new onset of GERD in patients without pre-existing GERD. The score obtained showed the appearance of GERD after LGS irrespective of age group, gender, and smoking status. The study confirmed that none of the variables could predict the onset or worsen the condition. GERD-HRQL questionnaire employed in the study reduced the burden on administrative people and gave a high-level precision score for the effect of a studied variable on GERD symptoms and suggested a strong correlation between LSG and GERD symptoms.

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Declarations

Conflict of interests

The authors declare no conflict of interest.

Ethics approval

Ethical approval was obtained from our local IRB committee.

Consent for publication

The authors claim no consent for publication.

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