Should Sleeve Gastrectomy Be Considered Only as a First Step in Super Obese Patients? 5-Year Results From a Single Center

Antonio Vitiello, MD, Giovanna Berardi, MD,* Nunzio Velotti, MD,* Giovanni D. De Palma,† and Mario Musella**

Purpose: Sleeve gastrectomy (SG) has been originally conceived as a first step procedure for super obese (SO) patients, but it is currently considered a stand-alone intervention. Medium-term to long-term studies have shown weight regain and risk of de novo gastroesophageal reflux (GERD). The aim of this study was to evaluate outcomes of SG in SO subjects.

Materials and Methods: A retrospective analysis of a prospectively maintained database was carried out to find all SO patients who had undergone SG with a minimum follow-up of 5 years. Inclusion criteria were preoperative endoscopy negative for esophagitis and/or hiatal hernia, and no GERD or acid reduction medication before SG. Reflux symptoms were evaluated using a validated questionnaire and endoscopy. Remission rates from comorbidities and percentage of excess body mass index (BMI) loss were recorded.

Results: A total of 66 (45 male/21 female) patients were included in our study. Mean preoperative BMI and age were $57.4 \pm 5.8\ kg/m^2$ and 32.7 ± 11.2 years, respectively. After 5 years, mean percentage of excess BMI loss was 56.42 ± 27.8, and remission rates from hypertension, diabetes, and dyslipidemia were 33.3%, 5.3%, and 20%, respectively. After 5 years, new-onset GERD occurred in 66.7% of patients and 33.3% were taking acid reduction medication. Endoscopy revealed 12 (18.2%) cases of esophagitis $\geq$ grade A.

Conclusions: After 5 years, weight loss in SO patients is satisfactory, but the vast majority of patients is still in class II obesity, and resolution of comorbidities is disappointing. High rates of de novo GERD and esophagitis may occur.

Key Words: sleeve gastrectomy, super obese, GERD, bariatric surgery

(*Surg Laparosc Endosc Percutan Tech* 2020;00:000–000)

Because of its laparoscopic feasibility, short learning curve, and satisfactory outcomes, sleeve gastrectomy (SG) has gained increasing popularity in the field of bariatric surgery. Originally SG was described as a first step procedure for super obese (SO) patients, but, as many patients lost enough weight with the sleeve, the secondary procedure was no longer necessary.[1] According to the IFSO (International Federation of Surgery for Obesity) survey,[2] SG overcame Roux-en-Y gastric bypass (RYGB) as the most commonly performed procedure worldwide in 2016. Furthermore, the fourth IFSO global registry report[3] showed that SG accounted for 46% of all bariatric interventions in 2018. Despite this success, short (staple-line leak, bleeding) and long-term (gastroesophageal reflux disease, GERD) complications have been associated with SG. Indeed, SG's popularity has been seriously undermined by several studies, whose results showed that postoperative GERD can be a worrisome problem after this procedure.[4,5] Some articles have also described intestinal metaplasia (Barrett esophagus, BE) after SG due to chronic acid exposure of the lower esophagus.[6,7] Rate of GERD in the general population is 10% to 20%,[8] but morbidly obese patients have a significantly higher prevalence (37% to 72%).[9] Thereby, GERD represents a serious problem for morbidly obese patients with a significant impact on their quality of life. The aim of our study was to evaluate weight loss, obesity-related diseases' remission, and de novo GERD at 5 years after SG in SO patients.

MATERIALS AND METHODS

The prospectively maintained database of our university bariatric center was searched to find all consecutive SO patients who had undergone SG at our department with a minimum follow-up of 5 years. Inclusion criteria were age between 18 and 60 years, body mass index (BMI) $> 50\ kg/m^2$, and no GERD symptoms before surgery. Exclusion criteria were *Helicobacter pylori* infection, use of acid reduction medication (ARM) at baseline, preoperative endoscopy positive for esophagitis and/or hiatal hernia, and history of previous bariatric or abdominal surgery. Collected data were age, BMI, de novo GERD, obesity-related diseases' remission, and weight loss.

