Surg Endosc (2015) 29:1760–1768
DOI 10.1007/s00464-014-3902-2

Does laparoscopic sleeve gastrectomy have any influence on gastroesophageal reflux disease? Preliminary results

Verónica Gorodner · Rudolf Buxhoeveden · Gastón Clemente · Laura Solé · Luis Caro · Alejandro Grigaites

Received: 4 April 2014 / Accepted: 4 September 2014 / Published online: 11 October 2014

Abstract
Introduction There is no question that Roux-en-Y gastric bypass (RYGB) is the best treatment option for obesity combined with GERD. However, the influence of laparoscopic sleeve gastrectomy (LSG) on this disease remains controversial. It has been said that LSG could induce de novo GERD or worsen it. The aim of our study was to evaluate the influence of LSG on GERD.
Methods and procedures Candidates for LSG underwent esophageal manometry (EM) and 24 h pH monitoring before and 1 year after LSG. Symptoms were evaluated using a validated score. Esophageal function test (EFT's) results and symptoms were compared before and after surgery.
Results Between 4/12 and 9/13, 118 patients underwent LSG. EFT's were performed in 92 (78 %) of them preoperatively. From the 19 patients 1 year out of surgery, 14 (73 %) completed their EFT's postop. There were 13 women, age 42 ± 12 years, BMI 40 ± 6 kg/m^2. At 14 months, % excess weight loss (EWL) was 74. EM: lower esophageal sphincter (LES) length increased from 2.7 to 3.2 cm (p = NS), and LES pressure decreased from 17.1 to 12.4 mmHg ($p \leq 0.05$). Preoperatively, LES was normotensive in 13 (93 %) patients; postoperatively, LES was normal in 10 (71 %) (p = NS). DeMeester score increased from 12.6 to 28.4 ($p \leq 0.05$). Postoperatively, 5 (36 %) patients had de novo GERD, in 3 (21 %) GERD worsened, 1 (7 %) remained with GERD and 5 (36 %) remained without reflux. No difference was seen between preop. and postop. symptoms score.
Conclusion Our preliminary data showed that after LSG LESP significantly decreased, and the DeMeester score significantly increased. Although LSG results appear appealing in terms of weight loss, patients should be warned that they might need proton pump inhibitors after the operation. Surgeons should probably lower their threshold for indicating RYGB in patients with known preoperative GERD.

Keywords Bariatric surgery · Gastroesophageal reflux disease (GERD) · Obesity · Laparoscopic sleeve gastrectomy

The prevalence of gastroesophageal reflux disease (GERD) is clearly increased among the obese population. As such, GERD is currently recognized as one of the obesity-related comorbidities. GERD is defined as the failure of the antireflux barrier that allows abnormal reflux of gastric contents into the esophagus. Considering GERD in the context of obesity, several factors like increased intraabdominal pressure, reduced esophageal clearance, increased transient relaxations of the lower esophageal sphincter (LES), distorted anatomy of the gastroesophageal junction (e.g., hiatal hernia (HH)), and high fat-containing diet undoubtedly play a role in the genesis of this disease [1].

There is no question that the Roux-en-Y gastric bypass (RYGB) is the best treatment option for obesity combined with GERD. The anatomic modifications including the creation of a small gastric pouch, the exclusion of the fundus and most part of the body, where parietal cells are

Presented at the SAGES 2014 Annual Meeting, April 2–5, 2014, Salt Lake City, Utah.

V. Gorodner (✉) · R. Buxhoeveden · G. Clemente · A. Grigaites
Programa de Unidades Bariátricas, Buenos Aires, Argentina
e-mail: vgorodner_72@yahoo.com.ar

L. Solé · L. Caro
GEDYT Gastroenterología Diagnóstica y Terapéutica, Buenos Aires, Argentina

concentrated, and the Roux-en-Y configuration result in decreased gastroesophageal reflux, independently of weight loss occurrence. Several studies confirm this observation [2, 3].

A few years ago, the ASMBS recognized the sleeve gastrectomy as an acceptable option as a primary bariatric procedure, establishing that its risk/benefit profile lies between the laparoscopic adjustable gastric band and the RYGB [4]. Since then, and considering that preliminary results were encouraging, the interest in this procedure has grown, becoming more popular among the bariatric community. However, the influence of laparoscopic sleeve gastrectomy (LSG) on GERD remains controversial. It has been said that LSG could induce de novo GERD or worsen it in those patients that already have it. Some authors advocate that the construction of a narrow conduit based on the lesser curve of the stomach could increase the resistance of the esophageal outflow avoiding esophageal clearance of normal reflux. This technique also modifies the anatomy of the gastroesophageal junction, by partially sectioning the sling fibers, and disrupting the angle of His, consequently affecting the antireflux barrier [5]. In addition, the mass of G cells left in place is greater compared to the amount left in the RYGB. On the contrary, the possibly increased rate of gastric emptying and considerable weight loss could contribute to resolve GERD [6].

