Role of esophagogastroduodenoscopy as a preoperative assessment tool in laparoscopic sleeve gastrectomy for patients with morbid obesity

Hatem ElGohary[a], Sherif Elbehiry[b], Mohamed Gamal Abdulrahman[c]

Departments of [a]Laparoscopic Upper GIT and Bariatric Surgery, [b]Internal Medicine, [c]General Surgery, Faculty of Medicine, Helwan University, Helwan, Egypt

Correspondence to Mohamed Gamal Abdulrahman, Lecturer of General Surgery, Faculty of Medicine, Helwan University; Department of General Surgery, Faculty of Medicine, Helwan University, Helwan, 11865, Egypt. Mob: 01001718678; e-mail: drgemi1981@gmail.com

Received: 22 July 2020
Revised: 19 August 2020
Accepted: 9 September 2020
Published: 12 October 2021

The Egyptian Journal of Surgery 2021, 40:415–422

Introduction
Incidence of gastroesophageal reflux disease (GERD) in patients with morbid obesity may reach up to 50%. In some centers, esophagogastroduodenoscopy (EGD) is performed routinely in the preoperative workup before bariatric surgery. However, it is still unclear what the optimal preoperative assessment is.
Patients and methods
This is a prospective descriptive cohort study that included 65 laparoscopic sleeve gastrectomy (LSG) patients who were evaluated preoperatively and postoperatively using a GERD questionnaire. EGD was done selectively for those high-risk patients having score more than 7 on the questionnaire.
Aim
The aim of this study was to evaluate the incidence of GERD in LSG patients and their outcome by using GERD questionnaire and selective EGD for patients at risk.
Results
Six (9.2%) patients had score more than 7 on the GERD questionnaire, and all of them had a preoperative EGD. Of 65 LSG patients, six (9.2%) patients had hiatus hernia repair, and three (50%) of these patients were discovered intraoperatively having silent hiatus hernia. There was a significant decrease in GERD in patients who underwent preoperative EGD (P=0.032). On the contrary, one (8.3%) patient developed de novo GERD and was converted to laparoscopic Roux-en-Y gastric bypass with hiatus hernia repair at 1 year.
Conclusion
Proper preoperative evaluation and close postoperative follow-up of LSG patients are crucial, especially in patients experiencing GERD. The GERD questionnaire and EGD are safe and effective tools and can suggest patients at risk.

Keywords:
bariatric surgery, esophagogastroduodenoscopy, gastroesophageal reflux disease, laparoscopy, morbid obesity, sleeve gastrectomy

Egyptian J Surgery 40:415–422

1110-1121

Introduction

Obesity is now recognized as a worldwide major health problem reaching epidemic proportions. It is also a chronic troublesome disease resulting in increased mortality and morbidity including gastroesophageal reflux disease (GERD) [1,2].

There is an established relationship between bariatric surgeons and endoscopists in treating obesity. The primary role of endoscopists relies on the preoperative and postoperative assessment for treatment of gastroesophageal diseases. Conditions such as GERD, hiatus hernia, reflux esophagitis, Barrett's esophagus, *Helicobacter pylori* infection, ulcers, polyps, and gastrointestinal stromal tumors (GIST) greatly affect the decision for bariatric surgery as well as the type of procedure chosen for each patient and their outcome [3].

Studies have shown that there is a high incidence of GERD in patients with morbid obesity, with up to 50% experiencing this condition. This is explained by the mechanical change of the esophagogastric junction associated with temporary relaxation of the lower esophageal sphincter and/or hiatus hernia presence [4].

Moreover, the increased intragastric pressure, organomegaly, and elasticity of the supporting core muscles and ligaments in obese patients cause an increase in the gastroesophageal pressure gradient during inspiration [4]. However, bariatric surgery is an effective method to sustained long-term weight loss, and it will result in the resolution of obesity-related comorbidities [5–7].

In some centers, esophagogastroduodenoscopy (EGD) is performed routinely as part of the preoperative workup for bariatric surgery candidates. However, it is still unclear what the optimal preoperative assessment is [8].