Surgical Technique

Closed CO_2 pneumoperitoneum was achieved through Veress needle. Five trocars (3×10 mm and 2×5 mm) were placed in the upper quadrants. Gastrocolic ligament was opened near the greater curvature of the stomach starting 4 cm from the pylorus up to the angle of His. Thus, preservation of antrum and complete visualization of the left crus were routinely performed. A 38 Fr bougie was used to calibrate the sleeve. The stomach was divided using a laparoscopic linear stapler with a complete excision of the fundus.[10–12]

Received for publication June 25, 2020; accepted August 14, 2020.
From the Departments of *Advanced Biomedical Sciences; and †Clinical Medicine and Surgery, Naples "Federico II" University, AOU "Federico II," Naples, Italy.
Informed consent was obtained from all the individual participants included in the study.
All procedures performed in this study 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.
The author declares no conflicts of interest.
Reprints: Antonio Vitiello, MD, Advanced Biomedical Sciences Department, Naples "Federico II" University, AOU "Federico II"—Via S. Pansini 5, Naples 80131, Italy (e-mail: antoniovitiello_@hotmail.it).

Weight Loss

Weight loss was calculated as percentage excess body mass index loss (%EBMIL): (initial BMI−final BMI)/(initial BMI−25)×100. Our database was searched to find data on %EBMIL at 1, 3, and 5 years. Success at 5 years was defined as %EBMIL ≥ 50, nonresponse was set as %EBMIL < 25,[13] while weight regain was set as %EBMIL <50 at 5 years for a patient who had previously achieved %EBMIL > 50. In addition, weight loss outcomes were also classified according to the criteria of Reinhold[14] modified by Christou et al[15]: insufficient when BMI > 35 kg/m^2, good when BMI = 30 to 35 kg/m^2, and excellent when BMI < 30 kg/m^2.

Remission From Obesity-related Disease

Remission of diabetes was considered as fasting blood glucose <126 mg/dL on 2 different occasions and as a value of glycated hemoglobin A1c <6.5% off antidiabetic medications.[16] Hypertension remission was defined as blood pressure <140/90 with no requirement for antihypertensive medication.[17] Hypercholesterolemia, hypertriglyceridemia, and low high-density lipoprotein cholesterolemia were diagnosed when values were 200 in men and 150 mg/dL in women and 40 mg/dL in men and 50 mg/dL in women. Cutoffs points were chosen according to the American Heart Association criteria to identify metabolic syndrome.[18]

GERD and Severity of Symptoms

At our center, GERD symptoms and ARM use are routinely investigated during clinical appointments, and all patients are asked to undergo preoperative endoscopy. All patients included in this study who had not undergone postoperative endoscopy were contacted to have the procedure. According to the Lyon Consensus Conference criteria, GERD was clinically diagnosed in case of heartburn and/or regurgitation,[19] while endoscopic diagnosis was established in case of esophagitis ≥ grade A. Severity of symptoms was evaluated with the GERD-HRQL (Gastroesophageal Reflux Disease Health-Related Quality of Life) questionnaire, which is validated to assess the impact of GERD on quality of life. Items are scored from 0 to 5 (0 = no symptoms, 5 = symptoms are incapacitating, unable to do daily activities). The summation of all scores represents overall quality of life, as it relates to GERD symptoms (0 = best score, 50 = worst score).[20,21] GERD-HRQL questionnaire was administered to all patients to calculate preoperative and 5-year scores.

Statistical Analysis

Means were compared using an unpaired 2-tailed *t* test. Significance was set at a *P*-value <0.05.

RESULTS

A total number of 87 SO patients were found in our database with a minimum follow-up of 5 years. Ten patients were excluded due to preoperative endoscopic or clinical diagnosis of GERD; 8 subjects refused to undergo postoperative endoscopy and could not be included in the study. Three patients had previously undergone intragastric balloon positioning and were also excluded. Thus, 66 subjects (45 male/21 female) were eventually included in the present study. Initial age and BMI were 32.7 ± 11.2 years and 57.4 ± 5.8 kg/m^2, respectively.