So far, objective data are scarce. The aim of our study was to evaluate the influence of LSG on GERD.

Material and procedures

Patient selection

Patients seeking treatment for obesity, who met the NIH criteria [7], were considered for bariatric surgery.

Since the purpose of the study was to evaluate the effect of LSG on GERD, only patients undergoing this procedure were included. Demographics and perioperative data were analyzed. Esophageal function test (EFT's) results and symptoms score were compared before and after surgery.

Preoperative evaluation

All bariatric patients in our practice underwent a classic preoperative evaluation consisting of lab tests, cardiac and pneumonologic evaluation, abdominal ultrasound, and chest X-Ray. Barium swallow (BS), esophagogastroduodenoscopy (EGD), and gastric biopsy were also routinely performed. Esophageal biopsy was performed only if Barrett's esophagus was suspected on EGD. The severity of esophagitis was graded according to the Los Angeles (LA) classification [8] (Table 1).

Table 1 Los Angeles classification

Grade A	One or more mucosal breaks <5 mm in maximal length
Grade B	One or more mucosal breaks <5 mm, but without continuity across mucosal folds
Grade C	Mucosal breaks continuous between >2 mucosal folds, but involving less than 75 % of the esophageal circumference
Grade D	Mucosal breaks involving more than 75 % of esophageal circumference

In addition, candidates for LSG were interrogated about GERD-like symptoms, and studied with esophageal manometry (EM) and 24-h pH monitoring before and 1 year after LSG.

Symptomatic assessment

Patients were interviewed by one of the surgeons, who filled in a standard questionnaire previously validated by Allen el at [9]. They were inquired about typical (heartburn, regurgitation and dysphagia) and atypical (cough, chest pain) GERD symptoms. The severity of symptoms was scored from 0 (no symptoms) to 3 (severely affecting quality of life). The frequency of symptoms was scored as follows: 0 absent; 1: once/month; 2: once/week; 3: two-four times/week; 4: daily.

Esophageal manometry

Patients were studied after 8 h fasting. Medications that could interfere with esophageal motility were discontinued 48 h prior to the study. A water-perfused 6-channel catheter was used with the station pull through technique. EM provided information about the esophageal motor function. This study also allowed accurate placement of the 24-h pH monitoring catheter. Patients were given ten wet swallows. LES position, length, resting pressure, and relaxation were assessed. Esophageal body motility was evaluated by progression and amplitude of waves.

Esophageal body abnormalities were classified as primary esophageal motility disorders (PEMD) and disorders that resulted from GERD.

PEMD are those that appear in the absence of GERD verified by pH monitoring. These include achalasia, nutcracker esophagus (NE), diffuse esophageal spasm (DES), and hypertensive LES.

Disorders resulting from GERD included ineffective esophageal esophageal motility (IEM: ≥30 % contraction <30 mmHg), hypertensive peristalsis (distal esophageal amplitude >140 mmHg), non-specific esophageal motility disorder (NSEMD: a vague category that includes patients with simultaneous, segmented, absent, dropped, retrograde, and/or multiple peaked waves). Normal esophageal

motility was considered when 100 % of the swallows were followed by peristaltic waves.

Distal esophageal amplitude (DEA) was calculated based on the average amplitude measured by the two most distal sensors located at 3 and 8 cm above the LES. Normal value was considered 100 ± 40 mmHg.

24-h pH monitoring

In preparation for the 24-h pH monitoring, proton pump inhibitors (PPI's) were discontinued 10 days prior to the study, and H2 blockers 3 days before. Regular antacid medications were allowed until the day before.

Patients were advised to follow a regular diet during the study, eluding ingestion of acidic beverages or food to avoid false-positive results.

The study was performed using a single-sensor catheter, placed 5 cm above the upper border of the LES, measured by EM. Data were recorded for a 24-h period and then analyzed using the Alacer Biomedica® software 1.22. The data were merged into the DeMeester score; normal value was 14.7 [10].