There are different surgical options for treating GERD during bariatric surgery. Laparoscopic Roux-en-Y gastric bypass (LRNYGB) is one of the most well-known treatment modalities for both obesity and GERD whether crural repair is done or not [9–14].

However, laparoscopic sleeve gastrectomy (LSG) is the most frequently requested operation by patients with obesity for fear of the increased morbidity and long-term vitamin intake in gastric bypass, and some authors recommend simultaneous cruroplasty during LSG as a second treatment option for both obesity and GERD [3,15,16].

On the contrary, de novo GERD may occur after LSG owing to many mechanisms, including decreased compliance in the narrow gastric tube with increased intragastric pressure while the pylorus is closed. Other factors include disruption of the anatomical anti-reflux mechanisms in the angle of His and resection of the sliding fibers in the lower esophageal sphincter causing incompetence. The final shape of the gastric sleeve also plays an important role in postoperative GERD especially when it is funnel shaped [17].

The aim of this study is to evaluate the incidence of GERD in LSG patients and their outcome by using a GERD questionnaire (Fig. 1) and selective preoperative EGD for patients at risk [18].

Patients and methods

This is a prospective descriptive cohort study done between July 2017 and April 2019 in Helwan University hospitals, which included 65 patients who underwent LSG. All surgical procedures were done by the same surgeons, and patients' consent and ethical committee approval were obtained.

Patients were eligible for LSG if their BMI was more than or equal to 35 kg/m^2, and they were preoperatively evaluated via full history taking including eating habits, thorough clinical examination, full laboratory blood testing (complete blood picture, coagulation profile, liver and kidney function tests, thyroid profile, fasting blood sugar, and glycosylated hemoglobin), pelvi-abdominal ultrasonography, chest radiograph, and ECG. Echocardiography was done for patients older than 50 years old or at any age with history of cardiac disease.

Patients were evaluated preoperatively for GERD through a GERD questionnaire and considered at risk when they had score more than 7 and were furtherly evaluated by EGD.

When hiatus hernia was intraoperatively detected in patients with asymptomatic reflux, simultaneous repair was done during the procedure, and cholecystectomy was also performed in the same setting if gallbladder stones were detected by preoperative abdominal ultrasonography.

Moreover, we included three patients with documented preoperative GERD and hiatus hernia as they underwent LSG with hiatus hernia repair after their refusal to undergo LRNYGB for fear of malnutrition and long-term supplement intake.

EGD findings suggesting GERD were defined as follows:

(1) Hiatus hernia: caudal dislocation of the gastroesophageal junction of more than or equal to 2 cm above the indentation of the diaphragm.
(2) Esophagitis: presence of mucosal breaks classified according to the Los Angeles classification [19].
(3) Barrett's esophagus: changed stratified squamous epithelium lining of the esophagus to simple columnar epithelium with goblet cells.

Surgical technique of laparoscopic sleeve gastrectomy

All patients underwent the procedures under general anesthesia, and they were placed in the supine position with the surgeon standing between the legs, camera operator to the right of the patient, and the assistant to the left side.

Ports were placed under vision using 30° camera lens after creation of pneumoperitoneum from the midline port, and the 15-mm and 12-mm ports were used as working ports (Fig. 2).

The procedure was started by the division of gastro-epiploic vessels by using advanced bipolar technology (ligasure; Covidien/Medtronic, Minneapolis, USA) and the gastric sleeve is then created after the introduction of 36-F calibration tube. Stapling was done by linear cutting Endo GIA 60 mm (Covidien/Medtronic, Minneapolis, USA) started 4 cm from pylorus and ended at the angle of His 1 cm away from the gastroesophageal junction.