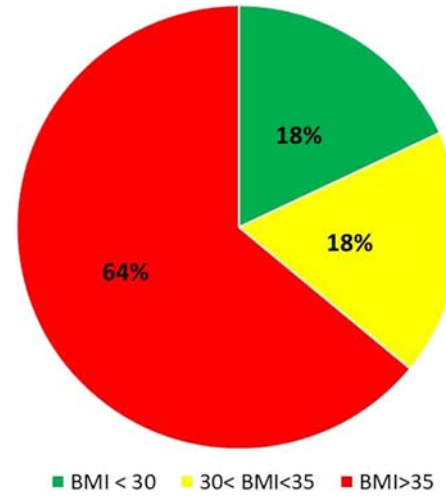

FIGURE 1. Classification of patients at 5 years according to Christou/Reinholds criteria. BMI indicates body mass index. full color online

Weight Loss

At 5 years, mean BMI was 39.8 ± 10.5 kg/m^2; 12 patients (18.2%) reached a BMI <30 kg/m^2, other 12 (18.2%) had a BMI between 30 and 35 kg/m^2, while 42 (63.6%) still had a value >35 kg/m^2. Classification according to Christou and Reinhold is shown in Figure 1. After 5 years, mean % EBMIL was 56.42 ± 27.8; 6 patients (9.1%) were nonresponders (% EBMIL < 25%), 38 (57.6%) achieved a success (% EBMIL > 50%), and 20 (30.3%) had a weight regain. %EBMIL during follow-up is presented in Figure 2.

De Novo GERD

At 5 years, 44 (66.7%) subjects were complaining of heartburn and regurgitation and were diagnosed with new-onset GERD. Among these patients, 22 (33.3%) were taking ARM. Endoscopy revealed 12 (18.2%) cases of esophagitis at 5 years: 11 (91.7%) were grade B, and 1 (8.3%) was grade C.

Overall GERD-HRQL score at baseline and after 5 years was 0.64 ± 0.55 and 7.12 ± 6 ($P < 0.01$), respectively; postoperative score was significantly higher in patients with GERD when compared with asymptomatic patients (3.1 ± 2.5 and 8.8 ± 6.3; $P < 0.01$). GERD score also resulted significantly higher in ARM− than in ARM+ patients (8.9 ± 6.6 and 4.2 ± 3.1; $P < 0.05$).

Obesity-related Diseases' Remission

At baseline, 24 (36.4%) patients were diagnosed of hypertension, 19 (28.8%) were diabetic, and 15 (22.7%) had dyslipidemia. After 5 years, remission rate from hypertension, type 2 diabetes mellitus, and dyslipidemia were 33.3% (n = 8), 5.3% (n = 1), and 20% (n = 3), respectively.

DISCUSSION

The number of SO patients seeking bariatric surgery is rapidly growing,[21] and the best treatment for these subjects is a matter of an ongoing debate.[22] SG has been conceived as a first step for obese individuals with BMI > 50 kg/m^2,[23] but it is now considered as a stand-alone procedure. However, several studies have demonstrated that RYGB[24] or mini gastric bypass-one anastomosis gastric bypass[25] achieve better results for this category of patients in terms of weight loss and remission from obesity-related diseases.

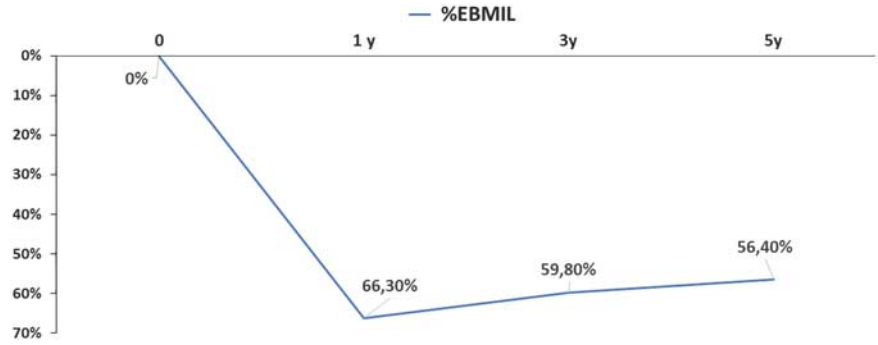

FIGURE 2. Percentage of excess body mass index loss (%EBMIL) during follow-up. full color online