Procedure selection criteria

RYGB

- Patients with BMI >42 kg/m^2
- Patients with BMI 35–41 kg/m^2 with diabetes
- Patients with documented GERD by pH monitoring
- Patients with esophagitis documented by EGD

LSG

- Patients with BMI ≤42 without diabetes
- Patients without GERD documented by pH monitoring
- Patients with documented GERD or diabetes, refusing to have RYGB surgery

LSG: surgical technique

The operation was performed under general anesthesia. Prophylactic antibiotics were administered at the time of the induction, and 3 ml of subcutaneous nadroparine were given 12 h prior to the operation. Pneumatic compression stockings were placed on both legs.

The patient was placed in the semi-lithotomy position in an anti-Trendelenburg position. The skin of the abdomen was prepped and draped in the usual sterile fashion. Pneumoperitoneum was induced using the Verress needle in the left upper quadrant. Once the pneumoperitoneum was completed at 14 mmHg, a 12-mm trocar was placed in the midline supraumbilical position under direct vision using the optiview® system. Four more trocars (two 12 mm, and two 5 mm) were then placed.

The left lobe of the liver was then retracted anteriorly using a 5 mm grasper. The stomach was exposed. The peritoneum overlying the left crus of the diaphragm was then divided, and the fat pad removed. The short gastric vessels were all carefully divided using the harmonic scalpel. The fundus and the body of the stomach were then carefully mobilized by isolating posterior adhesions to the anterior capsule of the pancreas. A 36 F Bougie was used to tailor the gastrectomy. Then using the 60-mm linear stapler (one green load, one gold, and then blue loads), the stomach was divided starting on the greater curvature about 6 cm from the pylorus parallel to the lesser curvature and from this position toward the angle of His. The suture line was reinforced with running suture of 2.0 vicryl.

With the stomach completely divided, a methylene blue test was performed to rule out the presence of leaks. The gastric remnant was retrieved through the incision located in the left upper quadrant. A Jackson Pratt drain was left along the suture line.

Statistical analysis

This was prospective non-randomized study. Student's t test was used for comparison of continuous variables, and χ^2 test for categorical variables. A p value < 0.05 was considered statistically significant.

Values were expressed as mean ± standard deviation.

Results

Between April 2012 and September 2013, 118 patients underwent LSG at our Institution. EFT's were performed in 92 (78 %) of them preoperatively. Thus far, of the 19 patients 1 year out of surgery, 14 (73 %) completed their EFT's postoperatively. Mean time to EFT's completion was 14 ± 2 months. There were 13 women and 1 man, mean age 42 ± 12 years, initial BMI 40 ± 6 kg/m^2. Operative time was 65 ± 8 min and length of hospital stay was 48 h. No complications were seen in these series. At 14 months follow-up, % excess weight loss (EWL) was 74 ± 15.

Symptomatic assessment

Preoperatively, 2 patients had heartburn, 3 had regurgitation, 1 chest pain, and 1 cough. None of them experienced dysphagia. Those patients having symptoms before remained symptomatic after the surgery, except for the one who had cough which was resolved. One patient reported de novo heartburn, and another one regurgitation. Preop. and postop. symptom score for severity and frequency are described in Table 2. All comparisons were statistically non-significant ($p \geq 0.05$).

Table 2 Severity and frequency of symptoms

	Severity			Frequency		
	PRE LSG	POST LSG	*p*	PRE LSG	POST LSG	*p*
Heartburn	0.4 ± 0.9	0.5 ± 1.2	NS	0.5 ± 1.3	0.6 ± 1.3	NS
Regurgitation	0.5 ± 1	0.4 ± 0.6	NS	0.6 ± 1.3	0.4 ± 0.9	NS
Chest pain	0.1 ± 0.3	0.2 ± 0.8	NS	0.3 ± 1.1	0.3 ± 1.1	NS
Dysphagia	–	–		–	–	
Cough	0.2 ± 0.8	0		0.2 ± 0.8	0	