Figure 1

Point-of-Care Guides

Diagnosis of Gastroesophageal Reflux Disease

GerdQ Questionnaire

SYMPTOM	*HOW MANY TIMES DOES THIS OCCUR PER WEEK?*			
	0 DAYS	*1 DAY*	*2 OR 3 DAYS*	*4 TO 7 DAYS*
Burning feeling behind the breastbone (heartburn)	0	1	2	3
Stomach contents moving up to the throat or mouth (regurgitation)	0	1	2	3
Pain in the middle of the upper stomach area	3	2	1	0
Nausea	3	2	1	0
Trouble getting a good night's sleep because of heartburn or regurgitation	0	1	2	3
Need for over-the-counter medicine for heartburn or regurgitation (such as Tums, Rolaids, Maalox, or other antacids), in addition to the medicine your doctor prescribed	0	1	2	3

NOTE: *Add the point values for each corresponding answer. Total score of 0 to 2 points = 0 percent likelihood of GERD; 3 to 7 points = 50 percent likelihood; 8 to 10 points = 79 percent likelihood; 11 to 18 points = 89 percent likelihood.*

GERD = gastroesophageal reflux disease.

Adapted with permission from Jones R, Junghard O, Dent J, et al. Development of the GerdQ, a tool for the diagnosis and management of gastrooesophageal reflux disease in primary care. Aliment Pharmacol Ther. *2009;30(10):1034.*

GERD questionnaire. GERD, gastroesophageal reflux disease.

Hiatus hernia repair was done after reduction of the herniated stomach and mobilization of at least 3–4 cm of the esophagus intraabdominally. Then anterior cruroplasty was done with two to three interrupted stitches using nonabsorbable suture material, and the bougie was kept in place during the repair to prevent postoperative dysphagia (Figs 3 and 4).

Postoperative management and follow-up

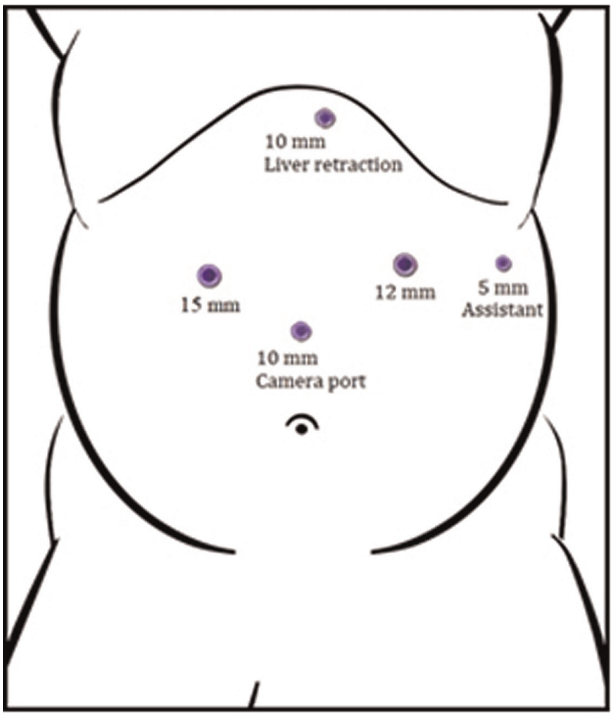
The surgeon and the clinical nutritionist assessed each follow-up visit starting from the fifth day of the discharge and then once weekly until the end of the first month. Then, patients were advised to follow-up in outpatient clinic (OPC) once per month for 1 year and the least accepted follow-up was 1 year.

Reflux symptoms were evaluated postoperatively through the GERD questionnaire, and it was furtherly evaluated by EGD if patients had persistent score more than 7 for two consecutive follow-up visits.

Postoperative EGD findings were recorded, and if GERD±hiatus hernia were found, patients were prescribed medical treatment for 3 months, and if they showed no improvement, then they were converted to LRNYGB±hiatus hernia repair.

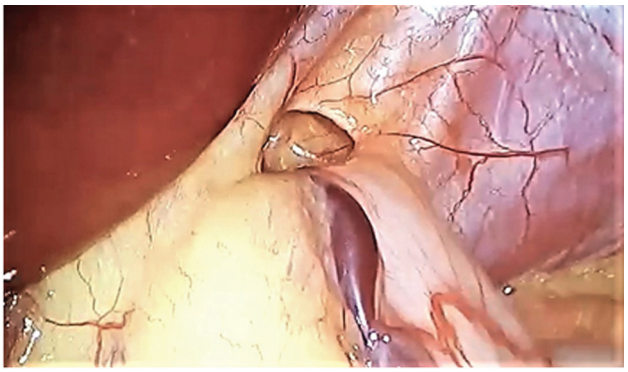
All patients received multivitamins, calcium, and protein powder supplements, and their nutritional status was assessed by clinical examination and

Figure 2



Port placement for LSG. LSG, laparoscopic sleeve gastrectomy.

