# Changes of the upper gastrointestinal endoscopy findings in patients with severe obesity after laparoscopic sleeve gastrectomy: a short-term study

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**Background**
Sleeve gastrectomy (SG) has rapidly gained acceptance all over the world owing to its technical simplicity, promising excellent outcome and safety. However, SG has its own complications that need a specialized management plan.
**Aim**
This study aimed to assess the potential gastroesophageal reflux disease (GERD) development and the upper gastrointestinal tract endoscopy findings 1 year after laparoscopic sleeve gastrectomy.
**Patients and methods**
Patients scheduled for laparoscopic sleeve gastrectomy in our institution during the period from August 2019 to July 2020 who were free of GERD symptoms and had no hiatus hernia were eligible for the study. Patients underwent esophagogastro duodenal endoscopy 1 week before the operation and 1 year after the operation. Data of the patients were analyzed and compared.
**Results**
A total of 100 patients were included in the study. One year after the operation, 26 patients experienced GERD symptoms. However, there was an improvement in the esophagogastro duodenal endoscopy GERD findings compared with the preoperative examination.
**Conclusion**
SG had an overall amelioration of the preoperative GERD findings. Our work raises questions about the real effect of SG on GERD. However, larger long-term studies are still needed to validate the results.

**Keywords:**
bariatric surgery, gastroesophageal reflux disease, obesity, sleeve gastrectomy, upper gastrointestinal endoscopy

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## Introduction

Sleeve gastrectomy (SG) was originally designated as a first step of other major bariatric surgery procedures [1,2]. SG has rapidly gained acceptance all over the world owing to its procedural simplicity, promising excellent outcome and safety [3].

SG does not include an anastomosis step. This makes the procedure simple, with little complications. Moreover, this precludes the complications related to the anastomosis, like stricture, fistula, and marginal ulcer [4]. Moreover, SG respects the continuity of the digestive system and hence keeps the pylorus functions, including gastric emptying regulation, as well as the duodenum functions, such as iron, calcium, and vitamin B absorption [5]. However, SG has its own complications that need a specialized management plan [6].

Data about the association of gastroesophageal reflux disease (GERD) with SG remain inconclusive. Some mechanisms were presumed to be implicated in the de novo GERD presentation after SG. In SG, the large compliant stomach is transformed into a narrow long tube, with decreased compliance and elevated intraluminal pressure. Another contributor of the de novo GERD after SG is the interference with the normal antireflux anatomy, such as disruption of the angle of His and resection of the lower sphincter distal sling fibers. The funnel-shaped sleeve also favors GERD. In addition, technical errors including sleeve twisting, anatomical narrowing, gastric fundus persistence, nondiagnosed hiatus hernia, and extensive resection of the antrum could be also contributing factors [7,8].



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De novo GERD after SG has been reported to affect the quality of life and increase the risk of esophagitis and Barrett's esophagus [9].

This study aimed to assess the potential GERD development and the upper gastrointestinal tract (GIT) endoscopy findings 1 year after laparoscopic sleeve gastrectomy (LSG).

## Patients and methods

This is a prospective longitudinal study that included patients scheduled for LSG during the period from August 2019 to July 2020 in Kasr Al-Ainy Hospitals. The study protocol was reviewed and permitted by the research ethics committee of the institution. The study was conducted in accordance with the declaration of Helsinki. An informed written consent was acquired from each included patient before commencing the study.

Adult patients with a BMI higher than 40 or 35 kg/m$^2$ with comorbidities and generally fit for surgery were eligible for bariatric surgery in our institution. Patients selected for LSG, according to the department protocol, were enrolled in the study. All patients underwent detailed history taking and general examination. Patients with history of upper GIT disorders, hiatus hernia, upper GIT surgery, inflammatory bowel disorder, or those who refused the study protocol were excluded. All recruited patients underwent esophagogastroduodenoscopy (EGD) 1 week before operation by the same physician using an Olympus EXERA GIF-Q160 video gastroscope. Patients with EGD-diagnosed hiatus hernia were further excluded from the study. Patients with asymptomatic GERD esophagitis were advised to shift to Roux-en-Y gastric bypass. Those who refused were informed about the risk of condition worsening after surgery.

