Obesity Surgery (2019) 29:2263–2269
https://doi.org/10.1007/s11695-019-03840-5

ORIGINAL CONTRIBUTION

Food Tolerance After Laparoscopic Sleeve Gastrectomy with Total Antral Resection

Ibrahim G. Khalifa[1] · Wael L. Tobar[1] · Tarek O. Hegazy[1] · Hany A. Balamoun[1] · Sameh Mikhail[1] · Mohammed Abdalla Salman[1] · Elsayed A. Elsayed[1]

Published online: 21 March 2019

Abstract

Background Among the controversial points in laparoscopic sleeve gastrectomy (LSG) is how much of the antrum to be resected. This study aimed to evaluate food tolerance after preservation or resection of the antrum during LSG.

Methods Prospective randomized study included 50 patients scheduled for LSG. Participants were randomly allocated into one of two groups. In antral resection (AR-LSG) group ($n = 25$), resection started 2 cm from the pylorus. In antral sparing (AS-LSG) group ($n = 25$), it started 6 cm from the pylorus. Percentage of excess weight loss (%EWL) and percentage of excess BMI loss (%EBL) were evaluated after 3 and 6 months. Quality of life (QOL) was evaluated by using the Bariatric Analysis and Reporting Outcome System (BAROS). Food tolerance was assessed using the Quality of Alimentation questionnaire. Primary outcome measure was food tolerance and %EWL.

Results Food tolerance was significantly better in the antral sparing group compared to the antral resection group after 3 and 6 months. The two groups were comparable in %EWL and BMI change after 3 and 6 months. Six months after surgery, the majority of patients had a very good quality of life, with no significant difference between the two groups ($p = 0.877$). There was no significant difference between the two groups in operative time, intraoperative blood loss, and hospital stay.

Conclusions Preservation of the pyloric antrum during LSG is associated with significantly better food tolerance and comparable effect of weight loss up to 6 months postoperatively when compared with total antral resection.

Keywords Sleeve gastrectomy · Antral resection · Food tolerance

Introduction

Obesity is one of the most common life-threatening conditions. It is the new epidemic of the twenty-first century [1]. Obesity is associated with increased mortality and a high burden of comorbidities including diabetes mellitus, hypertension, and obstructive sleep apnea syndrome [2].

Several procedures are involved in the surgical management of morbid obesity. According to the International Federation for the Surgery of Obesity and Metabolic Disorders, sleeve gastrectomy (SG) was the most commonly performed procedure worldwide in 2014 reaching 45.9% followed by Roux-en-Y gastric bypass (39.6%) [3].

Laparoscopic sleeve gastrectomy (LSG) has been demonstrated to be effective in weight loss and resolution of comorbidities [4, 5]. In a recent comparative study, excess body mass index (BMI) loss after LSG was comparable to that after Roux-en-Y gastric bypass [5]. The percentage of excess weight loss after LSG reaches 60 to 75% in different studies [6, 7].

✉ Hany A. Balamoun
hanyarmia@hotmail.com

Ibrahim G. Khalifa
ibrahimghk@yahoo.com

Wael L. Tobar
waeltobar@yahoo.com

Tarek O. Hegazy
ticegy@yahoo.com

Sameh Mikhail
samehmikhail@kasralainy.edu.eg

Mohammed Abdalla Salman
MOHAMMED.SALMAN@kasralainy.edu.eg

Elsayed A. Elsayed
ashour10000@gmail.com

[1] Department of General Surgery, Faculty of Medicine, Cairo University, Cairo 11562, Egypt

A review of studies evaluating long-term weight loss results reported that LSG appears to maintain well-documented weight loss outcome at 5 years or more postoperatively. The overall mean percentage of excess weight loss (%EWL) was above 50% [8].

Sleeve gastrectomy is a technically simple procedure with clear key steps. However, several technical details are not yet in consensus among bariatric surgeons. The controversial aspects include bougie size, the section shape at the gastroesophageal junction, and the need to reinforce the staple line [9]. Another controversy is the extent to which the antrum is excised, i.e., the distance from the pylorus to start gastric transection. This distance is highly variable between 2 and 8 cm [10–14].