Figure 3



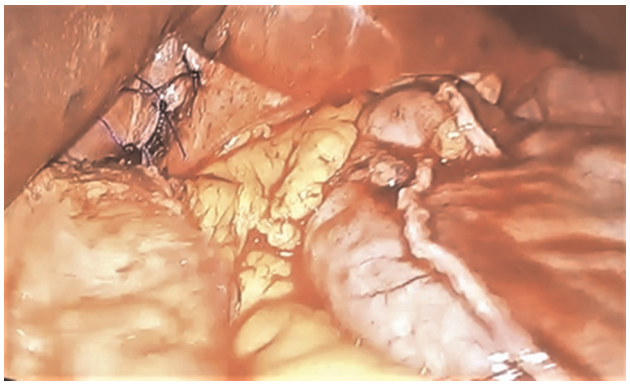
Hiatus hernia detected during sleeve gastrectomy.

routine laboratory tests every 3 months for any micronutrients or macronutrients deficiencies and were corrected as needed by the clinical nutritionist.

Statistical analysis

Data were analyzed using the statistical package for the social sciences (SPSS) (Released 2011, IBM SPSS Statistics for Windows, Version 20.0.; IBM Corp., Armonk, New York, USA). Quantitative variables were expressed as mean±SD and range, whereas qualitative variables were expressed using absolute and relative frequencies. The χ^2 test and Fisher exact test were used to study the association between qualitative variables. Student *t* test was used to study the differences between means for two groups. Statistical significance was set at *P* value less than 0.05.

Figure 4



Anterior cruroplasty.

Results

The demographic data show that 26.2% of patients in our study were females, with mean BMI of 45.2 ±7.07 kg/m^2 and mean age of 34.23±10.37 years, ranging from 17 to 65 years. Comorbid conditions were recorded (Table 1).

Six (9.2%) patients had significant preoperative GERD with score more than 7 on the questionnaire, and all of them had a preoperative EGD, and the findings are recorded in Table 2.

Of 65 LSG patients, six (9.2%) patients had hiatus hernia repair. Three (50%) of these patients were discovered intraoperatively having silent hiatus hernia without preoperative GERD (score <7) (Table 3).

Tables 4 and 5 show the 1, 3, 6, 9-month, and 1-year follow-up data for both BMI and development of postoperative GERD. There is dramatic decrease in BMI from 40.8 at 1 month to 27.09 at 1 year, indicating 66.4% decrease in BMI. Moreover, at 6 months, there were six patients who had GERD, and two of them improved at 1 year.

Table 6 shows the postoperative GERD outcome, as we can see that seven (58.3%) patients of 12 patients who experienced postoperative GERD needed postoperative UGI and one patient needed conversion to RNY bypass.

Table 7 shows the analysis of overall GERD. There was a significant relation between GERD and diabetes mellitus (DM), with *P* value of 0.005; other variables were nonsignificant.

Table 1 Demographic data, comorbidities, and preoperative gastroesophageal reflux disease

Variables	Value
Age	
Mean±SD	34.23±10.37
Range	17–65
Sex [*n* (%)]	
Male	48 (73.8)
Female	17 (26.2)
BMI	
Mean±SD	45.2±7.07
Range	35–60.40
Comorbidities [*n* (%)]	
DM	7 (10.8)
HTN	4 (6.2)
IHD	1 (1.5)
Preoperative GERD [*n* (%)]	6 (9.2)

DM, diabetes mellitus; GERD, gastroesophageal reflux disease; HTN, hypertension; IHD, ischemic heart disease.

Table 2 Preoperative esophagogastroduodenoscopy

Preoperative UGI	*n* (%)
Not done	59 (90.8)
Normal	2 (3.1)
Gastritis	1 (1.5)
HH <2 cm	1 (1.5)
HH >2 cm	2 (3.1)

HH, hiatus hernia.