Data regarding patients' age, sex, weight, height, comorbidities, and preoperative EGD findings were recorded.

### Operative technique

The preoperative workup was performed, and the surgery was conducted under general anesthesia. After pneumoperitoneum induction, LSG was performed via the five-port technique. The vascular supply of the stomach greater curvature was divided using advanced bipolar sealing device, beginning 6 cm from the pylorus and continuing upward till the His angle. After strict transoral positioning of a 36-Fr calibrating bougie against the lesser curve, the sleeve was formed with the use of a linear stapler (Covidien, Endo GIA, Ultra Universal Stapler, 60 mm, New York, USA), using green load firings for the antrum, and then sequential blue loads for the fundus and the remaining stomach body. The suture line was tested using the methylene blue test.

Patients were motivated for early mobility and permitted for oral fluid intake few hours after the operation. Gradual change to solid diet was done over a period of 2 to 3 weeks. Patients were administered intravenous proton pump inhibitors in the form of pantoprazole 40 mg on the day of surgery, and then continued on the oral form for 2 months regardless of the preoperative EGD findings. Prophylactic anticoagulant therapy in the form of enoxaparin sodium was prescribed for 2 weeks. Patients were advised to preclude fatty and high-sugar food as far as possible.

### Follow-up assessment of the patients

Patients underwent follow-up by thorough history taking and clinical examination 2 weeks, 6 months, and 1 year postoperatively. GIT history was evaluated based on Rome III criteria. EGD was repeated 1 year postoperatively by the same physician. EGD findings as well as the data regarding patients' weight and comorbidities were recorded.

### Study outcomes

The primary outcome of this study was the 1-year postoperative incidence of de novo GERD symptoms, and the secondary outcome was the difference between preoperative and postoperative endoscopy findings.

### Statistical methods

Data were analyzed using the statistical software SPSS (IBM Corp., Armonk, New York, USA), version 22. McNemar's and marginal homogeneity tests were used to compare the findings from the two EGD examinations: the preoperative and the 1-year postoperative ones. Comparison between patients who developed GERD symptoms and those who did not was done using Mann–Whitney $U$ test and $\chi^2$ test as appropriate.

## Results

The total number of patients included during the study period according to the eligibility criteria was 109 patients, of which four patients were excluded owing to an intraoperative diagnosis of hiatus hernia and five patients dropped out and did not complete the

postoperative follow-up. Finally, 100 patients were analyzed.

### Baseline data of the study patients

The included patients were predominantly females (89%), with a mean age of 37.95 years, a mean weight of 124.16 kg, and a mean BMI of 49.08 kg/m$^2$. Patients' comorbidities were diabetes mellitus, hypertension, and obstructive sleep apnea syndrome (Table 1).

The preoperative EGD revealed that despite all patients having no GERD symptoms, only 48% of the patients had no esophagitis, 42% had reflux esophagitis grade A, and 10% had reflux esophagitis grade B. Signs of gastritis were evident in 71% of patients (Table 1).

**Table 1 Baseline data of the study patients**

| | Mean±SD | |
|---|---|---|
| Age (years) | 37.95±10.94 | |
| Weight (kg) | 124.16±14.5 | |
| BMI (kg/m$^2$) | 49.08±5.41 | |
| | Count | % |
| Sex | | |
| Female | 89 | 89 |
| Male | 11 | 11 |
| Comorbidities | | |
| Diabetes mellitus | 55 | 55 |
| Hypertension | 48 | 48 |
| Obstructive sleep apnea | 54 | 54 |
| Preoperative EGD findings | | |
| No esophagitis | 48 | 48 |
| Esophagitis grade A | 42 | 42 |
| Esophagitis grade B | 10 | 10 |
| Gastritis | 71 | 71 |

EGD, esophagogastroduodenoscopy.