Nevertheless, bariatric procedures on SO patients represent a technical challenge, and they may require an experienced surgeon, as postoperative mortality increases with BMI during the learning curve.[26,27] Moreover, several studies have reported satisfactory outcomes after SG in SO patients, comparable to those achievable in morbidly obese individuals.[28,29] In other studies, the comparison of the most common obesity-related diseases—diabetes, obstructive sleep apnea, hypertension, dyslipidemia—between patients with a BMI between 30 and 50 kg/m^2 and those with BMI $\geq$ 50 kg/m^2 did not show a lower resolution after SG.[30,31] For these reasons, SG is still offered to SO individuals undergoing bariatric surgery.[32] Our outcomes demonstrated that, even if an acceptable mean %EBMIL was obtained at 5 years, the vast majority of subjects still had a BMI > 35 kg/m^2; resolution from comorbidities is disappointing, and weight regain occurs in 30% of cases. It is predictable that most of these patients will need a second procedure in the future.[33] Moreover, morbid and super obesity are also associated with higher incidence of gastroesophageal reflux. Excess of visceral fat causes a chronic increase in the intra-abdominal pressure, which reduces the efficacy of the lower esophageal sphincter, and induces the development of hiatal hernia.[34] Despite some studies that reported improvement of symptoms after SG,[35,36] published evidence shows a worsening of preexisting GERD and new-onset disease.[37,38] Undoubtedly, the main cause of postoperative GERD is that a sleeved stomach has an increased intragastric pressure with decreased compliance. Technical mistakes could also lead to a stenotic or twisted sleeve, which causes regurgitation of acid content into the esophagus.[4] Chronic reflux can lead to esophagitis and subsequent BE, which is a precancerous lesion for the development of esophageal carcinoma.[39] Braghetto and Csendes[40] first reported an incidence of 1.2% of BE at 1 year after SG; lately, other authors reported a rate of 15% to 17% after a longer follow-up (5 to 10 y).[6,7] Surprisingly, Soricelli et al[41] have shown that, in 21% of cases, BE arises in asymptomatic patients. However, in a recent multicenter study,[42] all but one patient with BE were suffering with GERD; the authors also stressed that they found only short BE, and no case of dysplasia was recorded. Indeed, the rate of malignant transformation of BE has been evaluated between 0.6% and 0.7% per year,[43,44] and the annual incidence of malignant transformation was 1.4% and 6% only in the presence of low-grade and high-grade dysplasia, respectively.[6,45] Remarkably, there are no reports in the literature of esophageal adenocarcinoma after duodenal switch, where the stomach is sleeved, after > 25 years of this surgery, and rare cases were published after SG.[46,47] Besides endoscopic and histopathologic changes of gastroesophageal mucosa after SG, clinical symptoms negatively impact patients' quality of life and forces them to permanently depend upon antireflux medication. For these reasons, our study focused not only on weight loss and remission from obesity-related disease in SO, but we decided to assess clinically and endoscopically de novo GERD as well in SO patients. A recent systematic review showed a rate of de novo GERD of 20%,[48] while a meta-analysis found that the increase of postoperative GERD after sleeve was 19%, and de novo reflux was 23%.[49] Our data showed a high rate of clinical de novo GERD, as almost 70% of patients had new-onset symptoms, and one third are taking antacid medications. GERD-HRQL questionnaire scores demonstrated an overall increase compared with baseline and a relief of symptoms in patients taking ARM. Moreover, endoscopic findings showed a worrisome rate of esophagitis at only 5 years.