Table 3 Operative details

Variables	*n* (%)
Concomitant cholecystectomy	12 (18.5)
Silent hiatus hernia	3 (4.6)
HH repair	6 (9.2)

HH, hiatus hernia.

Table 4 Postoperative BMI

	BMI
1 month	
Mean±SD	40.8±6.57
3 months	
Mean±SD	36.93±6.37
6 months	
Mean±SD	33.07±5.79
9 months	
Mean±SD	30.14±5.25
1 year	
Mean±SD	27.09±5.14

Tables 8 and 9 show the analysis of GERD at 6 months and at 1 year, respectively. There was a significant decrease in GERD in patients who underwent preoperative UGI, with *P* value of 0.032. Moreover, at 1-year follow-up, we noticed that increasing age is related to increased GERD, but these results were nonsignificant, with *P* value of 0.072.

Table 5 Postoperative gastroesophageal reflux disease

GERD	*n* (%)
1 month	1 (1.5)
3 months	4 (6.2)
6 months	6 (9.2)
9 months	5 (7.7)
1 year	4 (6.2)

GERD, gastroesophageal reflux disease.

Table 6 Postoperative gastroesophageal reflux disease outcome

Postoperative GERD outcome	*n* (%)
Medical TTT without UGI	4 (33.3)
Medical TTT after UGI	7 (58.3)
Conversion to RNY bypass	1 (8.3)

GERD, gastroesophageal reflux disease; RNY, Roux-en-Y.

Table 7 Analysis of overall gastroesophageal reflux disease

	GERD		*P* value	Test
	Yes (12)	No (53)		
Age				
Mean±SD	36.75±11.04	33.66±10.24	0.356	*t* test
BMI				
Mean±SD	45.03±8.10	45.24±6.91	0.925	*t* test
DM				
n (%)	4 (33.3)	3 (5.7)	0.005	χ^2
Preoperative UGI				
n (%)	3 (25)	3 (5.7)	0.071	Fisher
HH repair				
n (%)	2 (16.7)	4 (7.5)	0.305	Fisher

DM, diabetes mellitus; GERD, gastroesophageal reflux disease; HH, hiatus hernia..

Table 8 Analysis of gastroesophageal reflux disease at 6 months

	GERD at 6 months		*P* value	Test
	Yes (6)	No (59)		
Age				
Mean±SD	32.33±2.94	34.42±10.84	0.271	*t* test
BMI				
Mean±SD	44.88±8.97	45.23±6.95	0.909	*t* test
DM				
n (%)	2 (33.3)	5 (8.5)	0.061	χ^2
Preoperative UGI				
n (%)	2 (33.3)	4 (6.8)	0.032	χ^2
HH repair				
n (%)	1 (16.7)	5 (8.5)	0.509	χ^2

DM, diabetes mellitus; GERD, gastroesophageal reflux disease; HH, hiatus hernia..

All the patients who underwent hiatus hernia repair did not show postoperative GERD during their follow-up period, except for one (16.6%) patient who had reflux symptoms and proved to have grade C esophagitis on postoperative EGD.

Table 9 Analysis of gastroesophageal reflux disease at 12 months

	GERD at 12 months		*P* value	Test
	Yes (4)	No (61)		
Age				
Mean±SD	43.25±9.22	33.64±10.24	0.072	*t* test
BMI				
Mean±SD	48.78±7.51	44.97±7.05	0.3	*t* test
DM				
n (%)	1 (25)	6 (9.8)	0.373	Fisher
Preoperative UGI				
n (%)	1 (25)	5 (8.2)	0.328	Fisher
HH repair				
n (%)	1 (25)	5 (8.2)	0.328	Fisher

DM, diabetes mellitus; GERD, gastroesophageal reflux disease
HH, hiatus hernia.

On the contrary, one patient developed de novo postoperative GERD with score more than 7 and was found to have hiatus hernia and grade C esophagitis resistant to medical treatment and was converted to LRNGB with hiatus hernia repair at 1 year.