### One-year postoperative data of the study patients

Reassessment of the patients after 1 year of surgery revealed a mean BMI of 31.53 kg/m$^2$ and a mean weight of 78 kg. The mean percentage of the total weight loss (%TWL) was 37.1% (Table 2). Concerning patients' comorbidities, hypertension remission occurred in 54.17% of cases, diabetes remission occurred in 78.18% of patients, and obstructive apnea syndrome remission occurred in 94.44% of cases.

GERD symptoms were encountered in 26 patients; each of them experienced one or more of the following symptoms: regurgitation, heart burn, nausea/vomiting, early satiety, or bloating, at least once per week. The postoperative EGD revealed that 63% of cases had no esophagitis, 16% had grade A esophagitis, and 1% had grade B esophagitis.

### Distribution of the patients' postoperative esophagogastroduodenoscopy findings according to the patients' symptoms and the preoperative esophagogastroduodenoscopy findings

No statistically significant difference was noted between the preoperative and the 1-year postoperative EGD esophageal findings. Of the preoperative 48 patients without esophagitis, 17 developed postoperative grade A. Of the 42 patients having preoperative esophagitis grade A, 26 patients remitted and had no esophagitis and 16 patients remained of grade A esophagitis. Of the 10 patients having preoperative grade B esophagitis, six patients remitted, three patients improved to grade A esophagitis, and one patient remained grade B esophagitis.

No statistically significant difference was noted in the distribution of gastritis cases preoperatively and 1 year postoperatively. Of the 71 patients having preoperative

**Table 2 Data of the study patients 1 year postoperatively**

| | | Mean±SD | |
|---|---|---|---|
| Weight (kg) | | 78±10.85 | |
| BMI (kg/m$^2$) | | 31.53±3.52 | |
| %TWL | | 37.1±5.78 | |
| | Count (%) | Remission rate (%) | De novo cases (%) |
| Comorbidities | | | |
| DM | 12 (12) | 78.18 | 0 |
| HTN | 22 (22) | 54.17 | 0 |
| OSA | 3 (3) | 94.44 | 0 |
| Postoperative EGD findings | | | |
| No esophagitis | 63 (63) | – | – |
| Esophagitis grade A | 16 (16) | 61.9 | 35.4* |
| Esophagitis grade B | 1 (1) | 90 | 0* |
| Gastritis | 76 (76) | 22.54 | 72.4** |

Compared to cases had no esophagitis preoperatively. DM, diabetes mellitus; EGD, esophagogastroduodenoscopy; HTN, hypertension; OSA, obstructive sleep apnea. *Compared to have no esophagitis preoperatively. **Compared to cases had no gastritis preoperatively.

gastritis, 16 patients remitted and 65 remained showing gastritis. A total of 21 patients developed de novo gastritis (Table 3).

Of the 26 patients having GERD symptoms, one patient had postoperative grade B esophagitis, 12 had grade A, 15 had gastritis, and one had normal examination.

### Comparison between patients with gastroesophageal reflux disease symptoms and those without

Comparison between patients with GERD symptoms and those without revealed no statistically significant differences in the sex distribution, age, distribution of comorbidities, BMI, weight, or the %TWL (Table 4).

## Discussion

With the growing prevalence of obesity, variable bariatric procedures are currently available for management of severe obesity. Of them, SG has recently been one of the most popular bariatric procedures globally owing to its efficiency and low complications rate.

As found in the literature, SG has been frequently implicated in the development or worsening of GERD. Nevertheless, this relation is still a matter of debate.

This study aimed to assess the potential GERD development and the upper GIT endoscopy findings 1 year after LSG.