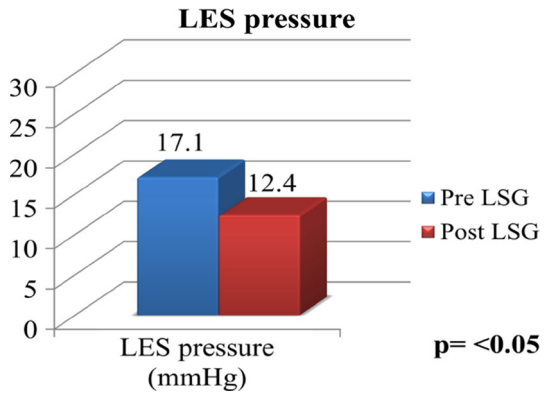

Fig. 1 LES pressure

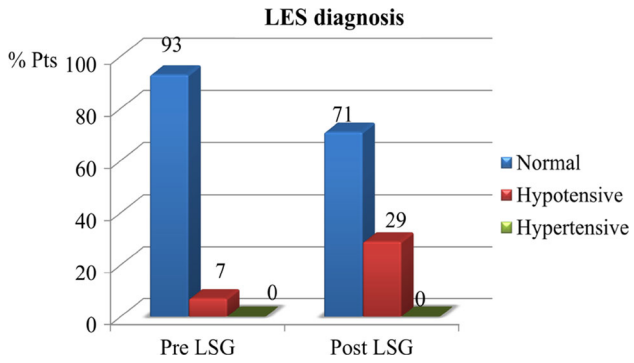

Fig. 2 LES diagnosis

Barium swallow

BS was only performed preoperatively. A small HH was present in 4 (28 %) of patients. Those HH were too small, and therefore were not repaired during surgery.

Esophagogastroduodenoscopy

EGD was performed only preoperatively. According to the LA classification, 3 patients had Grade A esophagitis, and 1 patient had Grade C esophagitis (total patients with esophagitis 29 %). Ten (71 %) patients had no esophagitis. Trying to establish a correlation between DeMeester score and the presence of esophagitis, we found that

(a) Two (50 %) patients out of 4 with abnormal reflux had esophagitis (one Grade A and the other one Grade C)
(b) Two (20 %) patients out of 10 with normal DeMeester score had esophagitis (both Grade A)

Esophageal manometry

EM results were compared before and after surgery. LES length increased from 2.7 to 3.2 cm (p = NS). However, the LESP pressure decreased significantly from 17.1 to 12.4 mmHg ($p \leq 0.05$) (Fig. 1). Preoperatively, LES was normotensive in 13 (93 %) patients and hypotensive in one (7 %). After the operation, the LES was normal in 10 (71 %) patients and hypotensive in 4 (29 %) (p = NS). LES relaxation was normal in all cases (Fig. 2).

Concerning the esophageal body prior to the LSG, 13 (93 %) patients had normal motility, and 1 (7 %) had IEM; subsequently, 11 (79 %) patients had normal motility, 2 (14 %) had NSEMD, and 1 (7 %) had IEM (p = NS). DEA increased from 71 to 75 mmHg (p = NS). (Table 3).

24-h pH monitoring

The DeMeester score increased from 12.6 in the preoperative period to 28.4 postoperatively ($p \leq 0.05$). The analysis of the components of the preop. and postop. DeMeester score showed the following results: number of reflux episodes decreased from 29.1 to 25.4 (p = NS), number of episodes longer than 5 min increased from 1.6 to 4.7 ($p \leq 0.05$), duration of longest episode went from 4.9 to 27.3 min ($p \leq 0.05$), % of time the pH <4 (total) raised from 3.8 to 7.7 ($p \leq 0.05$), total % of time pH <4 (upright) went from 4.9 to 8.3 (p = NS), and % of time pH <4 (supine) increased from 1.9 to 6.7 (p = NS) (Table 4) Figs. 3, 4.

The number of patients with abnormal DeMeester score also increased, from 4 (29 %) to 9 (64 %) after the operation, although this difference did not reach statistical

Table 3 Esophageal manometry

	PRE LSG	POST LSG	*p*
LES length	2.7 ± 0.9 (1–4) 3	3.2 ± 1.3 (1–6) 3	NS
LESP	17.1 ± 5.3 (9–26) 16	12.4 ± 4.5 (7–23)11	<0.05
LES relaxation	normal	normal	
LES diagnosis			NS
Normal	13 (93 %)	10 (71 %)	
Hypotensive	1 (7 %)	4 (29 %)	
Hypertensive	–	–	
Esophageal Body Diagnosis			NS
Normal	13 (93 %)	11 (79 %)	
NSEMD	1 (7 %)	2 (14 %)	
IEM	–	1 (7 %)	
DEA (mmHg)	71 ± 22 (30–110) 78	75 ± 26 (31–121) 79	NS

LES lower esophageal sphincter, *LESP* LES pressure, *NSEMD* non-specific esophageal motility disorder, *IEM* ineffective esophageal esophageal motility, *DEA* distal esophageal amplitude