Therefore, in this study, we proposed the question of whether to preserve or to sacrifice the antrum in laparoscopic sleeve gastrectomy for a better food tolerance.

Patients and Methods

This prospective randomized study included 50 patients with morbid obesity scheduled for LSG. They were recruited from Kasr Al-Aini hospital between September 2017 and December 2017. Written informed consent was obtained from each patient to be enrolled in the study after a complete explanation of the nature of the procedure and the research.

The inclusion criteria were adults with morbid obesity, defined as BMI > 40 kg/m^2 or > 35 kg/m^2 associated with comorbidity (diabetes mellitus, hypertension, arthritis, or obstructive sleep apnea). The exclusion criteria were cardiac diseases, hypothyroidism, previous upper GIT surgery, hiatus hernia, and pregnancy.

Preoperative Assessment

All patients were subjected to thorough history taking and clinical examination. Complete liver function tests, renal function tests, and the usual screening blood tests were performed. A routine preoperative screening upper endoscopy was done to rule the presence of GERD and intrinsic lesions of the stomach or duodenum. Low molecular weight heparin was routinely administered subcutaneously 12 h before the operation and at appropriate intervals after that, for at least 2 days or until the patient is ambulatory.

Operative Details

The participants were randomly allocated into one of two treatment groups using closed envelope method withdrawn by a nurse in the operative theater after the dissection step in the two groups. In antral resection (AR-LSG) group ($n = 25$), total antral resection was done where stapler line was started 2 cm from the pylorus. The antrum was preserved in antral sparing (AS-LSG) group ($n = 25$) where stapler line was started 6 cm from the pylorus.

With the patient in a modified lithotomy position, under general anesthesia, pneumoperitoneum was created using CO_2 up to a pressure of 14 to 15 mmHg. Five trocars were inserted in the upper abdomen, one for the camera, two for the operator, one for liver retraction, and one for the assistant. Complete devascularization of the greater curvature and fundus by using a harmonic scalpel was performed. A 38-Fr bougie was inserted transorally and advanced to the pylorus. The stomach was transected along the bougie by a reticulating linear stapler to create the gastric sleeve around the bougie starting proximal to the pyloric ring according to the group assignment. The stomach was then resected and retrieved, and all 12-mm trocar sites were closed.

Data collected intraoperatively included operative time, the number of the used stapler, blood loss, and the need for blood transfusion and conversion to open surgery in the two groups.

Postoperative Care

Postoperative evaluation by an oral gastrografin test in the 2nd postoperative day was done to assess the integrity of the suture line. Ryle was removed, and oral liquid diet was resumed immediately in the absence of fistula on this leak test. Then, the clear output drain was removed usually in the 2nd day, and the patient was discharged if hemodynamically stable, pain-free.

All patients followed the same postoperative regimen for oral intake which consists of exclusive oral fluids for 2 weeks after which semi-solid food is to be added and encouraged for another 2 weeks. Free oral diet is then allowed and encouraged after the fourth week. Subsequently, a long-term hypocaloric, protein-enriched solid diet was maintained. Long-term oral daily supplements of vitamins and monthly administration of the intramuscular vitamin B12 were given to all patients.

The postoperative evaluation of the patients was done through outpatient visits for any upper gastrointestinal symptoms (heartburn, regurgitation, dysphagia, and vomiting), change in BMI, %EWL, resolution or improvement in medical comorbidities, and symptoms and signs of vitamin deficiency after 3 and 6 months.

The %EWL was defined as lost weight/(preoperative weight − ideal body weight), with ideal body weight usually captured through the Metropolitan Life Tables. Percentage of excess BMI loss (%EBL) was defined as BMI points lost/(preoperative BMI − 25).