**Table 3 Comparison between preoperative and postoperative esophagogastroduodenoscopy examinations**

| | Preoperative: *n* (%) | | | *P* value |
|---|---|---|---|---|
| | No esophagitis: 48 (48) | Grade A esophagitis: 42 (42) | Grade B esophagitis: 10 (10) | |
| Postoperative: *n* (%) | | | | |
| No esophagitis: 63 (63) | 31 (31) | 26 (26) | 6 (6) | $0.12^{MH}$ |
| Grade A esophagitis: 36 (36) | 17 (31) | 16 (16) | 3 (3) | |
| Grade B esophagitis: 1(1) | 0 | 0 | 1 (1) | |
| | No gastritis: 29 (29) | | Gastritis: 71 (71) | |
| No gastritis: 24 (24) | 8 (8) | | 16 (16) | $0.52^{M}$ |
| Gastritis: 76 (76) | 21 (21) | | 55 (55) | |

$^{MH}$Marginal homogeneity test. $^{M}$McNemar test.

**Table 4 Comparison between patients who developed postoperative gastroesophageal reflux disease symptoms and those who did not regarding the postoperative data of the patients**

| | With GERD symptoms: *N*=26 (mean±SD) | | Without GERD symptoms: *N*=74 (mean±SD) | | *U* | *P* value |
|---|---|---|---|---|---|---|
| Age (years) | 37.2±10.6 | | 38.2±11.1 | | 898 | 0.62 |
| | 37 (21–56) | | 38.5 (20–58) | | | |
| Weight (kg) | 77.5±11.7 | | 78.2±10.6 | | 937 | 0.84 |
| | 77 (59–102) | | 78 (58–94) | | | |
| BMI (kg/m$^2$) | 31.3±3.8 | | 31.6±3.4 | | 896 | 0.6 |
| | 30 (25–39) | | 32(26–39) | | | |
| %TWL | 37±6.6 | | 37.1±5.5 | | 949 | 0.9 |
| | 38.4 (23.7–46.4) | | 38.5 (17.7–49.2) | | | |
| | Count | % | Count | % | $\chi^2$ | *P* value |
| Gender | | | | | | |
| Female | 24 | 92.3 | 65 | 87.8 | 0.39 | 0.53 |
| Male | 2 | 7.7 | 9 | 12.2 | | |
| Comorbidities | | | | | | |
| DM | 2 | 7.8 | 10 | 13.5 | 0.62 | 0.43 |
| HTN | 6 | 23.1 | 16 | 21.6 | 0.02 | 0.88 |
| OSA | 1 | 3.8 | 2 | 2.7 | 0.09 | 0.77 |
| EGD findings | | | | | | |
| No esophagitis | 13 | 50 | 50 | 67.6 | 4.8 | 0.09 |
| Grade A esophagitis | 12 | 46.2 | 24 | 32.4 | | |
| Grade B esophagitis | 1 | 3.8 | 0 | 0 | | |
| Gastritis | 17 | 65.4 | 59 | 79.8 | 2.2 | 0.14 |

$\chi^2$, $\chi^2$ test; DM, diabetes mellitus; EGD, esophagogastroduodenoscopy; GERD, gastroesophageal reflux disease; HTN, hypertension; OSA, obstructive sleep apnea; *U*, Mann–Whitney *U* test.

The study included 100 patients scheduled for LSG. Despite the absence of GERD symptoms, the preoperative EGD revealed that 52% of the patients had either grade A or grade B esophagitis and 71% had signs of gastritis.

Obesity has been extensively described as a risk factor for developing GERD with its consequent complications such as esophagitis among others [7]. The high prevalence of asymptomatic esophagitis found in this study is within the range of what was described by the previous studies by Cho *et al.* [10] (45.3%), Jung *et al.* [11] (36.7%), and Tu *et al.* [12] (76.7%). The high rate found in our cohort could be explained by the high prevalence of diabetes mellitus and its well documented association with peripheral neuropathy.

The effectiveness of LSG in induction of excellent weight loss and remission of comorbidities has been described elsewhere [6,13,14]. In concordance, the present work showed that the reassessment of patients after 1 year revealed a %TWL of 37.1% and a remission rate of comorbidities ranging from 54.17 to 94.44%.

