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Effect of Gastric Sleeve Surgery on Esophagitis in Obese Patients: A Pre-post Surgery Study

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ABSTRACT

Background: We aimed to perform a pre-post-test study to determine the prevalence of esophagitis assessed by anatomopathology study in obese patients undergoing laparoscopic sleeve gastrectomy (LSG).

Methods: Retrospective quasi-experimental study design without a control group (one-group pre-post-test) conducted in a private Peruvian clinic. We included obese patients who (i) underwent LSG from January 2013 to December 2016 and (ii) underwent anatomopathological assessment of the esophagus before and one year after LSG. The McNemar's test was used to perform the paired analysis.

Results: We selected 239 patients who met the inclusion criteria. Preoperatively, the proportion of esophagitis slightly differed between the Los Angeles classification (73.22%) and anatomopathological assessment (69.87%). Morbid obesity ($p<0.001$) and metabolic syndrome ($p<0.001$) were more frequent in men. While the prevalence of anatomopathologically-confirmed esophagitis significantly decreased from the preoperative to the postoperative period ($p=0.017$), the prevalence according to the Los Angeles classification did not significantly decrease ($p=0.664$). The prevalence of anatomopathologically-confirmed esophagitis significantly decreased in men ($p=0.047$) but not in women following LSG ($p=0.211$).

Conclusions: We reviewed the effects of LSG on anatomopathological esophagitis in obese patients. Our results suggest that LSG could reduce the prevalence of this complication; moreover, gender may have a role in the association. Literature is mixed, and surgeons must take a shared decision with the patient based on effectiveness, adverse events and cost-effectiveness.

Keywords: obesity, sleeve gastrectomy, digestive system surgical procedures, esophagitis, esophageal diseases

INTRODUCTION

Obesity is a pandemic that is associated with several diseases and mortality [1]. A systematic review of 230 cohort studies reported that overweight and obesity increases the risk of all-cause mortality [2]. Other reviews have described that obesity is associated with diabetes, coronary disease, hepatocellular cancer-related mortality, and lung cancer, among others [3-5]. Several public health strategies have been carried out to reduce the burden of obesity, with surgical procedures being relevant alternatives to achieve weight loss. The main procedures are sleeve gastrectomy (SG), adjustable gastric band (AGB), Roux-en-Y gastric bypass (RYGB), and biliopancreatic diversion with a duodenal switch [6], all having specific effectiveness and safety. A systematic review of these procedures reported that RYGB and SG could be more effective than AGB in achieving weight loss and superior than duodenal switch because of the complications related with malnutrition [7]; however, the decision as to the most appropriate procedure for each patient must be with the patient, and taking into account the comorbidities, cost-effectiveness, adverse events, among others. For instance, LRYGB is associated with postoperative anemia and marginal ulcer, but its effectiveness in increasing diabetes remission compared to SG [8].

Regarding adverse events, the literature varies greatly. Several studies have reported incident events of esophagitis or gastroesophageal reflux disease (GERD) mainly after SG [9]. This may be explained by the decreased lower esophageal sphincter pressure which occurs after SG but not following other procedures [10]. Moreover, esophagitis has been considered as a relative contraindication to SG since 2015 [11]. In spite of this evidence, there is previous literature that supports contradictory results as decreased prevalence of GERD symptoms after SG [12-14]. Hence, we aimed to perform a pre-posttest study to determine the prevalence of esophagitis assessed by anatomopathology study in obese patients undergoing laparoscopic SG (LSG).

MATERIAL AND METHODS

Study Design and Data Sources

This was a retrospective quasi-experimental study design without a control group (one-group pretest-posttest). It was conducted in the "*Clinica Avendaño*", which is a private clinic specialized in bariatric surgery located in Lima (Peru).

We selected obese patients (body mass index, BMI ≥30 kg/m^2) who (i) underwent LSG from January 2013 to December 2016 and (ii) underwent anatomopathological study of the esophagus before and one year after LSG. We excluded patients diagnosed with Barrett's esophagus and esophageal carcinoma prior to LSG in order to extend our external validity.

