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ORIGINAL CONTRIBUTIONS

Revision of Sleeve Gastrectomy with Hiatal Repair with Gastropexy for Gastroesophageal Reflux Disease

Tien-Chou Soong[1,2] · Owaid M. Almalki[2,3] · Wei-Jei Lee[2] · Kong-Han Ser[2] · Jung-Chien Chen[2] · Chun-Chi Wu[2] · Shu-Chun Chen[2]

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Abstract

Background Gastroesophageal reflux disease (GERD) is the major drawback of laparoscopic sleeve gastrectomy (LSG). Conversion to Roux-en-Y bypass is recommended but might not be suitable for all patients.

Methods We retrospectively reviewed the data of patients who underwent laparoscopic hiatal repair and gastropexy for intractable GERD after LSG between 2015 and 2017. Data on upper gastrointestinal (GI) study findings and proton pump inhibitor (PPI) use was collected. The GERD-health-related quality of life (GERD-HRQL) questionnaire assessed patient symptoms. Perioperative outcomes, GERD symptoms, and medication details were analyzed.

Results Twenty-eight patients were included. Mean interval from the initial LSG to revision surgery was 40.8 months (range, 6–108). Mean body mass index before LSG was 34 kg/m^2, whereas that before revision surgery was 25.7 kg/m^2. Mean revision surgery time was 126 min, whereas the mean length of stay was 3.6 days. No major surgical complication occurred. The mean GERD-HRQL score before revision surgery was 24.3 and decreased to 12.3 at 1 month after surgery. Mean GERD-HRQL scores at 6, 12, and 24 months after revision surgery were 16.8, 17.4, and 18.9, respectively. All patients required daily proton pump inhibitor pre-operatively; only 26% could discontinue them postoperatively. Of the 28 patients, 14 (50.0%) were satisfied with the surgery, 8 (28.6%) had a neutral attitude, and 6 (21.4%) were dissatisfied. Three (11.1%) patients agreed to undergo Roux-en-Y gastric bypass.

Conclusion Hiatal repair with gastropexy is an acceptable treatment option for GERD after LSG but not very effective because of partial remission of symptoms.

Keywords Sleeve gastrectomy · Intractable GERD · Gastropexy · Hiatal repair

Introduction

Obesity is a worldwide epidemic with an increasing prevalence, especially morbid obesity [1]. Bariatric surgery results in sustainable weight reduction and the remission of obesity-related comorbidities in cases of morbid obesity [2, 3]. Laparoscopic sleeve gastrectomy (LSG) has recently gained popularity among bariatric surgeons and has become the preferred bariatric procedure [4, 5]. LSG has the advantages of relative technical simplicity, reduced impact on the gut physiology, and few potential serious postoperative complications, but gastro-esophageal reflux disease (GERD) is a major side effect faced by surgeons [6, 7]. Although pre-operative GERD might improve after LSG, many patients develop de novo GERD in the long term. The incidence of GERD at 5–10 years is reportedly from 11 to 50% [6–10]; our own experience with de novo GERD at 10 years after LSG was 45% [10].

Conversion to Roux-en-Y gastric bypass (RYGB) is recommended in cases of intractable GERD after LSG [9]. However, this might not be the procedure of choice in those with good weight loss if its risks are considered [11, 12]. Other procedures that can provide good GERD symptom relief carry fewer risks and potential complications. Recent reports described anterior fundoplication for patients with a dilated gastric tube [13], magnetic ring (LINX) for patients without hiatal hernia and gastric tube dilatation [14], and round ligament

✉ Wei-Jei Lee
wjlee_obessurg_tw@yahoo.com.tw

[1] Center of Weight Loss and Health Management, E-DA Dachang Hospital, Kaohsiung, Taiwan

[2] Department of Surgery, Min-Sheng General Hospital, Taoyuan, Taiwan

[3] Department of Surgery, College of Medicine, Taif University, Taif, Saudi Arabia

reinforcement of the esophagocardia (EC) junction [15]. However, none of the techniques had sufficient case numbers or adequate follow-up data. Here, we present our experience with hiatal repair and gastropexy to align the distorted gastric tube for those who had intractable GERD that failed intense medical treatment.