The quality of life (QOL) was evaluated by using the Bariatric Analysis and Reporting Outcome System (BAROS). The Moorehead–Ardelt Quality of Life Questionnaire incorporated into the BAROS is designed on a single page and uses

simple drawings to offer five options for each of the five QOL questions: self-esteem, physical activity, social life, work conditions, and sexual activity. Points are added or subtracted according to the patient's response [15].

Food tolerance was assessed using the *Quality of Alimentation* questionnaire. This questionnaire is divided into four parts:

1. Overall assessment of the patient's satisfaction with the quality of his/her alimentation
2. Questions about the timing of meals and food intake between meals
3. Evaluation of tolerance of eight different types of food
4. Evaluation of the frequency of vomiting/regurgitation

A score is derived from parts 1, 3, and 4 of the questionnaire. Patient's satisfaction with food intake is given between 1 (very poor) and 5 (excellent) points. Food tolerance is given between 0 and 16 points: for each specific type of food, 2 points if the patient can eat this type without any particular difficulty, 1 point if he/she can eat it with some difficulties/restrictions, and 0 points if he/she cannot eat it at all. The importance of vomiting/regurgitation is given between 0 and 6 points: daily vomiting or regurgitation, 0 points; three or more times a week, 2 points; up to twice a week, 4 points; never, 6 points. The score can, therefore, vary between 1 and 27, 27 being the maximum for an excellent food tolerance [16].

The patients were evaluated postoperatively by oral gastrografin and esophagogastroscopy 3 and 6 months, to assess the gastric tube and to exclude the presence of GERD or stricture. Routine abdominal US was done at 6 months follow-up, to detect GB development.

The primary outcome measure was food tolerance and %EWL. Secondary outcome measures were operative time, length of postoperative stay, in-hospital mortality, resolution of comorbidity, and postoperative complication (leakage, internal bleeding, and wound complication).

Statistical Methods

Statistical analysis was done using IBM© SPSS© Statistics version 23 (IBM© Corp., Armonk, NY, USA). The power of the test used for primary outcome measure was estimated using the G*Power© software (Institutfür Experimentelle Psychologie, Heinrich Heine Universität, Düsseldorf, Germany) version 3.1.9.2. Chi-square test (Fisher's exact test) was used to examine the relationship between qualitative variables. For quantitative data, the comparison between the two groups was made using independent sample *t* test or Mann–Whitney test. Comparison of repeated measures was made using paired *t* test. A p value < 0.05 was considered significant.

Results

The mean age of the studied group was 34.1 ± 8.3 years. They were 17 males (34%) and 33 females (66%). There was no significant difference between the two groups in age, sex, and BMI (Table 1).

Six months after surgery, the majority of patients had a very good quality of life measured using the BAROS quality of life score (Table 2), with no significant difference between the two groups ($p = 0.877$). Food tolerance was significantly better in the antral sparing group compared to the antral resection group after 3 and 6 months (Table 3). In the two groups, the Quality of Alimentation scores increased significantly after 6 months compared to the 3-month readings ($p < 0.001$). There was no significant difference between the two groups in operative time, intraoperative blood loss, and hospital stay (Table 4).

The staple line failed in one case in AE-LSG group where oversewing of the risky part of the staple line was done by a running suture, and no postoperative leakage was detected. Bleeding from staple line was noticed in 11 cases, 5 cases in AE-LSG group and 6 in AS-LSG group. Hemostasis was achieved using ligaclips in eight cases and suturing in three cases.

Table 1 Baseline characteristics of the two studied groups

	AR-LSG group ($n = 25$)	AS-LSG group ($n = 25$)	p value
Age (years)	35.1 ± 9.1	33.1 ± 7.5	0.326
Sex	8/17	9/16	0.597
Body mass index (kg/m^2)	59.5 ± 9.4	58.4 ± 8.4	0.479
Comorbid conditions			
Diabetes mellitus	6 (24%)	5 (20%)	0.347
Hypertension	6 (24%)	3 (12%)	0.235
Co-arthritis	7 (28%)	8 (32%)	0.573
Sleep apnea	6 (24%)	6 (24%)	0.740

Data are expressed as mean ± SD or number (%)