We calculated the sample size for paired data to detect differences between the prevalence of esophagitis (*Epidat 4.1*) considering a 99% confidence interval (CI), statistical power of 0.99, and prevalence of esophagitis before and after LSG of 14.3% and 44.4%, respectively [15]. The calculated sample size was 111 patients; however, we included all the patients who met the study criteria.

Study Variables

The following variables were assessed: gender (female or male), morbid obesity (BMI ≥40 kg/m^2), metabolic syndrome (Adult Treatment Panel [ATP] III criteria [16]), presence of hiatal hernia (HH), Los Angeles visual classification (no esophagitis, grade A, grade B, and grade C) according to international guidelines, symptoms of esophagitis (dysphagia, odynophagia, chest pain, reflux, or pyrosis) and anatomopathological esophagitis (yes or no). The Los Angeles visual classification and anatomopathologically-confirmed esophagitis were assessed in the preoperative period and at 1-year after LSG. In fact, the all pathological assessments from all the cases were reviewed by just one experimented pathologist at the health center, this results were described and corroborated by two surgeons whose expertise area is bariatric surgery in order to avoid misdiagnosis and the correct classification of the patients. Moreover, all the endoscopies were performed by a trained surgeon in this field.

Data Analysis

The variables are described using absolute frequencies and proportions (%). We used the Chi-square test to assess the statistical significance of the differences between independent variables regarding the dependent variable in the non-paired analysis. We considered a p-value >0.05 as statistically significant.

The McNemar's test was used to perform the paired analysis [17]. The aim of the McNemar's test is to compare frequencies of nominal variables of matched pairs of individuals. We used the Stata v.14.0 (Stata Corporation, College Station, Texas, USA) to analyze the database.

Ethical Considerations

The protocol was approved by the institutional review boards at "*Clinica Avendaño" in* Lima, Peru. We did not include information that could reveal patients' identities; they were identified using codes. Patient data were codified in order to ensure patient confidentiality. The database was only available for the authors and the institutional review board of the *"Clinica Avendaño*".

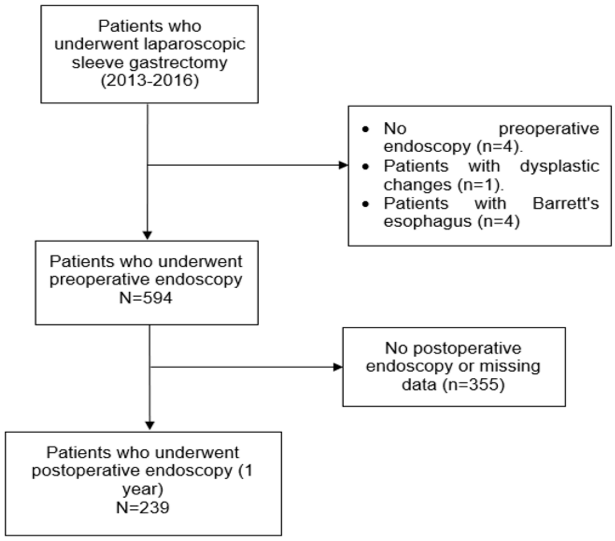

Figure 1. Selection criteria

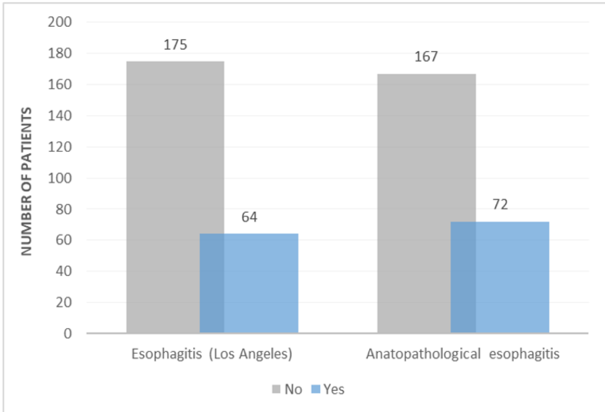

Figure 2. Preoperative esophagitis on anatomopathological assessment & Los Angeles classification

RESULTS

From 603 patients who underwent to LSG during the period 2013-2016, we included 239 patients who had preoperative and postoperative endoscopies, and did not present missing data (**Figure 1**).