Regarding the postoperative complications, there was no mortality or leakage in both groups. Moreover, bleeding occurred in two (3.08%) patients, and they were managed conservatively. Moreover, gastric sleeve partial twist was found in one (1.5%) patient and was managed by endoscopic balloon dilatation (Table 10).

Table 10 Postoperative complications

Complication	*n* (%)
Bleeding	2 (3.08)
Leakage	0
Twist	1 (1.5)
GERD	12 (18.5)

GERD, gastroesophageal reflux disease.

Discussion

Morbid obesity is a chronic disorder that influences a significant extent of the population, and the commonness is increasing quickly [20]. GERD was presented in 9.2% of our patients, which is less than other studies, which had assessed the presence of upper gastrointestinal symptoms in patients with morbid obesity with a range of 10–87% [21].

Some authors noticed improved symptoms and decreased medications for GERD after LSG owing to loss of increased intra-abdominal fat, which causes high pressure [22–25].

However, others noticed significant incidence of postoperative de novo GERD, which ranges from 16 to 37.7% [26].

Moreover, there is a debate over the importance of preoperative EGD preceding bariatric procedures. Albert *et al*. [20] proposed that upper endoscopy is shown uniquely in patients with peptic ulcers or the individuals who have anatomic changes to their stomachs resulted from an earlier surgical procedure.

Cowan and Hiler [27] prescribed that all patients experiencing bariatric operations have preoperative EGD, especially as after surgical procedure, gastric or potentially duodenal mucosa may not be reached by the endoscope.

The most experienced findings in our patients were hiatal hernia (4.6%) and gastritis (1.5%), and our findings are in agreement with other presented reports portraying the pervasiveness of endoscopic discoveries in seriously obese patient [28].

Concerning gastric banding and vertical band gastroplasty, Frigg *et al*. [28] and Verset *et al*. [29] recommended EGD before the bariatric procedures on account of the high commonness of upper gastrointestinal sores that regularly require medical treatment or give data affecting the operation methodology.

Flejou *et al*. [30], with respect to vertical band gastroplasty, recommended that endoscopy has been shown to build up pattern gastric pathology before the surgical procedure. Finally, Ghassemian *et al*. [31] stated that EGD is not a piece of their preoperative gastric bypass convention.In our study, we analyzed different variables in relation with GERD, and we found a significant reduction of GERD at 6 months in those patients who underwent preoperative EGD (*P*=0.032). However, there was no significant relation between GERD and preoperative EGD at 12 months (*P*=0.328).

Moreover, there was a significant higher incidence of postoperative GERD in patients with DM (*P*=0.005), and this may be explained by possibility of autonomic neuropathy, which is a common association with DM.

The results of LRNYGB in the treatment of obesity and GERD are excellent [32]. Another study showed that the results of LSG with concomitant hiatal hernia repair are also satisfactory, with improvement of esophagitis in more than 80% of patients and persistence of GERD in the remaining 20%, and it was not related to esophagitis [33].

In our study, all hiatal hernias were repaired whether detected preoperative or intraoperative despite the presence of indications, in order to avoid GERD after the procedure. All of these patients showed no significant postoperative GERD except in one patient, and her postoperative EGD at 6 months revealed grade C esophagitis.

Postoperative EGD was done to six patients, and it showed esophagitis (1.5%), hiatus hernia and esophagitis (1.5%), Barrett's esophagus without dysplasia (1.5%), staple line ulcer (1.5%), partial gastric twist (1.5%), and normal in 1.5%. All of these patients responded well to medical treatment except in one patient who was resistant to medical treatment and was converted to LRNGB and hiatus hernia repair at 1 year.

After analyzing our data, three patients who required preoperative and postoperative EGD due to presence of GERD were found to be normal on EGD. So, we suggest further investigation to those candidates for LSG if they had preoperative GERD without clear explanation by EGD.

Conclusion

Proper preoperative evaluation and close postoperative follow-up to LSG patients are crucial especially in patients experiencing GERD. The GERD questionnaire and EGD are safe and effective tools and can suggest patients at risk. Further studies are needed on a larger number of patients with long-term follow-up to prove the optimum preoperative and postoperative workup.

