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RESEARCH

Evaluation of Clinical Score, Esophageal Manometry and pH Monitoring before and after Conversion from Sleeve Gastrectomy to Roux-en-Y Gastric Bypass for Refractory Gastroesophageal Reflux Disease

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Abstract

Introduction Gastroesophageal reflux disease (GERD) after sleeve gastrectomy (SG) responds well to medical treatment. However, in refractory cases, surgical conversion to Roux-en-Y gastric bypass (RYGB) is considered the best option. The objective of this study was to evaluate the outcomes of sleeve-to-bypass conversion in patients with refractory GERD.

Method Retrospective analysis of prospectively collected patients undergoing this conversion, in which the clinical questionary (GERDq), esophageal manometry and pH monitoring were evaluated before and after 9 months after surgery.

Results Eleven patients with a mean age of 44.1 years were included, 10 of whom were female, with a mean BMI of 32.3 kg/m2 and a mean postoperative time of 6.1 years after SG. After conversion, the mean total weight loss was 14.1% and the mean total GERDq decreased from 35.4 to 8.3. There was no difference between the esophageal manometry results before and after surgery. There was a reduction in the mean DeMeester score at pH monitoring from 70 to 34, in the total number of distal reflux episodes from 43.8 to 19.1, and in the total number of proximal reflux episodes from 7.8 to 2.2. In esophageal manometry, the mean lower esophageal sphincter length before conversion was shorter in patients who maintained abnormal pH monitoring after surgery (2.3 vs. 4.4 cm).

Conclusion SG to RYGB conversion may lower GERD, but it does not always resolve it. Although pH monitoring changes persisted, there was an improvement in the DeMeester score. The lower esophageal sphincter length may be associated with persistent reflux after conversion.

Key Points

- The conversion from sleeve to bypass clinically improves gastroesophageal reflux.
- The conversion improved the DeMeester score, but some pH monitoring changes persist.
- LES length may be associated with persistent reflux after conversion.

Keywords Bariatric surgery · Sleeve gastrectomy · Gastric bypass · Revisional surgery · Gastroesophageal reflux disease · Barrett's esophagus

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Introduction

Sleeve gastrectomy (SG) is currently one of the most frequently performed metabolic bariatric surgery (MBS) techniques worldwide [1]. The procedure involves resection of the greater gastric curvature, resulting in a narrow, high-pressure gastric tube. This new anatomical shape has been associated with both the persistence of pre-existing gastroesophageal reflux disease (GERD) symptoms and the emergence of de-novo symptoms in previously asymptomatic patients [2, 3].

In most cases, clinical treatment with proton pump inhibitors (PPIs) is effective in controlling symptoms. However, in cases of treatment failure or symptomatic recurrence, surgical conversion is needed. The main revision strategy in such cases is conversion to Roux-en-Y gastric bypass (RYGB), which creates a smaller-volume, rapid emptying and low-pressure gastric reservoir, thus providing significant improvement in GERD symptoms [4–12].

Several studies have shown high rates of symptomatic resolution of GERD after conversion to RYGB, often achieving 100% subjective improvement in patients [13–19]. However, studies that objectively evaluate the impact of this conversion on GERD through clinical parameters and functional tests such as esophageal manometry and pH monitoring are still scarce. We aim to provide this evidence with our study.

Materials and Methods

This was a retrospective analysis of prospective observational cohort study that included patients undergoing conversion from SG to RYGB because of GERD refractory to clinical treatment.

The patients in the study had previously undergone SG and had developed postoperative GERD symptoms that were clinically difficult to control. The indication for surgical conversion was based on an individualized outpatient evaluation, including medical history, physical examination, and additional tests (esophagogastroduodenoscopy (EGD), high-resolution esophageal manometry (HRM), and 24-hour pH monitoring), with the aim of promoting symptomatic relief and functional improvement of GERD.

This study was submitted to and approved by the research ethics committee. All patients were evaluated during a preoperative consultation, at which time they signed the Free and Informed Consent Form.