Strengths and Limitations

The retrospective nature of the study and collection of data from a single center are the limitations of the present study. However, the strengths of our paper are a deep analysis of weight loss and a proper evaluation of GERD through endoscopy and a validated clinical questionnaire. Moreover, the evaluation of the new-onset symptoms in patients with no clinical or endoscopic preoperative signs of GERD is more objective and less subject to bias.

CONCLUSIONS

After 5 years, mean weight loss in SO patients is satisfactory, but the vast majority of patients is still in class II obesity, and resolution of obesity-related diseases is disappointing. High rates of de novo GERD and esophagitis may occur. SG patients should be adequately informed that postoperative GERD or not successful weight loss may require conversion to other bariatric procedures, such as RYGB[50,51] or one anastomosis gastric bypass.[52,53]

REFERENCES

1. Gagner M, Gumbs AA, Milone L, et al. Laparoscopic sleeve gastrectomy for the super-super-obese (body mass index > 60 kg/m^2). *Surg Today*. 2008;38:399–403.
2. Angrisani L, Santonicola A, Iovino P, et al. IFSO Worldwide Survey 2016: primary, endoluminal, and revisional procedures. *Obes Surg*. 2018;28:3783–3794.
3. Welbourn R, Hollyman M, Kinsman R, et al. Bariatric surgery worldwide: baseline demographic description and one-year