Table 4 Preop and postop DeMeester score

	PRE LSG	POST LSG	*p*
# reflux episodes	29.1 ± 16.3	25.4 ± 12.8	NS
# >5 min	1.6 ± 2.9	4.7 ± 3.9	<0.05
Longest	4.9 ± 3.4	27.3 ± 24.6	<0.05
Total time pH < 4	43.2 ± 33.7	110 ± 83	<0.05
Clearance	1.5 ± 0.7	4.1 ± 3	<0.05
% Time pH < 4			
Total	3.8 ± 3.1	7.7 ± 5.4	<0.05
Upright	4.9 ± 3.2	8.3 ± 6.8	NS
Supine	1.9 ± 3.6	6.7 ± 8.6	NS
DeMeester score	12.6 ± 10.1	28.4 ± 19	<0.05

Results are expressed as mean ± SD

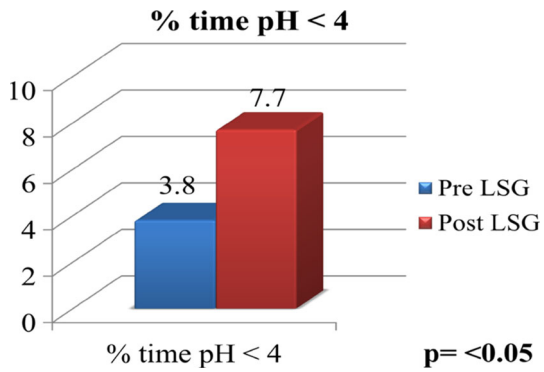

Fig. 3 % time pH <4

significance. Postoperatively, 5 (36 %) patients had de novo GERD, in 3 (21 %) GERD worsened, 1 (7 %) remained with GERD (same status) and 5 (36 %) patients remained without reflux (Table 5).

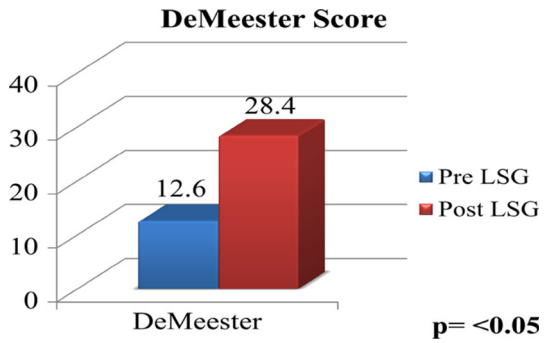

Fig. 4 DeMeester score

Table 5 GERD status before and after LSG

	PRE LSG	POST LSG	*p*
# pts normal DeMeester	10 (71 %)	5 (36 %)	NS
# pts abnormal DeMeester	4 (29 %)	9 (64 %)	NS
GERD status after LSG			
Same (No GERD)		5 (36 %)	
Same (with GERD)		1 (7 %)	
Worse		3 (21 %)	
De novo		4 (36 %)	
Better		–	

Correlation between postoperative symptoms and 24-h pH monitoring

Symptoms were analyzed on those patients who had abnormal DeMeester score after the LSG. Six (66 %) patients from those 9 with positive pH monitoring reported GERD symptoms.

Discussion

There is consensus that bariatric surgery is considered the gold standard treatment for morbid obesity. Nevertheless, the effect of bariatric surgery on GERD needs to be further investigated. Obese patients with GERD may represent a dilemma when choosing the surgical technique: what operation should we offer to a patient in the lower range of BMI (e.g., BMI <40), no diabetes and GERD? Is RGYB too much? What would be the effect of LSG on GERD? Is LSG truly associated with GERD? If so, will GERD get better once the patient losses weight or the antireflux barrier will be damaged forever?

Currently in our practice, our first question while approaching this type of patient would be: does the patient really have GERD? When studying a patient with possible GERD, four tests are mandatory: (1) BS, (2) EGD, (3) EM, and (4) pH monitoring. Certainly, symptomatic assessment is also key during this process.

Symptomatic assessment

Diagnosis of GERD is usually based on symptoms in the regular clinical practice. We would like to emphasize how erroneous the diagnosis could be if it is supported merely on patient's symptoms. It has been previously documented by several authors that symptoms can be misleading at the time of identifying patients with GERD. Investigators at the University of California San Francisco [11] conducted a study over 124 patients reporting GERD-like symptoms after laparoscopic Nissen fundoplication. This study showed that only 48 (39 %) patients had abnormal DeMeester score, and in the remaining 61 % of patients symptoms might have come from another source. Analyzing the usage of medication, the same effect was observed. In the same study, 62 (50 %) patients were taking some type of antacid medication after the fundoplication. Of those 62 patients, only 20 (32 %) of them had abnormal reflux. This means that 68 % of the patients were taking unnecessary medications.