Table 2 BAROS quality of life score after 6 months in the two studied groups

Quality of life score	AR-LSG group ($n = 25$)	AS-LSG group ($n = 25$)	p value
Fair	1 (2.0%)	1 (2.0%)	
Good	8 (16.0%)	9 (18.0%)	0.877
Very good	16 (32.0%)	13 (26.0%)	
Excellent	1 (2.0%)	2 (4.0%)	

Data are expressed as number (%)

Postoperative complications were recorded in three patients in each group. These were one case of SMV thrombosis, internal hemorrhage, and gastric leak in AE-LSG group and two cases of internal bleeding and one wound complication in AS-LSG group. In cases of hemoperitoneum, conservative treatment by blood transfusion succeeded in one patient and laparoscopic re-exploration was done for the other two patients. The gastric leak was treated by a combined approach of laparoscopic re-exploration and endoscopic prosthesis. No mortalities or conversion to open surgery occurred. Re-operation was required in three patients (6%) due to suture line bleeding (two patients, one in each group) and gastric leak (one patient).

Table 5 shows that the two groups were comparable in %EWL and BMI change after 3 and 6 months and complete resolution of associated comorbid conditions after 6 months.

Eleven patients (22%) had persistent attacks of vomiting for more than 3 weeks, nine (36%) in AE-LSG group and two (8%) in AS-LSG group ($p = 0.004$). Oral gastrografin study and endoscopy were normal, and vomiting frequency decreased gradually in all cases after 3 months. They were successfully managed conservatively by IV fluids and antiemetic. Thirteen patients had symptoms and signs of vitamin B12 deficiency with no significant difference between the two groups ($p = 0.567$). They were treated by oral or IM vitamin B12 supplementation.

Nine patients had preoperative GERD with no significant difference between the two groups. After surgery, complete resolution of GERD was observed in AE-LSG group, while GERD resolved in only two of the four cases in AS-LSG group. Two patients developed GERD de novo after surgery, one in each group.

Discussion

The results of this study demonstrated significantly better food tolerance after 3 and 6 months when gastric resection proximity to the pylorus was extended to 6 cm compared to starting resection 2 cm from the pylorus. Antral sparing and resection techniques were comparably effective regarding weight loss, and resolution of comorbid conditions up to 6 months of follow-up. The majority of patients had a very good quality of life after surgery with no significant difference between the two groups. Also, the two groups were comparable in the frequency of postoperative complications. Nonetheless, persistent vomiting was more commonly encountered in antral resection group.

Despite the increasing popularity of LSG, to date, there is no consensus about many aspects in the surgical technique. One controversial point is where to start the staple line. According to the consensus panel for LSG, the mean resection proximity to the pylorus was 5.6 ± 1.5 cm [17]. Some surgeons prefer to start stapling 2 cm from pylorus [12–14], while others start 6 cm from the pylorus [10, 11, 18, 19]. More recently, in 2014, 120 expert bariatric surgeons completed Web-based survey on aspects of LSG to identify best practice. The same survey was administered to 103 bariatric surgeons attending the 5th International Conference on Sleeve Gastrectomy in 2014. Most experts (77.5%) believe that a distance > 3 cm from the pylorus is recommended to start the stapling line [20].

Advocates of a total antral resection claim that since LSG is principally a restrictive procedure, more restriction attains better weight loss [13]. Conservative surgeons underscore the necessity to preserve the physiological emptying mechanism of the stomach to avoid increasing the intraluminal pressure

Table 3 Quality of Alimentation Questionnaire score in the two studied groups after 3 and 6 months

	AR-LSG group ($n = 25$)	AS-LSG group ($n = 25$)	p value
Post 3 months	18.8 ± 1.0	22.4 ± 0.6	< 0.001
Post 6 months	21.4 ± 0.6	23.6 ± 0.5	0.012
Mean diff.	2.58 ± 0.2	1.12 ± 0.1	
p value	< 0.001	< 0.001	

Data are expressed as mean ± SD (%)

Table 4 Operative time, hospital stay, blood loss, and number of staplers used in both groups

	AR-LSG group ($n = 25$)	AS-LSG group ($n = 25$)	p value
Operative time (min)	141 ± 50	137 ± 43	0.713
Hospital stay (day)	4 (2–6)	3 (1–5)	0.430
Blood loss (ml)	81 ± 38	89 ± 64	0.197

Data are expressed as mean ± SD or median (range)

which may increase staple-line leak and gastroesophageal reflux [21, 22].