Materials and Methods

Eligibility

Approval was obtained from our institutional review board. This retrospective review of a prospectively maintained database identified patients who underwent LSG with a non-RYGB procedure (hiatal repair and gastropexy) for intractable GERD after LSG. A thorough assessment was performed The inclusion criteria were: history of intractable GERD for more than 6 months, hiatal hernia, gastric kinking or torsion (Figs. 1 and 2), and refusal to undergo conversion to RYGB. The exclusion criteria were: Barrett's esophagus, gastric tube stenosis, and revision surgery. All patients provided written informed consent before undergoing surgery.

Surgical Technique

All surgeries were performed laparoscopically. The operation started with mobilizing of the gastric tube from its adhesion to the adjacent structures (e.g., greater omentum) from the antrum to the left hiatal pillar using hook diathermy and a blunt-tip 5-mm Ligasure (Covidien, Norwalk, CT, USA). The EC junction was identified with mobilization of the right and left hiatal pillars after being freed from the adhesion (anterior and posterior). Care was taken to preserve the vagus nerve and its hepatic branch. The hiatal hernia sac along with the herniated gastric pouch was completely reduced into the abdomen. The hiatal hernia was then closed using non-absorbable sutures with a 36F bougie inserted to prevent an over tight closure. After the adhesion of the gastric tube was completely released and all of its kinking and torsion was corrected, the gastric tube was straightened and gastropexy was performed to fix the tube in situ. A variety of techniques were used. If a pre-operative upper gastro-intestinal (UGI) examination demonstrated a dilated proximal tube or fundus, anterior gastric fundoplication was performed using non-absorbable sutures [13]. If no dilated proximal portion of the gastric tube was noted, a Hill gastropexy was added [16]. Finally, the gastric tube was fixed with an anchoring suture to the pancreatic fascia using a non-absorbable suture (Fig. 3). An abdominal drain was usually left for 24 h to aid the drainage of fluid discharge from the dissection. Post-operatively, the patient was monitored in the general ward. UGI contrast studies were performed on post-operative day 1. The patient was allowed to drink and was discharged once oral intake was successful.

Measurement of Reflux Symptoms

The GERD-health-related quality of life (GERD-HRQL) questionnaire was used to assess self-reported GERD symptoms. The questionnaire included 10 questions scored on a numerical scale from 0 to 5. The overall score ranged from 0 to 50 for each patient. The higher the score, the poorer the

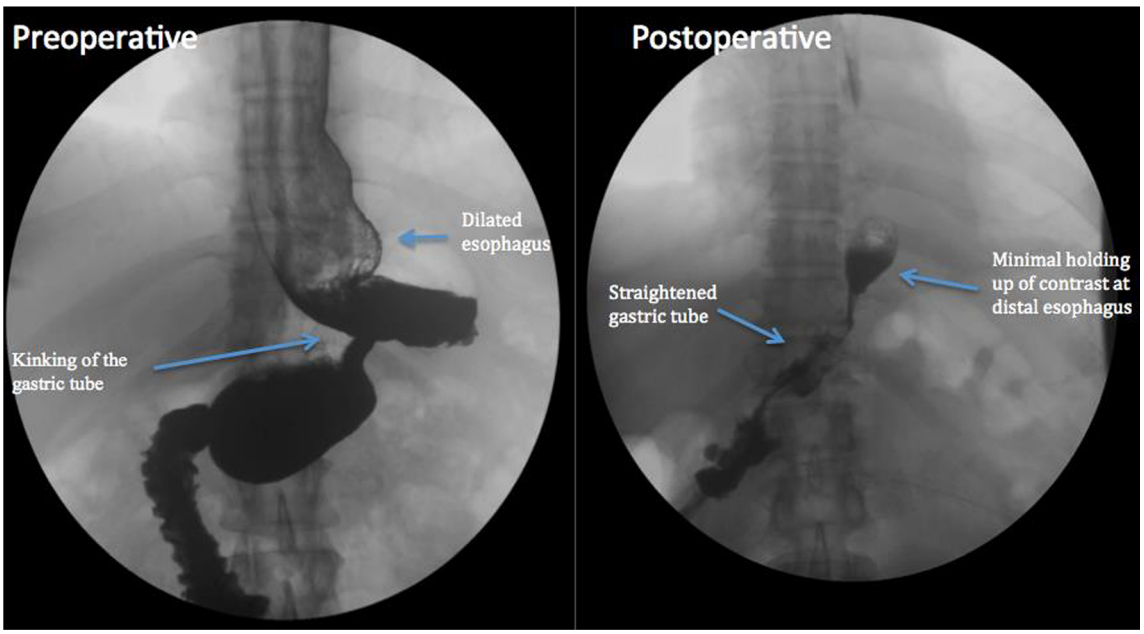

Fig. 1 Case no. 1—pre-operative upper gastrointestinal series showing a dilated esophagus and gastric tube kinking. Post-operative image showing a straightened gastric tube