Clinical and demographic data were collected, including the following: sex, date of birth, date of SG, height, weight prior to SG, lowest weight achieved after SG, current weight and use of PPI; the use and, when applicable, the dose taken was also recorded.

During the same preoperative consultation, the clinical questionnaire for assessing GERD (Gastroesophageal Reflux Disease Questionnaire – GERDq) was applied, and the following complementary exams were requested: EGD, HRM and 24-hour pH monitoring.

All procedures were performed by laparoscopy. The conversion consisted of creating a gastric pouch measuring approximately 4–5 cm, followed by a stapled gastrojejunostomy of 3 cm. A Roux limb of 100 cm and a biliopancreatic limb of 100 cm were constructed to complete the Roux-en-Y gastric bypass.

Nine months after surgical conversion, patients were reassessed with a new GERDq test, in addition to repeated HRM and pH monitoring. Weight fluctuations and continued or discontinued PPI use were also analyzed.

Weight loss was assessed by using the percentage of total weight loss (%TWL), calculated through the formula: initial weight subtracted from current weight and divided by initial weight. Recurrent weight gain (RWG) was considered as a recovery greater than 25% of the minimum weight previously achieved after the SG.

The GERDq assesses six symptoms associated with GERD: heartburn, regurgitation, epigastric or chest pain, postprandial bloating, dysphagia, and cough. Each symptom is classified according to its frequency (scale from 0 to 4) and intensity/severity (scale from 0 to 3). The total score is obtained by multiplying the frequency by the severity of each item, with the final sum ranging from 0 to 72 points, as described by Mouli and Ahuja [20]. This version of the questionnaire differs from the shorter GERD-Q (6–18 points) that is widely used in gastroenterology practice.

For the purposes of this study, patients with a score ≤ 7 were considered mildly or not symptomatic and those with a score > 7 were considered severely symptomatic, as proposed by Guetter et al. [21].

HRM and 24-hour pH monitoring, both preoperatively and postoperatively, were performed on all patients in the same specialized external clinic, ensuring standardization of methods.

In HRM, the main parameters evaluated were the length of the lower esophageal sphincter (LES) and its integrated relaxation pressure (IRP). For the diagnosis of ineffective esophageal motility, the criteria of the Chicago Classification 4.0 were adopted, which defines as altered those cases with more than 70% of ineffective waves or with at least 50% of peristaltic failures [22].

To perform 24-hour esophageal pH monitoring, patients were instructed to discontinue PPI use for at least 2 weeks. This recommendation was applied to both preoperative and postoperative assessments, and all pH monitoring was performed off PPIs. The main parameters evaluated were as follows: DeMeester score, total number of distal reflux episodes, number of long-lasting reflux episodes (longer than 5 min), percentage of time with pH < 4 in the upright position, percentage of time with pH < 4 in the supine position, percentage of total time with pH < 4, duration of the longest reflux episode (in minutes), and total number of proximal reflux episodes.

In order to identify possible predictors of better or worse response to surgical conversion, the following items were analyzed: influences of weight recurrence, weight loss after conversion, the presence of hiatal hernia (HH) identified in the EGD and manometric changes on the results of pH monitoring and the GERDq clinical score in the postoperative period.

In the statistical analysis, the comparison between two categories of a variable in relation to a quantitative variable was performed using the Mann-Whitney U test, a nonparametric test. To compare the two assessment time points (preoperative and postoperative) in quantitative variables, another nonparametric test, the Wilcoxon signed-rank test for paired samples, was used. The association between two qualitative variables was analyzed using Fisher's exact test. The correlation between two quantitative variables was assessed using Spearman correlation coefficient. P-values lower than or equal to 0.05 were considered statistically significant.

Results

A total number of 11 patients were included in the study, of whom 10 were female (90.9%). At the time of conversion to RYGB, the mean age was 44.1 ± 5.7 years and the mean time after SG was 6.1 ± 2.9 years.