In this study, we tested another aspect of the effect of the extent antral resection, i.e., food tolerance. We proposed that preserving more of the antrum during LSG may result in better food tolerance. This assumption was based on the role of the antrum in the process of gastric emptying. The proximal stomach relaxes in two phases following food intake, an initial receptive phase followed by a prolonged adaptive phase. Retained solids are transferred to the distal stomach to be ground into small particles by the irregular tonic antral and phasic pyloric contractions. These particles are mixed with gastric juice to form the chyme that is propelled into the duodenum [23]. Therefore, lack of the antral part of the stomach may interfere with proper manipulation of solid foods with the consequent food intolerance.

Traditionally, postoperative results in bariatric surgery are judged by BAROS questionnaire. In the current study, both approaches of antral management were comparably effective in accomplishing very good quality of life using the BAROS score. It was judged as a useful tool for assessment of QOL following bariatric surgery. It addresses five QOL questions: self-esteem, physical activity, social life, work conditions, and sexual activity [15]. Nevertheless, this questionnaire does not evaluate food tolerance [24], which is the primary objective of the current study.

Therefore, we used the *Quality of Alimentation* score to assess food intolerance when antrum was excised or preserved. It is a specially tailored tool for assessment of food tolerance following bariatric surgery [16]. It interviews the patients about their satisfaction with food quality, the time between meals and food intake between them, tolerance of eight different types of food, and frequency of vomiting or regurgitation. It was validated in 300 patients who underwent gastric banding, 600 who underwent RYGB, 75 nonobese patients, and 55 morbidly obese patients not operated [16].

This questionnaire was used in many similar articles and was found to be an easy and fast tool to evaluate food tolerance. In a descriptive–exploratory study, Stumpf et al. reported its use in a total of 2745 patients in 14 articles following different bariatric procedures. The questionnaire showed good acceptability by the patients [25].

To the best our knowledge, the current study is the first to test the effect of antral resection on food tolerance clinically. Michalsky et al. [26] investigated the impact of radical resection on the physiological stomach evacuation function using gastric emptying scintigraphy. In their pilot study, 12 patients were randomly divided to have antrum resection or preservation. They found no significant difference between antrum resection and antrum preservation regarding the values of weight, BMI, or %EWL. Evacuation half-time and average food retention dropped

Table 5 Changes of body mass index and EWL at 3 and 6 months in the two studied groups

	AR-LSG group ($n = 25$)	AS-LSG group ($n = 25$)	p value
Body mass index (kg/m^2)			
After 3 months	46.4 ± 7.6	49.5 ± 7.6	0.114
After 6 months	38.6 ± 6.7	42 ± 6.8	0.095
%EWL			
After 3 months	35.1 ± 7.6	31.1 ± 6.5	0.069
After 6 months	54.5 ± 9.1	49.2 ± 10.4	0.083
Complete resolution of			
Diabetes mellitus	5/6 (83.3%)	4/5 (80.0%)	0.899
Arthritis	5/7 (71.4%)	5/7 (71.4%)	0.554
Hypertension	5/6 (83.3%)	3/3 (100.0%)	0.708
Sleep apnea	5/6 (83.3%)	4/6 (66.7%)	0.677

Data are expressed as mean ± SD or number (%)

significantly and 3 months after surgery. Therefore, in *their pilot study*, they concluded that radical resection of the antrum did not lead necessarily to gastric emptying disorder with clinical symptoms as gastroesophageal reflux or dumping syndrome [26].