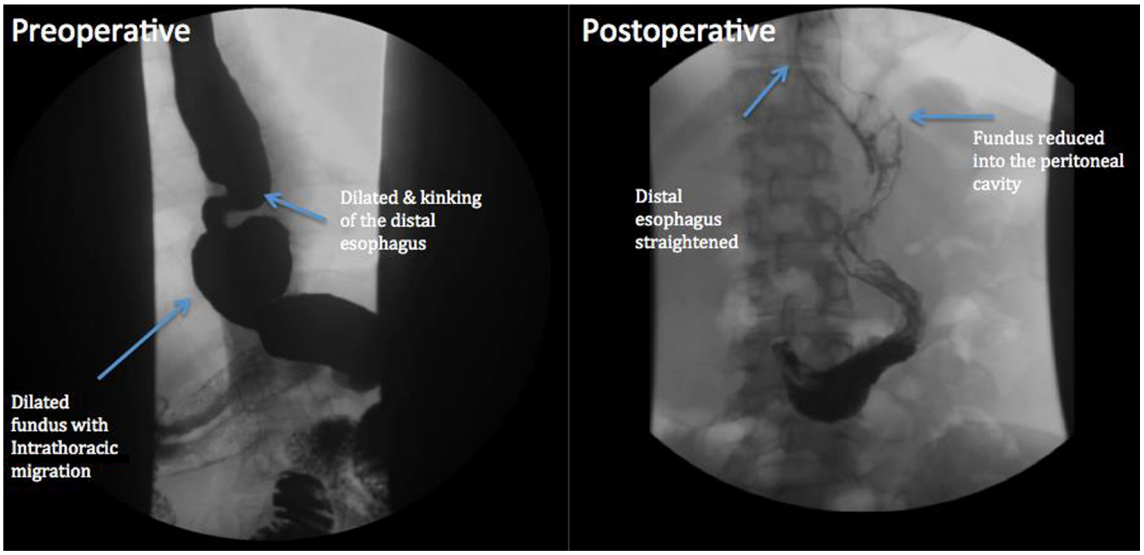

Fig. 2 Case no. 2—pre-operative upper gastrointestinal series showing a large hiatal hernia with intrathoracic migration of the neo-fundus. Post-operative image showing a straightened gastric tube

quality of life. The questionnaire has been validated and translated into several languages and appears reliable and practical [17]. The patient was questioned pre-operatively and at 1, 3, 6, and 12 months postoperative.

Classification of Erosive Esophagitis

All patients underwent pre-operative UGI evaluation and endoscopic examinations. Follow-up endoscopy was usually recommended at yearly visit. The diagnosis and classification of esophagitis was based on the Los Angeles (LA) classification [18]. According to this system, endoscopic esophagitis (EE) was classified into grade A (one or more mucosal break less than 5 mm long that do not extended between the tops of two mucosal folds), grade B (one or more mucosal breaks greater than 5 mm long that do not extend between the tops of two mucosal folds), grade C (one or more continuous mucosal breaks between the tops of two or more mucosal folds involving < 75% of the esophageal circumference), and grade D (one or more mucosal breaks that involve at least 75% of the esophageal circumference).

A hiatal hernia was diagnosed in the presence of a diaphragmatic indentation that was at least 2 cm distal to the *Z*-line and the proximal margins of the gastric mucosal folds [19].

Statistical Analysis

Continuous variables are expressed as mean (standard deviation). The descriptive results of the categorical variables are expressed as percentages (%) of the subjects affected. Changes in clinical characteristics, symptoms scores, and EE grade were compared pre- and post-operatively. The categorical variables were compared using McNemar's test, whereas the continuous variables were compared using a paired *t* test or Wilcoxon signed-rank test, as appropriate. Two-sided *P* values < .05 were considered statistically significant. All statistical analyses were performed using SPSS for Windows version 12.01 (SPSS Inc., Chicago, IL, USA).