Preoperative Characteristics

The proportion of females (64.4%) undergoing bariatric surgery was higher than that of males (35.56%). Morbid obesity and metabolic syndrome were present in 32.2%% and 36.13% of the patients, respectively. The diagnosis of esophagitis slightly differed between the Los Angeles classification (73.22%) and the anatomopathological study (69.87%). None of the patients died during the follow-up period (**Figure 2** and **Table 1**).

Male gender (p=0.001) and HH (p=0.032) were more frequent in patients with preoperative anatomopathologically-confirmed esophagitis (**Table 1**). Moreover, men more frequently presented morbid obesity (p<0.001), metabolic syndrome (p<0.001) and esophagitis (anatomopathological assessment and Los Angeles classification), while symptoms of esophagitis were more frequent in women (p=0.05) (**Table 2**).

Table 1. Preoperative characteristics regarding preoperative esophagitis established by anatomopathological study (n=239)

Preoperative characteristics	Preoperative anatomopathologically-confirmed esophagitis		Total (%)	p-value
	No (%) N=167	Yes (%) N=72	No (%) N=239	
Gender				**0.001**
Female	119 (71.26%)	35 (48.61%)	154 (64.4%)	
Male	48 (28.74%)	37 (51.39%)	85 (35.56%)	
Morbid obesity (BMI)				0.586
No	115 (68.86%)	47 (65.28%)	162 (67.78%)	
Yes	52 (31.14%)	25 (34.72%)	77 (32.22%)	
Metabolic syndrome				0.200
No	111 (66.47%)	41 (57.75%)	152 (63.87%)	
Yes	56 (33.53%)	30 (42.25%)	86 (36.13%)	
Hiatal hernia				**0.032**
No	145 (87.88%)	53 (76.81%)	198 (84.62%)	
Yes	20 (12.12%)	16 (23.19%)	36 (15.38%)	
Los Angeles classification				**<0.001**
No	160 (95.81%)	15 (20.83%)	175 (73.22%)	
Yes	7 (4.19%)	57 (79.17%)	64 (26.78%)	
Esophagitis symptoms				0.278
No	106 (67.52%)	53 (74.65%)	159 (69.74%)	
Yes	51 (32.48%)	18 (25.35%)	69 (30.26%)	

Note. BMI: Body mass index

Table 2. Preoperative characteristics of the patients according to gender (n=239)

Preoperative characteristics	Women (%)	Men (%)	p-value
Age in years, mean (SD)	37.87 (11.82)	37.79 (10.53)	0.958[a]
Morbid obesity (BMI)			**<0.001[b]**
No	118 (76.62%)	44 (51.76%)	
Yes	36 (23.38%)	41 (48.24%)	
Metabolic syndrome			**<0.001[b]**
No	114 (74.03%)	38 (45.24%)	
Yes	40 (25.97%)	46 (54.76%)	
Hiatal hernia			0.199[b]
No	132 (86.84%)	66 (80.49%)	
Yes	20 (13.16%)	16 (19.51%)	
Anatomopathologically-confirmed esophagitis			**0.039[b]**
No	128 (83.12%)	61 (71.76%)	
Yes	26 (16.88%)	24 (28.24%)	
Los Angeles classification			**0.002[b]**
No	123 (79.87%)	52 (61.18%)	
Yes	31 (20.13%)	33 (38.82%)	
Esophagitis symptoms			0.050[b]
No	96 (65.31%)	63 (77.78%)	
Yes	51 (64.69%)	18 (22.22%)	

Note. SD: Standard deviation; BMI: Body mass index; [a]Calculated using t-test; [b]Calculated using Chi-square

Table 3. Change in the prevalence of esophagitis between the preoperative and postoperative periods (n=239)

Variables	Preoperative, n	Postoperative, n	p-value
Anatomopathological esophagitis			
No	167	189	**0.017[a]**
Yes	72	50	
Esophagitis (Los Angeles classification)			
No	175	177	0.664[a]
Yes	64	62	

Note. [a]Calculated using the McNemar test

Prevalence of Esophagitis: Overall and Gender Disparities

While proportion of anatomopathological esophagitis significantly decreased from the preoperative period to the postoperative period (p=0.017), the proportion considering the Los Angeles classification did not significantly decrease (p=0.664) (**Table 3**).