In the current study, antrum preservation and resection were comparable in other aspects dealt with in previous studies, i.e., bariatric efficacy and procedure complications. Regarding weight loss, in the current study, there was no significant difference between the two techniques regarding weight and BMI loss after 6 months. In agreement with this, other investigators reported a similar effect on weight loss of antral preservation of resection [26–28]. Contrarily, better weight loss up to 12 months was reported by Abdallah et al. [21]. A recent meta-analysis demonstrated nonsignificantly better weight loss at 12 months after antral resection [29].

The staple line failed in one case in AE-LSG group in the current study, and no postoperative leakage was detected. Abdallah et al. reported failed staple line in one patient in each group of their series with no postoperative leakage [21]. Similarly, ElGeidie et al. reported a single case of postoperative leakage. The recent meta-analysis did not reach a statistical significance owing to the small number of cases with leakage and the wide confidence intervals [29]. Similar results were obtained concerning staple-line bleed. There was no difference between the two surgical approaches in the incidence of bleed in individual studies [21, 26, 27, 30, 31] and on meta-analysis [29]. In the current study, two patients developed de novo GERD postoperatively, one in each group. This finding is concordant with previous results [21, 26, 29, 30].

Therefore, we can conclude that preservation of the pyloric antrum during LSG is associated with significantly better food tolerance up to 6 months postoperatively when compared with total antral resection. This relative advantage was not accompanied by compromised efficacy regarding weight loss and resolution of comorbidities. Both approaches provide very good quality of life with limited postoperative complications apart from more common persistent vomiting after antral resection.

Compliance with Ethical Standards The study protocol was approved by the local ethical committee.

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Ray I, Bhattacharya A, De RK. OCDD: an obesity and co-morbid disease database. BioData Min [Internet]. 2017 [cited 2018 Nov 27];10. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5697160/.
2. Must A, NM MK. The disease burden associated with overweight and obesity. In: De Groot LJ, Chrousos G, Dungan K, Feingold KR, Grossman A, Hershman JM, et al., editors. Endotext [Internet]. South Dartmouth: MDText.com, Inc; 2000. [cited 2018 Nov 27]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK279095/.
3. Angrisani L, Santonicola A, Iovino P, et al. Bariatric surgery and endoluminal procedures: IFSO worldwide survey 2014. Obes Surg. 2017;27:2279–89.
4. Helmiö M, Victorzon M, Ovaska J, et al. SLEEVEPASS: a randomized prospective multicenter study comparing laparoscopic sleeve gastrectomy and gastric bypass in the treatment of morbid obesity: preliminary results. Surg Endosc. 2012;26:2521–6.
5. Peterli R, Wölnerhanssen BK, Peters T, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss in patients with morbid obesity. JAMA. 2018;319:255–65.
6. Skrekas G, Lapatsanis D, Stafyla V, et al. One year after laparoscopic "tight" sleeve gastrectomy: technique and outcome. Obes Surg. 2008;18:810–3.
7. Nocca D, Krawczykowsky D, Bomans B, et al. A prospective multicenter study of 163 sleeve gastrectomies: results at 1 and 2 years. Obes Surg. 2008;18:560–5.
8. Diamantis T, Apostolou KG, Alexandrou A, et al. Review of long-term weight loss results after laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2014;10:177–83.
9. Ferrer-Márquez M, Belda-Lozano R, Ferrer-Ayza M. Technical controversies in laparoscopic sleeve gastrectomy. Obes Surg. 2012;22:182–7.
10. Cottam D, Qureshi FG, Mattar SG, et al. Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high-risk patients with morbid obesity. Surg Endosc. 2006;20:859–63.
11. Silecchia G, Boru C, Pecchia A, et al. Effectiveness of laparoscopic sleeve gastrectomy (first stage of biliopancreatic diversion with duodenal switch) on co-morbidities in super-obese high-risk patients. Obes Surg. 2006;16:1138–44.
12. Givon-Madhala O, Spector R, Wasserberg N, et al. Technical aspects of laparoscopic sleeve gastrectomy in 25 morbidly obese patients. Obes Surg. 2007;17:722–7.
13. Baltasar A, Serra C, Pérez N, et al. Laparoscopic sleeve gastrectomy: a multi-purpose bariatric operation. Obes Surg. 2005;15:1124–8.
14. Mognol P, Chosidow D, Marmuse J-P. Laparoscopic sleeve gastrectomy as an initial bariatric operation for high-risk patients: initial results in 10 patients. Obes Surg. 2005;15:1030–3.
15. Oria HE, Moorehead MK. Bariatric analysis and reporting outcome system (BAROS). Obes Surg. 1998;8:487–99.
16. Suter M, Calmes J-M, Paroz A, et al. A new questionnaire for quick assessment of food tolerance after bariatric surgery. Obes Surg. 2007;17:2–8.
17. Deitel M, Crosby RD, Gagner M. The first international consensus summit for sleeve gastrectomy (SG), New York City, October 25-27, 2007. Obes Surg. 2008;18:487–96.
18. Bernante P, Foletto M, Busetto L, et al. Feasibility of laparoscopic sleeve gastrectomy as a revision procedure for prior laparoscopic gastric banding. Obes Surg. 2006;16:1327–30.
19. Sánchez-Santos R, Masdevall C, Baltasar A, et al. Short- and mid-term outcomes of sleeve gastrectomy for morbid obesity: the experience of the Spanish National Registry. Obes Surg. 2009;19:1203–10.