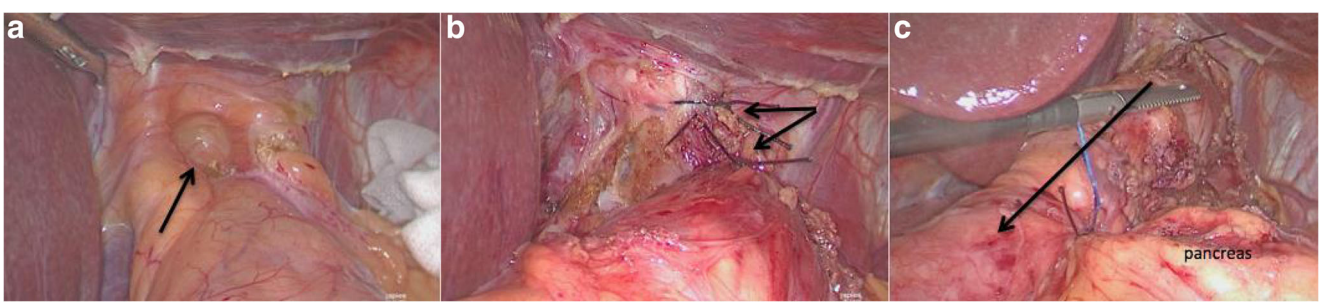

Fig. 3 Intra-operative findings of case no. 3: **a** large hiatal defect (black arrow); **b** closure of the hiatal defect (black arrow); **c** straightened gastric tube with fixation (black arrow)

Results

Patient Demographics

Twenty-eight patients (9 men [32.2%], 19 women [16.7%]; mean age, 41.4 years [range, 36–59 years]) underwent hiatal repair and gastropexy due to intractable GERD between April 2015 and January 2017. All 28 patients underwent LSG at our hospital and later developed intractable de novo reflux that failed to respond to intense medical treatment. The patients' characteristics are shown in Table 1. Their mean body mass index (BMI) before LSG surgery was 34.0 ± 5.2 kg/m^2. The mean interval from the initial operation to the revision surgery was 40.8 months (range, 6–108). The mean BMI before revision surgery was 25.7 kg ± 5.2 kg/m^2. The pre-operative UGI series usually showed reflux, hiatal hernia, intra-thoracic migration of the sleeve gastrectomy, and gastric tube kinking and torsion. Pre-operatively, all patients had EE; 1 (3.6%) with grade A, 3 (10.7%) with grade B, 16 (57.1%) with grade C, and 8 (28.6%) with grade D on LA classification (Table 2).

All procedures were performed laparoscopically. The mean operative time was 126.0 ± 31.2 min (range, 90–185). No intra-operative complications occurred. The mean postoperative hospitalization stay was 3.6 ± 2.3 days. No major surgical complications occurred.

Table 1 Patient characteristics

		Number	Mean	Range
Sex	Male	9		
	Female	19		
Age			44.1 ± 8.9	31–57
Interval since SG(month)			40.8 ± 30.1	6–108
Operation time(min)			126 ± 31.2	90–185
Blood loss(cc)			37.5 ± 25.7	5–100
Length of stay(day)			3.6 ± 2.3	2–13
Complication		0		
BMI	Initial		34.0 ± 5.2	26.3–43.6
	Revision		25.7 ± 3.9*	19.4-33.6
	6 month		25.3 ± 4.3	16.5–35.5
	1 year		25.5 ± 4.3	19.9–35.6
	2 years		26.9 ± 4.3	21.1–38.7
GERD-HROL	Initial	27	24.3 ± 8.4	7–49
	1 month	20	12.3 ± 10.2*	0-40
	6 month	15	16.8 ± 12.5*	0-36
	1 year	17	17.4 ± 16.5*	4-45
	2 years	15	18.4 ± 16.5*	4-49

SG, sleeve gastrectomy; *BMI*, body mass index; *GERD-HRQL*, gastro-esophageal reflux disease-health-related quality of life