Demographic data and weight loss before and after surgical conversion are detailed in Table 1.

Preoperative upper endoscopy findings were available for all 11 patients. Two patients had small hiatal hernias (approximately 2.5 cm each), five had Los Angeles grade A esophagitis, and two had grade B erosive esophagitis after sleeve gastrectomy.

Before SG, the mean weight of patients was 116.8 kg and the mean body mass index (BMI) was 41.8 kg/m². After SG, the mean minimum weight reached was 77.1 kg, corresponding to a mean TWL of 33.3%. At the time of conversion to RYGB, the mean weight of patients was 93.4 kg, the mean BMI was 33.2 kg/m², and the TWL was 20%. The mean RWG compared to nadir was 20%, and three patients (27.3%) experienced RWG greater than 25%. After conversion to RYGB, the mean weight reduced to 78.8 kg and the mean BMI reduced to 28.6 kg/m², resulting in an average additional TWL of 14.1%.

Table 1 – General data and evolution of weight before and after conversion from sleeve to Roux-en-Y gastric bypass ($N = 11$)

Variable	Before sleeve gastrectomy	At Time of conversion	Nine months after conversion to bypass
Age (years)	38.1 ± 7.4	44.1 ± 5.7	–
Weight (kg)	116.8 ± 21.2	93.4 ± 23.3	78.8 ± 16.1
BMI (kg/m²)	41.8 ± 4.8	33.2 ± 5.9	28.6 ± 4.6
Total weight loss %	–	20.0 ± 14.8	14.1 ± 11.5

Before conversion, the mean total GERDq was 35.4; the symptom with the worst mean score was retrosternal heartburn (10.2) and the second worst was regurgitation (8.1). After conversion, the mean total GERDq decreased to 8.3 ($p = 0.003$). And when comparing the mean of each symptom individually before and after conversion, five of the six complaints showed a statistically significant decrease in score. The data from the pre-conversion and post-conversion questionnaire are detailed in Table 2.

After conversion, seven of the 11 patients were classified as very mildly symptomatic and four as severely symptomatic, although all of them had decreased their scores.

Before conversion, all patients were taking PPIs. After conversion, three patients

(27.3%) continued taking them, with one patient using a daily dose of 20 mg and two patients using 40 mg per day.

All patients underwent HRM and pH monitoring before conversion to RYGB. In the postoperative period, 9 patients (81.8%) repeated these exams, approximately 9 months after surgical conversion.

There was no statistical difference between the results of HRM performed before and after conversion. Before surgery, three of the 11 patients (27.3%) had LES hypotonia and four (36.3%) had ineffective esophageal motility. After conversion, four of the 9 patients (44.4%) who underwent manometry again had LES hypotonia and three (33%) had

Table 2 – Data from GERDq before and after conversion from sleeve to RYGB ($N = 11$)

Symptom	Before	After	p*
Heart burn	10.2 ± 2.5	2.6 ± 3.5	0.03
Regurgitation	8.1 ± 3.8	0.5 ± 1.2	< 0.01
Epigastric pain	4.0 ± 3.8	1.2 ± 2.4	0.05
Epigastric fullness	6.5 ± 5.4	3.3 ± 3.6	0.14
Dysphagia	4.7 ± 4.5	0.2 ± 0.4	0.01
Cough	1.8 ± 2.0	0.5 ± 1.2	0.04
Total *GERDq*	35.4 ± 11.3	8.3 ± 7.5	0.01

(*) Wilcoxon signed-rank test (nonparametric); $p < 0.05$

Table 3 – Comparison between esophageal manometry before and after conversion from sleeve to gastric bypass

Result	Before	After	p*
LES length (cm)	3.5 ± 1.6	3.8 ± 1.2	0.59
Integrated Relaxation Pressure (mmHg)	12.4 ± 13.7	12.3 ± 5.3	0.52

LES – Lower Esophageal Sphincter (*) Wilcoxon signed-rank test (nonparametric); $p < 0.05$

Note: Analysis includes only patients who performed high-resolution esophageal manometry pre and postoperatively (N = 9).

ineffective esophageal motility. The data from the HRM performed can be seen in Table 3.