outcomes from the Fourth IFSO Global Registry Report 2018. *Obes Surg*. 2019;29:782–795.
4. Stenard F, Iannelli A. Laparoscopic sleeve gastrectomy and gastroesophageal reflux. *World J Gastroenterol*. 2015;21: 10348–10357.
5. Melissas J, Braghetto I, Molina JC, et al. Gastroesophageal reflux disease and sleeve gastrectomy. *Obes Surg*. 2015;25: 2430–2435.
6. Genco 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;13:568–574.
7. Felsenreich DM, Kefurt R, Schermann M, et al. Reflux, sleeve dilation, and Barrett's esophagus after laparoscopic sleeve gastrectomy: long-term follow-up. *Obes Surg*. 2017;27: 3092–3101.
8. Dent J, El-Serag HB, Wallander MA, et al. Epidemiology of gastrooesophageal reflux disease: a systematic review. *Gut*. 2005;54:710–717.
9. Anand G, Katz PO. Gastroesophageal reflux disease and obesity. *Rev Gastroenterol Disord*. 2008;8:233–239.
10. Velotti N, Manigrasso M, Di Lauro K, et al. Comparison between LigaSure™ and Harmonic® in laparoscopic sleeve gastrectomy: a single-center experience on 422 patients. *J Obes*. 2019;2019:3402137.
11. Musella M, Milone M, Gaudioso D, et al. A decade of bariatric surgery. What have we learned? Outcome in 520 patients from a single institution. *Int J Surg*. 2014;12(suppl 1):S183–S188.
12. Musella M, Milone M, Bianco P, et al. Acute leaks following laparoscopic sleeve gastrectomy: early surgical repair according to a management algorithm. *J Laparoendosc Adv Surg Tech A*. 2016;26:85–91.
13. Brolin R, Kenler HA, Gorman RC, et al. The dilemma of outcome assessment after operations for morbid obesity. *Surgery*. 1989;105:337–346.
14. Reinhold RB. Critical analysis of long-term weight loss following gastric bypass. *Surg Gynecol Obstet*. 1982;155: 385–394.
15. Christou NV, Look D, Maclean LD. Weight gain after short- and long-limb gastric bypass in patients followed for longer than 10 years. *Ann Surg*. 2006;244:734–740.
16. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2010;33(suppl 1):S62–S69.
17. National Institute for Health and Clinical Excellence. NICE guideline [NG136]; 2019. Available at: www.nice.org.uk/guidance/ng136/chapter/recommendations.
18. Goldstein LB, Bushnell CD, Adams RJ, et al. Guidelines for the primary prevention of stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2011;42:517–584.
19. Gyawali CP, Kahrilas PJ, Savarino E, et al. Modern diagnosis of GERD: the Lyon Consensus. *Gut*. 2018;67:1351–1362.
20. Velanovich V. The development of the GERD-HRQL symptom severity instrument. *Dis Esophagus*. 2007;20:130–134.
21. Sturm R, Hattori A. Morbid obesity rates continue to rise rapidly in the US. *Int J Obes (Lond)*. 2013;37:889–891.
22. De Maria EJ, Schauer P, Patterson E, et al. The optimal surgical management of the super-obese patient: the debate. Presented at the annual meeting of the Society of American Gastrointestinal and Endoscopic Surgeons, Hollywood, Florida, USA, April 13-16, 2005. *Surg Innov*. 2005;12:107–121.
23. Regan JP, Inabnet WB, Gagner M, et al. Early experience with two-stage laparoscopic Roux-en-Y gastric bypass as an alternative in the super-super obese patient. *Obes Surg*. 2003;13: 861–864.
24. Arapis K, Macrina N, Kadouch D, et al. Outcomes of Roux-en-Y gastric bypass versus sleeve gastrectomy in super-super-obese patients (BMI $\geq 60\ kg/m^2$): 6-year follow-up at a single university. *Surg Obes Relat Dis*. 2019;15:23–33.
25. Plamper A, Lingohr P, Nadal J, et al. Comparison of mini-gastric bypass with sleeve gastrectomy in a mainly super-obese patient group: first results. *Surg Endosc*. 2017;31:1156–1162.
26. Stephens DJ, Saunders JK, Belsley S, et al. Short-term outcomes for super-super obese (BMI $>$ or $=60\ kg/m^2$) patients undergoing weight loss surgery at a high-volume bariatric surgery center: laparoscopic adjustable gastric banding, laparoscopic gastric bypass, and open tubular gastric bypass. *Surg Obes Relat Dis*. 2008;4:408–415.
27. Ballantyne GH, Ewing D, Capella RF, et al. The learning curve measured by operating times for laparoscopic and open gastric bypass: roles of surgeon's experience, institutional experience, body mass index and fellowship training. *Obes Surg*. 2005; 15:172–182.
28. Ece I, Yilmaz H, Alptekin H, et al. Comparative effectiveness of laparoscopic sleeve gastrectomy on morbidly obese, super-obese, and super-super obese patients for the treatment of morbid obesity. *Obes Surg*. 2018;28:1484–1491.
29. Lemanu DP, Srinivasa S, Singh PP, et al. Single-stage laparoscopic sleeve gastrectomy: safety and efficacy in the super-obese. *J Surg Res*. 2012;177:49–54.
30. Hariri K, Guevara D, Dong M, et al. Is bariatric surgery effective for co-morbidity resolution in the super-obese patients? *Surg Obes Relat Dis*. 2018;14:1261–1268.
31. Hariri K, Kini SU, Herron DM, et al. Resolution of symptomatic obstructive sleep apnea not impacted by preoperative body mass index, choice of operation between sleeve gastrectomy and Roux-en-Y gastric bypass surgery, or severity. *Obes Surg*. 2018;28:1402–1407.
32. Angrisani L, Vitiello A, Ferraro L. Comment on: two-stage approach is still the gold standard for super-super obese patients (SSO) undergoing bariatric surgery. *Surg Obes Relat Dis*. 2019;15:33–35.
33. Hidalgo M, Vilallonga R, Ruiz de Godejuela AG, et al. Effectiveness of laparoscopic sleeve gastrectomy in super-obese and non–super-obese patients. *Surg Laparosc Endosc Percutan Tech*. 2020. Doi: 10.1097/SLE.0000000000000801.
34. Barr AC, Frelich MJ, Bosler ME, et al. GERD and acid reduction medication use following gastric bypass and sleeve gastrectomy. *Surg Endosc*. 2017;31:410–415.
35. Che F, Nguyen B, Cohen A, et al. Prevalence of hiatal hernia in the morbidly obese. *Surg Obes Relat Dis*. 2013;9:920–924.
36. Pilone V, Tramontano S, Renzulli M, et al. Gastroesophageal reflux after sleeve gastrectomy: new onset and effect on symptoms on a prospective evaluation. *Obes Surg*. 2019;29:3638–3645.
37. Rebecchi F, Allaix ME, Giaccone C, et al. Gastroesophageal reflux disease and laparoscopic sleeve gastrectomy: a physiopathologic evaluation. *Ann Surg*. 2014;260:909–914.
38. Iannelli A, Sans A, Martini F, et al. Hiatal hernia, GERD, and sleeve gastrectomy: a complex interplay. *Obes Surg*. 2016;26: 2485–2487.
39. Drahos J, Li L, Jick SS, et al. Metabolic syndrome in relation to Barrett's esophagus and esophageal adenocarcinoma: results from a large population-based case-control study in the clinical practice research Datalink. *Cancer Epidemiol*. 2016;42:9–14.
40. Braghetto I, Csendes A. Prevalence of Barrett's esophagus in bariatric patients undergoing sleeve gastrectomy. *Obes Surg*. 2016;26:710–714.
41. Soricelli E, Casella G, Baglio G, et al. Lack of correlation between gastroesophageal reflux disease symptoms and esophageal lesions after sleeve gastrectomy. *Surg Obes Relat Dis*. 2018;14:751–756.
42. Sebastianelli L, Benois M, Vanbiervliet G, et al. Systematic endoscopy 5 years after sleeve gastrectomy results in a high rate of Barrett's esophagus: results of a multicenter study. *Obes Surg*. 2019;29:1462–1469.
43. Steevens J, Schouten LJ, Driessen ALC, et al. A prospective cohort study on overweight, smoking, alcohol consumption, and risk of Barrett's esophagus. *Cancer Epidemiol Biomark Prev*. 2011;20:345–358.
44. Gatenby P, Ramus J, Caygill C, et al. Routinely diagnosed low grade dysplasia in Barrett's oesophagus: a population-based study of natural history. *Histopathology*. 2009;54:814–819.
45. Rastogi A, Puli S, El-Serag HB, et al. Incidence of esophageal adenocarcinoma in patients with Barrett's esophagus and