*$P < 0.05$ compared with pre-operative data

Change in Clinical Characters After LSG Revision

All patients achieved good weight loss after LSG: their body weights remained stable after the revision surgery. The mean BMI at 6, 12, and 24 months after revision was 25.3, 25.5, and 26.1 kg/m^2, respectively. All patients needed daily proton-pump inhibitors (PPI) before the operation. After revision surgery, only 7 patients (25%) discontinued the PPI, the other 75% still required them. Twelve (42.8%) patients required daily PPI and the other 9 (32.1%) took them as needed. After surgery, follow-up gastroscopy was performed in 16 patients. All but one patient still experienced EE: 1 (6.2%) without esophagitis, 6 (37.5%) with grade A, 4 (25%) with grade B, 3 (18.8%) with grade C, and 2(12.5%) with grade D (Table 3). Of the 28 patients, 14 (50%) were satisfied with their surgery, 8 (28.6%) had a neutral attitude, and 6 (21.4%) were unsatisfied. Three (10.7%) patients to date agreed to undergo conversion to RYGB, while the other patients refused.

Change of GERD-HRQL Score After Revision

The mean GERD-HRQL prior to revision surgery was 24.3 ± 8.4; this value decreased to 12.3 ± 10.2 at 1 month after surgery ($P < 0.01$). The mean GERD-HRQL at 3, 6, and 12 months after the revision surgery was 14.8 ± 12.5, 16.8 ± 12.5, and 17.4 ± 16.5, respectively (Table 1). However, the change in GERD-HRQL varied widely among patients. Some patients had very good response and some had a worse response. Those with severe gastric tube kinking and torsion tended to have a better response, but those with a very wide EC junction tended to have a worse response after revision surgery (Table 2).

Discussions

The development of de novo GERD is the main long-term drawback of LSG, as it reportedly affects up to half of the LSG patients [6–10]. Several anatomic and pathophysiologic changes to the lower esophageal sphincter (LES) function that occur secondary to the creation of the gastric sleeve might cause de novo GERD after LSG. The most important mechanism for the development of GERD after LSG is probably related to the intragastric high pressure after fundal resection [20–22]. The persistent high pressure in the LSG may contribute to LES defect, hiatal hernia, and intrathoracic migration of the LSG tube [23]. The second mechanism is related to LES destruction by the LSG. It is possible that the LSG may severe the fibrous sling around the EC junction and impair the LES. Patients with normal LES function and no GERD symptoms developed de novo GERD after LSG, whereas patients with pre-operative GERD and hypotensive LES developed worsened GERD following LSG [24].

Table 2 Upper gastrointestinal findings at baseline

UGI findings	Kinking	Torsion	Intrathoracic migration	Hiatal hernia	Dilated proximal pouch	Loose EC junction
All 28 *N* (%)	27 (98.4%)	16 (57.1%)	17 (62.1%)	25 (89.2%)	9 (32.1%)	14 (50.0%)
7 with good response *N* (%)	7 (100%)	7 (100%)	4 (57%)	6 (86%)	3 (42.8%)	1 (14.3%)

UGI, upper gastrointestinal; *EC*, esophagocardia

This study is the first to report the mid-term outcomes of laparoscopic management of severe GERD after LSG without conversion to RYGB. Our findings are similar to those of a recent report of 9 patients with GERD after LSG who underwent hiatal repair with short-term follow-up [25]. Although the technique was safe, most patients reported partial improvement of their symptoms and still required medication to manage them. This approach may not have been very effective because it does not address the two important pathophysiological pathologies related to the development of de novo GERD after LSG. Although the technique addressed hiatal repair, gastric tube kinking or torsion, and intrathoracic migration, it did not improve the loose LES or the high pressure in the gastric tube. It is possible to use anterior fundoplication for LES reconstruction, but this procedure is possible only for those with proximal gastric pouch dilatation [13]. Without a sizable dilated pouch, an anterior wrap is impossible. Only 6 patients in this series had a dilated proximal pouch that would enable wrapping. Although another possible technique, Hill gastropexy, was proposed for those without a dilated proximal pouch [16], the usefulness of the techniques was not confirmed in this study.

Some authors tried to use LINX® magnetic sphincter augmentation system or ligamentum teres to reconstruct the LES [14, 15]. However, these reports were limited by small case numbers, limited follow-up, and a lack of validating reports. The true effectiveness of these reconstructive methods requires further well-designed studies.