In our experience, only 66 % of patients with abnormal pH monitoring after LSG were able to recognize GERD symptoms. The remaining 34 % were completely asymptomatic.

Therefore, we considered that symptomatic assessment alone should not be used either in the preoperative or during the postoperative evaluation.

Barium swallow

This test provides details about the anatomy. Even though this test can offer information about the occurrence of reflux episodes, by no means can be used to certify the diagnosis of GERD.

Esophagogastroduodenoscopy

The absence of esophagitis on EGD does not exclude the diagnosis of GERD [12]. It has been documented that mucosal changes are absent in about 50 % of patients with GERD [13]. Patti et al. found in their experience that esophagitis was absent in 54 % of the patients who had positive pH monitoring studies [14]. Although our sample was small, our findings were consistent with those mentioned above: from those 4 patients with abnormal DeMeester score preoperatively, only 2 (50 %) had esophagitis. For that reason, EGD cannot confirm the presence/absence of GERD either.

Esophageal manometry

EM supplies information about motility of the esophagus. Preoperatively, this test is crucial to exclude the diagnosis of achalasia avoiding a mistaken approach. In addition, EM allows to accurately placing the pH probe by indicating the LES location, minimizing the risks of false-positives or false-negative results during pH monitoring. EM by itself cannot be utilized to diagnose GERD. The value of postoperative EM lies in the ability to provide information about LES function and esophageal peristalsis; defects in any of them could result in GERD.

pH monitoring

So far, pH monitoring is the only objective test that allows documenting GERD. This test not only determines the presence and severity of GERD, but also establishes correlation between symptoms and episodes of reflux.

Once the diagnosis of GERD is established, what should we do? Our results showed that:

(1) Those patients having symptoms before remained symptomatic after the surgery, except for the one who had cough which was resolved. One patient reported de novo heartburn; coincidently, the DeMeester score in that patient rose from 2.9 to 58.6. Another patient reported de novo regurgitation; in that case the De Meester score increased from 3.2 to 42. However, preop and postop symptom score for severity and frequency did not show any statistical significance.

(2) BS showed the presence of a small HH in 4 (28 %) patients. Intraoperatively, we considered the defect was too small to be repaired, and perhaps opening the crura during the dissection would have been

Table 6 Literature review supporting LSG association with postoperative GERD

	LSG		SX		EGD		EM		pH		
Author	#pt	F/U	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Comments
Braghetto [16]	20	6 months	–	–	–	–	LESP: 14.2	LESP: 10.5 Hypot.: 85 % pts	N/A	N/A	LSG not for pt w/GERD
Braghetto [5]	167	N/A	0 %	27.5 %	WNL	15 % pt esophagitis	WNL	Hypot.: 74 % pts	N/A	ABN: 65.3 % pt	No preop pH for comparison. Only 23 pt had postop EFT's
Himpens [17, 18]	53	6 years	3.3 %	23 %	–	–	–	–	–	–	
Carter [19]	176	–	34.6 %	47.2 %							
Howard [20]	28		0 %	22 %							
Burgerhart [21]	20	3 months					LESP: 18.3	LESP: 11	% time pH <4: 4.1	% time pH <4: 12	Pt w/preop GERD should have RYGB.

WNL within normal limits, *ABN* abnormal, *LESP* lower esophageal sphincter pressure, *Hypot* hypotensive, *EFT's* esophageal function tests

worse. In addition, 3 (75 %) of those 4 patients with HH had normal DeMeester score.

3) According with the published literature, we found that only 50 % of patients with abnormal reflux had esophagitis on esophagastroduodenoscopy.

(4) Evaluating the EM results, we found that the LESP significantly decreased after the operation from 17.1 to 12.4 mmHg ($p \leq 0.05$). Accordingly to this finding, the percentage of patients with hypotensive LES increased from 7 to 29 %. Regarding the esophageal body behavior, the percentage of patients with abnormal motility increased from 7 to 21 %. Although these last two finding showed a tendency toward worsening the esophageal motor function after the LSG, the difference did not reach statistical significance.

5) Postoperatively, the DeMeester score significantly increased from 12.6 to 28.4 ($p \leq 0.05$). The analysis of the components of the preop. and postop. DeMeester score showed that the number of episodes longer than 5 min increased from 1.6 to 4.7 ($p \leq 0.05$), and the % of total time the pH <4 (total) rose from 3.8 to 7.7 ($p \leq 0.05$).