Acknowledgements

The authors acknowledge all the working members and nurses in General Surgery Department and Endoscopy Unit in Helwan University Hospital and El Dar Elshifa Hospital.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis AH. The incidence of co-morbidities related to obesity and over-weight: a systematic review and meta-analysis. BMC Public Health 2009; 25:88.

2 Muñoz R, Ibáñez L, Salinas J, Escalona A, Pérez G, Pimentel F, *et al.* Importance of routine pre-operative upper GI endoscopy: why all patients should be evaluated?. Obes Surg 2009; 19:427–431.

3 Rosenthal RJ. International Sleeve Gastrectomy Expert Panel Consensus Statement: best practice guidelines based on experience of >12,000 cases. Surg Obesity Relat Dis 2012; 8:8–19.

4 Doulami G, Triantafyllou S, Natoudi M, Albanopoulos K, Leandros E, Zografos G, *et al.* GERD-related questionnaires and obese population: can they really reflect the severity of the disease and the impact of GERD on quality of patients' life?. Obes Surg 2015; 25:1882–1885.

5 Carlsson LM, Peltonen M, Ahlin S, Anveden Å, Bouchard C, Carlsson B, *et al.* Bariatric surgery and prevention of type 2 diabetes in Swedish obese subjects. N Engl J Med 2012; 367:695–704.

6 Sjöström L, Lindroos AK, Peltonen M, Torgerson J, Bouchard C, Carlsson B, *et al.* Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med 2004; 351:2683–2693.

7 Sjöström L, Narbro K, Sjöström CD, Karason K, Larsson B, Wedel H, *et al.* Effects of bariatric surgery on mortality in Swedish obese subjects. N Engl J Med 2007; 357:741–752.

8 Sharaf RN, Weinshel EH, Bini EJ, Rosenberg J, Sherman A, Ren CJ. Endoscopy plays an important preoperative role in bariatric surgery. Obes Surg 2004; 14:1367–1372.

9 Perry Y, Courcoulas AP, Fernando HC, Buenaventura PO, McCaughan JS, Luketich JD. Laparoscopic Roux-en-Y gastric bypass for recalcitrant gastroesophageal reflux disease in morbidly obese patients. JSLS 2004; 8:19–23.

10 Salvador-Sanchis JL, Martinez-Ramos D, Herfarth A, Rivadulla-Serrano I, Ibañez-Belenguer M, Hoashi JS. Treatment of morbid obesity and hiatal paraesophageal hernia by laparoscopic Roux-en-Y gastric bypass. Obes Surg 2010; 20:801–803.

11 Raftopoulos I, Awais O, Courcoulas AP, Luketich JD. Laparoscopic gastric bypass after antireflux surgery for the treatment of gastroesophageal reflux in morbidly obese patients: initial experience. Obes Surg 2004; 14:1373–1380.

12 Angrisani L, Iovino P, Lorenzo M, Santoro T, Sabbatini F, Claar E, *et al.* Treatment of morbid obesity and gastroesophageal reflux with hiatal hernia by Lap-Band. Obes Surg 1999; 9:396–398.

13 Landen S. Simultaneous paraesophageal hernia repair and gastric banding. Obes Surg 2005; 15:435–438.

14 Frezza EE, Barton A, Wachtel MS. Crural repair permits morbidly obese patients with not large hiatal hernia to choose laparoscopic adjustable banding as a bariatric surgical treatment. Obes Surg 2008; 18:583–588.

15 Boules M, Corcelles R, Guerron AD, Dong M, Daigle CR, El-Hayek K, *et al.* The incidence of hiatal hernia and technical feasibility of repair during bariatric surgery. Surgery 2015; 158:911–916.

16 Balla A, Quaresima S, Ursi P, Seitaj A, Palmieri L, Badiali D, *et al.* Hiatoplasty with crura buttressing versus hiatoplasty alone during laparoscopic sleeve gastrectomy. Gastroenterol Res Pract 2017; 2017:6565403.