Table 3 Endoscopic findings at baseline and after surgery

Endoscopic Findings	Pre-op	Post-op	*P*
Total number (%)	28 (100)	16 (100)	< 0.001
No esophagitis	0	1 (6.2)	
Grade A	1 (3.6)	6 (37.5)	
Grade B	3 (10.7)	4 (25.0)	
Grade C	16 (57.1)	3 (18.8)	
Grade D	8 (28.6)	2 (12.5)	

Another interesting possible technique for LES reconstruction involves using the endoluminal approach and applying radiofrequency ablation (Stretta) [26]. Although the Stretta is an effective treatment for GERD, the technique alone was ineffective for treating de novo GERD after LSG [27]. However, whether Stretta in combination with hiatal repair and gastropexy might help treat intractable GERD after LSG is an interesting proposal that remains to be studied.

Another important limitation of his technique is Barrett's esophagus developed after LSG in some patients [28]. Because Barrett's esophagus can involve malignant transformation in the long term, choosing this procedure may need further consideration [29]. On the other hand, RYGB may be a better option for those diagnosed with Barrett's esophagus after LSG [30]. For patients with true stenosis of the gastric tube, this procedure is unsuitable. Patients with these conditions may also benefit from RYGB. Our experience also suggested that patients with severe gastric tube torsion and kinking might benefit from this technique. In contrast, patients with a loose EC junction might not be suitable candidates for this technique. Whether adding an endoluminal therapy, such as Stretta, to hiatal repair and gastropexy would help these patients remained an interesting future research topic [31].

The limitation of our study was that we did not have 24-h pH monitoring and manometry to enable detailed GERD evaluation. However, the results of these sophisticated investigations may not be directly correlated to the symptoms. We think serial radiological studies, endoscopic evaluations, and GERD score monitoring are sufficient for managing this group of patients to determine the efficacy of the procedure. We hope the findings in this case series will lead to further studies with larger numbers of patients and longer follow-up periods to assess the efficacy of the technique.

In conclusion, hiatal repair and gastropexy without conversion to RYGB is a safe and technically feasible procedure for patients with intractable GERD after LSG. However, the patient should be cautioned that only half of the patients were satisfied with the outcomes and that patients with Barrett's esophagus or gastric tube stenosis are unsuitable candidates for it. Long-term follow-up is necessary to confirm our findings.

Compliance with Ethical Standards

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

Statement of Informed Consent This retrospective study did not require the participation of the subjects.

Human and Animal Rights No human or animal rights were violated in this study.