We found gender disparities in the paired analysis. The prevalence of esophagitis based on the anatomopathological study significantly decreased in men (p=0.047) but not in women (p=0.211) after 1 year of the surgery. According to the Los Angeles classification the prevalence of esophagitis did not significant vary in either group (**Table 4**).

DISCUSSION

Main Findings

The key message of this paper is that the LSG could reduce esophagitis prevalence among obese patients and the gender had a significant role since male population was significantly related to the prevalence of this disease.

Table 4. Change in the prevalence of esophagitis between preoperative and postoperative periods in relation to gender (n=239)

Variables	Men			Women		
	Pre-operative, n	Post-operative, n	p-value	Pre-operative, n	Post-operative, n	p-value
Anatomopathologically-confirmed esophagitis						
No	48	61	**0.047[a]**	119	128	0.211[a]
Yes	37	24		35	26	
Esophagitis (Los Angeles classification)						
No	52	56	0.644[a]	123	121	0.868[a]
Yes	33	29		31	33	

Note. [a]Calculated using the McNemar test

Comparison with Other Studies

We found that the prevalence of esophagitis significantly decreased after LSG. However, the literature provides discrepant results. It was shown that GERD symptoms decreased from 45% to 6% (point percentage difference, PPD: -39) in obese patients undergoing LSG [12]. Other studies have reported similar PPDs in this respect (-62 to -60) [13,14,18]. On the contrary, a meta-analysis reported that the estimated prevalence of esophagitis after LSG was high (28%) [9]. However, this result did not reveal the change in prevalence before and after LSG, and moreover, the statistical heterogeneity was high. As each patient has his/her own risk or protective factors of worsening esophagitis, an interesting way to see change of prevalence is to compare progression with remission of esophagitis as the SM-BOSS trial did. The results showed that worsened and *de novo* development of GERD were more frequent (31.8% and 31.6%) than remission (25%) in the LSG group [19]. We also reported our results in this way and found that the prevalence of remission was almost double that of progression. Despite several papers describing the benefits of LSG, there is still great debate.

Studies based on changes in physiopathology support both the beneficial and harmful effects of LSG. The results of a systematic review revealed that eight out of 10 studies described new-onset GERD after LSG [20]. Several papers have reported the harmful effects of LSG on the esophagus. For instance, it was found that a reduction in the resting pressure of the lower esophageal sphincter (LES) and an increase in acid reflux after three months of undergoing to LSG [21]. Moreover, at 13 months after LSG, it was reported an increase ineffective peristalsis, incomplete bolus transit, and an increase of both refluxes during postprandial periods and esophageal acid exposure, which are risk factors for esophageal inflammation [22]. Furthermore, surgical instruments can also play a role in the prevalence of esophagitis following bariatric surgery. Indeed, as the size of the bougie to prevent sleeve narrowing and GERD is not standardized, surgeons probably do not consider the impact of a small bougie that may lead to the creation of a narrower sleeve and higher intra-sleeve pressure, thereby favoring the incidence of GERD. Nevertheless, a large sleeve could also have a negative impact [23]. In our case, the surgeons used a medium sized 36-Fr bougie (size range: from 26.4 Fr to 50 Fr) [23].