20. Gagner M, Hutchinson C, Rosenthal R. Fifth International Consensus Conference: current status of sleeve gastrectomy. Surg Obes Relat Dis. 2016;12:750–6.
21. Abdallah E, El Nakeeb A, Youssef T, et al. Impact of extent of antral resection on surgical outcomes of sleeve gastrectomy for morbid obesity (a prospective randomized study). Obes Surg. 2014;24:1587–94.
22. Nakane Y, Michiura T, Inoue K, et al. Length of the antral segment in pylorus-preserving gastrectomy. Br J Surg. 2002;89:220–4.
23. Stevens JE, Jones KL, Rayner CK, et al. Pathophysiology and pharmacotherapy of gastroparesis: current and future perspectives. Expert Opin Pharmacother. 2013;14:1171–86.
24. Moreira M de A, Espínola PR, de Azevedo CW. Food intolerances and associated symptoms in patients undergoing FOBI-CAPELLA technique without gastric ring. Arq Bras Cir Dig. 2015;28:36–9.
25. Stumpf MA, Rodrigues MR, Kluthcovsky AC, et al. Analysis of food tolerance in patients submitted to bariatric surgery using the questionnaire quality of alimentation. Arq Bras Cir Dig. 2015;28:79–83.
26. Michalsky D, Dvorak P, Belacek J, et al. Radical resection of the pyloric antrum and its effect on gastric emptying after sleeve gastrectomy. Obes Surg. 2013;23:567–73.
27. ElGeidie A, ElHemaly M, Hamdy E, et al. The effect of residual gastric antrum size on the outcome of laparoscopic sleeve gastrectomy: a prospective randomized trial. Surg Obes Relat Dis. 2015;11:997–1003.
28. Sabench Pereferrer F, Molina López A, Vives Espelta M, et al. Weight loss analysis according to different formulas after sleeve gastrectomy with or without antral preservation: a randomised study. Obes Surg. 2017;27:1254–60.
29. McGlone ER, Gupta AK, Reddy M, et al. Antral resection versus antral preservation during laparoscopic sleeve gastrectomy for severe obesity: systematic review and meta-analysis. Surg Obes Relat Dis. 2018;14:857–64.
30. Obeidat F, Shanti H, Mismar A, et al. The magnitude of antral resection in laparoscopic sleeve gastrectomy and its relationship to excess weight loss. Obes Surg. 2015;25:1928–32.
31. Yormaz S, Yılmaz H, Ece I, et al. Midterm clinical outcomes of antrum resection margin at laparoscopic sleeve gastrectomy for morbid obesity. Obes Surg. 2017;27:910–6.