This is particularly important, since some authors reported that increased % time <4, increased number of reflux longer than 5 min, and greater DeMeester scores have been associated with higher degree of mucosal injury [15]. It is worth of mention that the percentage of patients with abnormal DeMeester score also increased, from 29 to 64 % after the operation, although this difference was not statistically significant. We should also underline that 36 % of patients developed de novo GERD, and in 21 % of patients GERD got worse.

Data in the literature remain controversial. Some authors assure that LSG is clearly associated with GERD. Literature review supporting this statement is shown in Table 6.

Conversely, some other authors advocated that GERD could improve or even resolve after LSG. These authors' findings are shown in Table 7.

Only one study [21] from all those mentioned above was able to assess objectively the presence/absence of GERD.

Clearly, opinions are contradictory. Based on our early experience, we believe that even if there is no consensus on what the effects of LSG on GERD are, our results showed that this operation provoked de novo reflux in 36 % of patients and worsened it in another 21 %. In addition, LESP was significantly decreased, and esophageal body motility was poorer after the operation, even though the change of this last parameter did not show statistical significance. In our minds, this would be enough reason to avoid indicating LSG to patients who are diagnosed with GERD during the preoperative evaluation. Most likely these patients, even if they are in the lower BMI range, would benefit from a RYGB.

We still do not know if GERD will improve over time once the patient losses weight or on the contrary, the antireflux barrier will be perpetually damaged. At 14 months

Table 7 Literature review rejecting LSG association with postoperative GERD

	LSG		SX		EGD	EM		pH	Comments
Author	#pt	F/U	Preop	Postop	N/A	Preop	Postop	N/A	
Melissa [22]	23	N/A	N/A	50 % pt resolved/improved 8.7 % de novo GERD		N/A	N/A		They attributed this finding to weight loss and accelerated gastric emptying.
Weiner [23]	120	2 years	35 %	43 % improvement 57 % resolution		N/A	N/A		–
Petersen [24]	17	6 days	45 %	N/A		LESP: 21	LESP: 24		–
Petersen [24]	20	8 months				LESP: 8.4	LESP: 11		–

follow-up, our patients lost a considerable amount of weight, being their %EWL 74 ± 15; however, the acid exposure was still high.

We do believe that the presence of GERD should be always objectively assessed when indicating LSG, evaluating the patient with all four required tests for that purpose. GERD should never be diagnosed based on symptoms, and should never be underestimated.

We would like to clarify that despite of the statement mentioned above, 4 patients with abnormal DeMeester score preoperatively underwent LSG, 2 of them having esophagitis. Specifically, two patients refused to have RYGB; the third patient had a slightly abnormal De Meester score of 15.4, and in agreement with her we decided to do a LSG. The remaining patient was taking multiple medications, including tamoxifen, therefore decision was made based on that.

Assuming that LSG could negatively affect GERD, the decision on what surgical technique we should offer to the patient was eventually modified. Analyzing the total of patients who underwent EFT's preoperatively in our practice, we switched from LSG to RYGB in 12 % of cases.

Conclusion

Although LSG appears to be an appealing alternative in terms of weight loss, our results showed that this operation is associated with postoperative GERD. When indicating LSG, the surgeon should be clear enough in warning patients that they might need PPI's after the operation, and that symptoms are not reliable for the diagnosis of GERD. Surgeons should probably lower their threshold for indicating RYGB in patients with known preoperative GERD.

Our study has some weaknesses such as small number of patients, short-term follow-up and non-randomization of patients when selecting the type of operation. Future studies objectively assessing the effects of LSG on GERD, with greater number of patients and longer follow-up are needed.

Disclosures Drs Verónica Gorodner, Rudolf Buxhoeveden, Gastón Clemente, Laura Solé, Luis Caro, and Alejandro Grigaites have no conflict of interests or financial ties to disclose.