On the other hand, effects of obesity could indirectly explain the benefits of LSG in the esophagus. It was found that obesity was associated with increasing esophageal acid exposure in GERD patients; moreover, the gastroesophageal pressure gradient increased with the increase in the BMI [24]. Results from a case-control study based on age-and-gender-matched patients with increased and normal waist circumferences reported that increasing acid exposure was most marked in obese subjects. The authors found that the migration of the squamo-columnar junction was significantly reduced in obese individuals [25], which could explain the important inflammation observed. Other studies have also reported an increase in reflux associated with obesity [26,27].

Moreover, it was reported an improvement on reflux symptoms following LSG in obese patients with preoperative GERD [14]. Interestingly, one study proposed the influence of weight gain over time associated with the prevalence of GERD symptoms, being 21.8% at 1-year of follow-up after LSG. Both this figure and BMI mean reduced to 3.1% and 26.6 kg/m2 at the third year, but latter it raised to 23% and 31.1 kg/m^2 respectively at the sixth year [28]. Another study in healthy individuals found that the cardiac mucosa was significantly longer in obese subjects [27], which could be a risk factor of metaplasia. Several studies have suggested a possible association between obesity and HH [29,30]. Some HH's physiological consequences explain this association such as a reduction in the pressure of LES, impairment of esophageal clearance, and trapping of refluxes during swallow-induced LES relaxations [31]. Esophageal acid exposure, the gastric pressure gradient and HH could have a role in preventing esophagitis by decreasing weight/BMI. Although we could not collect these factors before and after LSG, the median weight loss was significant and important.

Based on the possible indirect effects of LSG through weight loss, we may explain the gender disparities. Several papers have described that esophagitis is more frequent in men than in women [32,33], especially in overweight or obese men [34]. In addition, the prevalence of morbid obesity and metabolic syndrome were higher in men than in women. For instance, weight loss after LSG could differ regarding the gender since some articles suggested that BMI could be lower in men at follow-up [35,36]. This greater reduction in weight could explain the greater reduction in the prevalence of esophagitis in men compared to women. Nevertheless, predictors of weight loss could also differ by gender [35], and there could be other confounders, such as unhealthy behaviors, that we could not collect due to the retrospective design of the study. Future studies should include comprehensive analysis of these factors.

Relevance for Clinical Practice

Our study showed that LSG has a statistically significant benefit on esophagitis, and that male gender has a role in the effect. However, several aspects must take into account about this evidence.

Literature regarding the influence of LSG on esophagitis is controversial. Patients who will undergo LSG should also undergo an endoscopic evaluation, since obesity is associated with gastrointestinal complications, such as esophagitis, cancer, gastritis, polyps, among others [37]. Although the effectiveness of LSG on weight loss may be superior to other bariatric surgery procedures [7], the surgeon must consider the existing evidence to make a shared decision with the patient. Other aspects must be taken into account such as (i) the lower prevalence of risk factors for esophageal damage (intragastric pressure and gastroesophageal pressure gradient) in other bariatric procedures [10] and (ii) the cost-effectiveness [38]. Finally, it is important to inform the patient about the possible therapies in case of GERD after LSG, from medical treatment with proton pump inhibitors to surgical approach as the conversion of LSG to RYGB [23].

Strengths and Limitations

We selected our sample from a private clinic located in Lima (capital city of Peru), and therefore, there could be a selection bias, and our results may not be nationally representative. Although our follow-up period was similar to that of other studies [12,13], a longer period (> two years) might have been more useful to observe a greater change in the prevalence of esophagitis. In addition, we did not assess esophageal acid exposure, changes in the gastric pressure gradient or the presence of HH after LSG, and these characteristics might have altered the interpretation of results. However, we defined the presence of esophagitis by anatomical pathology study, thereby reducing the bias of visual examination. Indeed, we demonstrated a significant effect considering the anatomical pathology study but not the visual classification, and therefore, we strongly recommend taking this method into account to determine the presence of esophagitis in future studies.

CONCLUSIONS

We reviewed the effects of LSG on anatomopathologically-confirmed esophagitis in obese patients. Our results suggest that LSG could reduce the prevalence of this complication and that gender may have a role in the association. The literature is controversial, and surgeons must take a shared decision with the patient based on effectiveness, adverse events, and cost-effectiveness.

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