17 Iannelli A, Martini F, Schneck AS, Gugenheim J. Twisted gastric sleeve. Surgery 2015; 157:163–165.

18 Jones R, Junghard O, Dent J, Vakil N, Halling K, Wernersson B, Lind T. Development of the GerdQ, a tool for the diagnosis and management of gastrooesophageal reflux disease in primary care. Aliment Pharmacol Ther 2009; 30:1034.

19 Lundell LR, Dent J, Bennett JR, Blum AL, Armstrong D, Galmiche JP, *et al.* Endoscopic assessment of esophagitis: clinical and functional correlates and further validation of the Los Angeles classification. Gut 1999; 45:172–180.

20 Albert M, Spanos C, Shikora S. Morbid obesity: the value of surgical intervention. Clin Fam Pract 2002; 4:447–458.

21 Korenkov M, Köhler L, Yücel N, Grass G, Sauerland S, Lempa M, *et al.* Esophageal motility and reflux symptoms before and after bariatric surgery. Obes Surg 2002; 12:72–76.

22 Pallati PK, Shaligram A, Shostrom VK, Oleynikov D, McBride CL, Goede MR. Improvement in gastroesophageal reflux disease symptoms after various bariatric procedures: review of the bariatric outcomes longitudinal database. Surg Obes Relat Dis 2014; 10:502–507.

23 Varban OA, Hawasli AA, Carlin AN, Genaw JA, Wayne E, Dimick JB, *et al.* Variation in utilization of acid reducing medications at 1 year following bariatric surgery: results from the Michigan Bariatric Surgery Collaborative. Surg Obes Relat Dis 2015; 11:222–228.

24 Barr AC, Frelich MJ, Bosler ME, Goldblatt MI, Gould JC. GERD and acid reduction medication use following gastric bypass and sleeve gastrectomy. Surg Endosc 2017; 31:410–415.

25 Santonicola A, Angrisani L, Cutolo P, Formisano G, Iovino P. The effect of laparoscopic sleeve gastrectomy with or without hiatal hernia repair on gastroesophageal reflux disease in obese patients. Surg Obes Relat Dis 2014; 10:250–255.

26 Althuwaini S, Bamehriz F, Aldohayan A, Alshammari W, Alhaidar S, Alotaibi M, *et al.* Prevalence and predictors of gastroesophageal reflux disease after laparoscopic sleeve gastrectomy. Obes Surg 2018; 28:916–922.

27 Cowan GSM, Hiler ML. Upper gastrointestinal endoscopy in bariatric surgery. Deitel M, ed. Update: surgery for the morbidly obese patient. Toronto: FD Communications Inc. 2000. 387–416

28 Frigg A, Peterli R, Zynamon A, Lang C, Tondelli P. Radiologic and endoscopic evaluation for laparoscopic adjustable gastric banding: preoperative and follow-up. Obes Surg 2001; 11:594–599.

29 Verset D, Houben JJ, Gay F, Elcheroth J, Bourgeois V, Van Gossum A. The place of upper gastrointestinal tract endoscopy before and after vertical banded gastroplasty for morbid obesity. Dig Dis Sci 1997; 42:2333–2337.

30 Flejou JF, Owen ER, Smith AC, Price AB. Effect of vertical banded gastroplasty on the natural history of gastritis in patients with morbid obesity: a follow-up study. Br J Surg 1988; 75:705–707.

31 Ghassemian AJ, MacDonald KG, Cunningham PG, Swanson M, Brown BM, Morris PG, *et al.* The workup for bariatric surgerydoes not require a routine upper gastrointestinal series. Obes Surg 1997; 7:16–18.

32 Biter LU, van Buuren MMA, Mannaerts GHH, Apers JA, Dunkelgrün M, Vijgen GHEJ. Quality of life 1 year after laparoscopic sleeve gastrectomy versus laparoscopic Roux-en-Y gastric bypass: a randomized controlled trial focusing on gastroesophageal reflux Disease. Obes Surg 2017; 2557–2565

33 Garg H, Vigneshwaran B, Aggarwal S, Ahuja V. Impact of concomitant laparoscopic sleeve gastrectomy and hiatal hernia repair on gastro-oesophageal reflux disease in morbidly obese patients. J Minim Access Surg 2017; 13:103–108.