The present study showed that de novo GERD symptoms were exhibited in 26% of patients. Nevertheless, the number of cases showing no EGD evidence of esophagitis increased in comparison with the preoperative findings (63 vs. 48%). The difference was shown to be statistically nonsignificant. However, we assume that it could be clinically significant as the rate of remission considerably exceeded the rate of de novo cases. Moreover, all of the de novo cases were of grade A, whereas the highest remission rate was particularly evident in grade B esophagitis (90%), denoting an overall favoring effect seen postoperatively. These postoperative EGD-improving findings were shown also in the grades of the esophagitis cases, where only 16 patients were still showing grade A esophagitis, compared with 26 patients preoperatively, and one patient was still showing grade B esophagitis, compared with 10 patients preoperatively.

Most of the published evidence describes that, after LSG, the preexisting GERD symptoms gets worse and new-onset GERD symptoms develop [15]. Previous meta-analyses reported de novo GERD rates of 20 and 23% after LSG [16–18]. In our experience, the de novo evolvement of GERD symptoms despite the improvement in the EGD findings was perplexing. However, it is well documented that evaluation of symptoms by itself is not reliable when diagnosing GERD [19], although several authors still base their diagnosis on symptoms. SG, theoretically, should cause remission or improvement of the GERD symptoms. Actually, it includes the removal of the acid-producing parts of the stomach, that is, the body and fundus [20]. The investigators point of view is that the de novo encountered GERD symptoms in the study patients could be partially related to increased gastritis rate. In addition, it may be attributed to the improved overall conditions of the patients after surgery, including the high rate of diabetes mellitus remission that might be reflected on peripheral neuropathy improvement, hence, the better realizing of the disease symptoms.

In agreement with our findings, Rebecchi and colleagues published their series that showed a significant improvement in patients who were diagnosed with GERD preoperatively. They did not find any changes in the lower esophageal sphincter pressure, however, with still cases of de novo GERD [21]. In the series by Viscido *et al.* [22], 45.5% resolved their condition and none of those who remained with esophagitis worsened their status. The recent study of Pilone *et al.* [23] was also in line with our findings, as it demonstrated an overall beneficial effect of LSG on GERD condition.

In alignment with the literature, we respect that the findings of EGD could not totally preclude the presence/absence of GERD. Mucosal lesions can be nonevident in up to 50–60% of patients with documented GERD [22]. Nevertheless, we believe that endoscopic findings are crucial, particularly when comparing two time settings.

After 1 year of surgery, 16 patients showed gastritis remission, and 21 patients developed de novo gastritis. SG enhances the GIT motility, and hence, it is less likely for bile to reflux into the stomach, and mostly the developed gastritis was not reflux, and may be attributed to helicobacter infection.

As far as we know, this is the first study assessing the effect of SG on GERD in a cohort that was preoperatively free of symptoms, and it excluded hiatus hernia cases. From our experience, the beneficial outcomes of GERD exceeded the adverse events. The postoperative considerable GERD effect that was documented previously could be a matter of technical heterogeneities, hiatus hernia effect, or higher appreciation of symptoms. However, in view of the alarming findings recently reported by Braghetto *et al.* [24] that Barrett's esophagitis occurred at an

incidence of 1.2% after 6 years of follow-up of patients who underwent LSG, larger long-term studies are still needed to validate our results.

### Strengths and limitations

The current work is strengthened by being a prospective longitudinal study and being the first to assess a cohort that was preoperatively asymptomatic and had no hiatus hernia using EGD at two times settings: preoperatively and 1 year postoperatively. However, the study is limited by the short-term follow-up period and nonassessment of the patients by esophageal function tests.

## Conclusion

The present study concludes that SG had an overall amelioration effect on the preoperative GERD findings. Our work raises inquiries about the real effect of SG on GERD. However, larger long-term studies are still needed to validate the results.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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