References

1. Suter M, Dorta G, Giusti V, Calmes JM (2010) Gastro-esophageal reflux and esophageal motility disorders in morbidly obese patients. Obes Surg 14:959–966
2. Madalosso CA, Gurski RR, Callegari-Jacques SM, Navarini D, Thiesen V, Fornari F (2010) The impact of gastric bypass on gastroesophageal reflux disease in patients with morbid obesity: a prospective study based on the Montreal Consensus. Ann Surg 251:244–248
3. Nelson LG, Gonzalez R, Haines K, Gallagher SF, Murr MM (2005) Amelioration of gastroesophageal reflux symptoms following Roux-en-Y gastric bypass for clinically significant obesity. Am Surg 71:950–953 discussion 953-954
4. Clinical Issues Committee of the American Society for Metabolic and Bariatric Surgery (2010) Updated position statement on sleeve gastrectomy as a bariatric procedure. Surg Obes Relat Dis 6(1):1–5
5. Braghetto I, Csendes A, Korn O, Valladares H, Gonzalez P, Henriquez (2010) Gastroesophageal reflux disease after sleeve gastrectomy. Surg Laparosc Endosc Percutan Tech 20(3):148–153
6. Prachand VN, Alverdy JC (2010) Gastroesophageal reflux disease and severe obesity: fundoplication or bariatric surgery? World J Gastroenterol 16(30):3757–3761
7. Gastrointestinal Surgery for Obesity (1992) National institutes of health consensus development conference statement. Am J Clin Nutr 55:615S–619S
8. Lundell LR, Dent J, Bennett JR et al (1999) Endoscopic assessment of oesophagitis: clinical and functional correlates and further validation of the Los Angeles classification. Gut 45(2): 172–180
9. Allen CJ, Parameswaran K, Belda J, Anvari M (2000) Reproducibility, validity, and responsiveness of a disease-specific symptom questionnaire for gastroesophageal reflux disease. Dis Esophagus 13:265–270
10. Castell D (2000) Esophageal motility and pH testing. Technique and interpretation (chap. 16), 3rd edn. Sandhill Scientific, Colorado, pp 197–216
11. Galvani C, Fisichella M, Gorodner MV, Perretta S, Patti MG (2003) Symptoms are poor indicators of reflux status after fundoplication for gastroesophageal reflux disease. Arch Surg 138:514–519
12. Jobe BA, Richter JE, Hoppo T, Peters JH, Bell R (2013) Preoperative diagnostic workup before antireflux surgery: an

evidence and experience-based consensus of the esophageal diagnostic advisory panel. J Am Coll Surg 217:586–597
13. Richter JE (1996) Typical and atypical presentations of gastroesophageal reflux disease: the role of esophageal testing in diagnosis and management. Gastroenterol Clin North Am 25:75–102
14. Patti MG, Diener U, Tamburini A, Molena D, Way LW (2001) Role of esophageal function tests in diagnosis of gastroesophageal reflux disease. Dig Dis Sci 46:597–602
15. Xu DT, Feng GJ, Zhao LL, Liu YL (2013) Relationship among symptoms, mucosal injury and acid exposure in gastroesophageal reflux disease. Chin Med J 126(23):4430
16. Braghetto I, Lanzarini E, Korn O, Valladares H, Molina JC et al (2010) Manometric changes of the lower esophageal sphincter after sleeve gastrectomy in obese patients. Obes Surg 20:357–362
17. Himpens J, Dobbeleir J, Peeters G (2010) Long term results of laparoscopic sleeve gastrectomy for obesity. Ann Surg 252(2):319–324
18. Himpens J, Dapri G, Cadière GB (2006) A prospective randomized study between laparoscopic gastric banding and laparoscopic isolated sleeve gastrectomy: results after 1 and 3 years. Obes Surg 16:1450–1456
19. Carter P, LeBlanc KA, Hausmann MG, Kleinpeter KP, deBarros SN et al (2011) Association between gastroesophageal reflux disease and laparoscopic sleeve gastrectomy. Surg Obes Relat Dis 7:569–574
20. Howard DD, Caban AM, Cendan CJ, Ben-David K (2011) Gastroesophageal reflux after sleeve gastrectomy in morbidly obese patients. Surg Obes Relat Dis 7:709–713
21. Burgerhart JS, Charlotte AI, Schotborgh, Schoon EJ, Smulders JF, van de Meeberg PC, Siersema PD, Smout AJ (2014) Effect of sleeve gastrectomy on gastroesophageal reflux. Obes Surg 24:1436
22. Melissas J, Koukouraki S, Askoxylakis J, Stathaki M, Daskalakis M et al (2007) Sleeve gastrectomy—a restrictive procedure? Obes Surg 17:57–62
23. Weiner R, Weiner S, Pomhoff I, Jacobi C, Makarewicz W, Weigand G (2007) Laparoscopic sleeve gastrectomy—influence of sleeve size and resected gastric volume. Obes Surg 17:1297–1305
24. Petersen W, Meile T, Küper MA, Zdichavsky M, Königsrainer A, Schneider JH (2012) Functional importance of laparoscopic sleeve gastrectomy for the lower esophageal sphincter in patients with morbid obesity. Obes Surg 22:360–366