References

1. Chang HC, Yang HC, Chang HY, et al. Morbid obesity in Taiwan: prevalence, trends, associated social demographics, and lifestyle factors. PLoS One. 2017;12:e0169577.
2. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. JAMA. 2004;292:1724–37.
3. Sjöström L, Narbro K, Sjöström CD, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. N Engl J Med. 2007;357:741–52.
4. Angrisani L, Santonicola A, Iovino P, et al. Bariatric surgery and endoluminal procedure: IFSO worldwide survey 2014. Obes Surg. 2017;27:2279–89.
5. Ponce J, DeMaria E, Nguyen NT, et al. American Society for Metabolic and Bariatric Surgery estimation of bariatric surgery procedures in 2015 and surgeon workforce in the United States. Surg Obes Relat Dis. 2016;12:1637–9.
6. Felsenreich D, Langer FB, Kefurt R, et al. Weight loss, weight regain, and conversions to Roux-en-Y gastric bypass: 10-year results of laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2016;12:1655–62.
7. Rawlins L, Rawlins MP, Brown CC, et al. Sleeve gastrectomy: 5-year outcomes of a single institution. Surg Obes Relat Dis. 2013;9:21–5.
8. Arman GA, Himpens J, Dhaenens J, et al. Long-term (11+ years) outcomes in weight, patient satisfaction, comorbidities, and gastroesophageal reflux treatment after laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2016;12:1778–86.
9. Mahawar KK, Jennings N, Balupuri S, et al. Sleeve gastrectomy and gastro-oesophageal reflux disease: a complex relationship. Obes Surg. 2013;23:987–91.
10. Chang DM, Lee WJ, Chen JC, et al. Thirteen-year experience of laparoscopic sleeve gastrectomy: surgical risk, weight loss, and revision procedures. Obes Surg. 2018;28:2991–7.
11. Ignat M, Vix M, Imad L, et al. Randomized trial of Roux-en-Y gastric bypass versus sleeve gastrectomy in achieving excess weight loss. Br J Surg. 2017;104:248–56.
12. Ikrammudin S, Billington C, Lee WJ, et al. Roux-en-Y gastric bypass for diabetes (the Diabetes Surgery Study): 2-year outcomes of a 5-year, randomized controlled trial. Lancet Diabetes Endocrinol. 2015;3:413–22.
13. Hawasli A, Bush A, Hare B, et al. Laparoscopic management of severe reflux after sleeve gastrectomy, in selected patients, without conversion to Roux-en-Y gastric bypass. J Laparoendosc Adv Surg Tech. 2015;25:631–5.
14. Desart K, Rossidis G, Michel M, et al. Gastroesophageal reflux management with the LINX® system for gastroesophageal reflux disease following laparoscopic sleeve gastrectomy. J Gastrointest Surg. 2015;19:1782–6.
15. Gálvez-Valdovinos R, Cruz-Vigo JL, Marín-Santillán E, et al. Cardiopexy with ligamentum teres in patients with hiatal hernia and previous sleeve gastrectomy: an alternative treatment for gastroesophageal reflux disease. Obes Surg. 2015;25:1539–43.
16. Sanchez-Pernaute A, Talavera P, Perez-Aguirre E, et al. Technique of Hill's gastropexy combined with sleeve gastrectomy for patients with morbid obesity and gastroesophageal reflux disease or hiatal hernia. Obes Surg. 2016;26:910–2.
17. Velanovich V. The development of the GERD-HRQL symptom severity instrument. Dis Esophagus. 2007;20:130–4.
18. Lundell LR, Dent J, Bennett JR, et al. Endoscopic assessment of esophagitis: clinical and functional correlates and further validation of the Los Angeles classification. Gut. 1999;45:172–80.
19. Johnson DA, Younes Z, Hogan WJ. Endoscopic assessment of hiatal hernia repair. Gastrointest Endosc. 2000;2:650–9.
20. Frenkel C, Telem DA, Pryor AD, et al. The effect of sleeve gastrectomy on extraesophageal reflux disease. Surg Obes Relat Dis. 2016;12(7):1263–9.
21. Del Genio G, Tolone S, Limongelli P, et al. Sleeve gastrectomy and development of de novo gastroesophageal reflux. Obes Surg. 2014;24:71–7.
22. Mion F, Tolone S, Garros A, et al. High-resolution impedance manometry after sleeve gastrectomy: increased intragastric pressure and reflux are frequent events. Obes Surg. 2016;26:2449–56.
23. Saber AA, Shoar S, Khoursheed M. Intra-thoracic sleeve migration (ITSM): an underreported phenomenon after laparoscopic sleeve gastrectomy. Obes Surg. 2017;27:1917–23.
24. Klaus A, Weiss H. Is preoperative manometry in restrictive bariatric procedures necessary? Obes Surg. 2008;18:1039–42.
25. Macedo FIB, Mowzoon M, Mittal VK, et al. Outcomes of laparoscopic hiatal hernia repair in nine bariatric patients with prior sleeve gastrectomy. Obes Surg. 2017;27:2768–72.
26. Guerron DA, Portenier D. A case series on gastroesophageal reflux disease and the bariatric patients: Stretta therapy as a non-surgical option. Bariatric Times. 2016;13:18–20.
27. Khidir N, Angrisani L, Al-Qahtani J, et al. Initial experience of endoscopic radiofrequency waves delivery to the lower esophageal sphincter (Stretta procedure) on symptomatic gastroesophageal reflux disease post-sleeve gastrectomy. Obes Surg. 2018;28(10):3125–30.
28. Andrew B, Alley JB, Aguilar CE, et al. Barrett's esophagus before and after Roux-en-Y gastric bypass for severe obesity. Obes Endosc. 2018;32(2):930–6.
29. Solaymani Dodaran M, Logan RFA, West J, et al. Risk of oesophageal cancer in Barrett's oesophagus and gastro-oesophageal reflux. Gut. 2004;53:1070–4.
30. Felsenreich DM, Kefurt R, Schermann M, et al. Reflux, sleeve dilatation, and Barrett's esophagus after laparoscopic sleeve gastrectomy: long-term follow-up. Obes Surg. 2017;27:3092–101.
31. Geno A, Soricelli E, Casella G, et al. Gastroesophageal reflux disease and Barrett's esophagus after laparoscopic sleeve gastrectomy: a possible, underestimated long-term complication. Surg Obes Relat Dis. 2017;13:568–74.