highgrade dysplasia: a meta-analysis. *Gastrointest Endosc*. 2008;67:394–398.
46. Gagner M. Is sleeve gastrectomy always an absolute contra-indication in patients with Barrett's? *Obes Surg*. 2016;26: 715–717.
47. Musella M, Berardi G, Bocchetti A, et al. Esophagogastric neoplasms following bariatric surgery: an updated systematic review. *Obes Surg*. 2019;29:2660–2669.
48. Oor JE, Roks DJ, Ünlü Ç, et al. Laparoscopic sleeve gastrectomy and gastroesophageal reflux disease: a systematic review and meta-analysis. *Am J Surg*. 2016;211:250–267.
49. Yeung KTD, Penney N, Ashrafian L, et al. Does sleeve gastrectomy expose the distal esophagus to severe reflux? A systematic review and meta-analysis. *Ann Surg*. 2020;271:257–265.
50. Frezza EE, Ikramuddin S, Gourash W, et al. Symptomatic improvement in gastroesophageal reflux disease (GERD) following laparoscopic roux-en-Y gastric bypass. *Surg Endosc*. 2002;16:1027–1031.
51. Parmar CD, Mahawar KK, Boyle M, et al. Conversion of Sleeve Gastrectomy To Roux-en-Y gastric bypass is effective for gastro-oesophageal reflux disease but not for further weight loss. *Obes Surg*. 2017;27:1651–1658.
52. Musella M, Bruni V, Greco F, et al. Conversion from laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG) to one anastomosis gastric bypass (OAGB): preliminary data from a multicenter retrospective study. *Surg Obes Relat Dis*. 2019;15:1332–1339.
53. Musella M, Apers J, Rheinwalt K, et al. Efficacy of bariatric surgery in type 2 diabetes mellitus remission: the role of mini gastric bypass/one anastomosis gastric bypass and sleeve gastrectomy at 1 year of follow-up. A European survey. *Obes Surg*. 2016;26:933–940.