There was a significant statistical difference when comparing several parameters of pH monitoring performed before and after conversion. Before surgery, the mean DeMeester score was 70, with four patients presenting values above 90. The mean total number of distal and proximal reflux episodes was 43.8 and 7.8, and the total time with pH lower than 4 was 16.9%. After surgery, the mean DeMeester score decreased to 34, with only one patient maintaining values above 90. The mean total number of distal and proximal reflux episodes decreased to 19.1 and 2.2, as did the percentage of time with pH lower than 4 in the upright position, which decreased from 18% to 8%. No changes were observed in the total time with pH lower than 4, neither in the percentage of time with pH lower than 4 in the supine position, the number of long-lasting reflux episodes, or the duration of the longest reflux episode. The data from the pH measurements performed can be seen in Table 4.

Among the two patients who underwent pH monitoring and manometry only preoperatively, DeMeester scores were 27.9 and 39.3, which were slightly lower than the overall preoperative mean. Both patients also presented lower esophageal sphincter hypotonia on manometry, consistent with the findings of the other patients. For the statistical analysis of pH monitoring, only the nine patients who completed both pre- and postoperative evaluations were included, and the comparative results in Table 4 reflect exclusively this subgroup.

After conversion, 8 of the 9 patients showed a decrease in DeMeester scores, and 3 patients normalized their scores. However, 6 patients still had scores above 14.72, and 1 patient showed an increase in their scores after conversion. In this case, the DeMeester score increased from 95.9 to 115.6 after conversion, despite a marked clinical improvement, with the GERDq score decreasing from 46 to 20. RWG before conversion, weight loss after conversion, and the presence of a HH identified on EGD did not show a statistically significant association with reflux-related outcomes after conversion, either when comparing clinical scores or pH monitoring results.

Table 4 – Comparison of pH monitoring before and after conversion from sleeve to gastric bypass

Result	Before	After	p*
DeMeester Score	70.0 ± 30.6	34.0 ± 34.7	0.02
Number of total episodes of distal reflux	43.8 ± 18.4	19.1 ± 19.2	0.04
Number of long-term reflux episodes (> 5 min)	10.6 ± 5.2	6.1 ± 4.9	0.07
Time % with pH < 4 in orthostatic position	18.8 ± 11.9	8.2 ± 10.7	0.05
Time % with pH < 4 in supine position	22.0 ± 16.9	12.0 ± 11.9	0.14
Total time % with pH < 4 Longest episode duration (min)	18.8 ± 9.3	10.3 ± 10.4	0.11
Longest episode duration (min)	48.0 ± 27.6	35.8 ± 36.0	0.59
Total number of proximal reflux episodes	7.8 ± 12.5	2.2 ± 4.4	0.04

(*) Wilcoxon signed-rank test (nonparametric); $p < 0.05$

Note: Analysis includes only patients who performed twenty-four-hour esophageal pH monitoring pre and postoperatively (N = 9).

However, when evaluating the outcomes in relation to the manometric data, it was observed that the length of the LES before conversion was a statistically relevant factor. The mean and median lengths of the LES in patients with normal pH monitoring after conversion were 4.4 cm and 4.0 cm, respectively, while in patients with abnormal pH monitoring, these values were 2.3 cm and 2.1 cm ($p = 0.03$). This difference is illustrated in Graph 1.

The other pre-conversion and post-conversion manometry results were not risk factors for a worse clinical or pH monitoring result after conversion, and these data can be seen in Table 5.

Discussion

This is the first study to prospectively evaluate pH monitoring before and after conversion from SG to RYGB for refractory GERD, allowing for objective measurement of improvement in acid gastroesophageal reflux. Until now, most publications on this surgical conversion were limited to clinical or endoscopic parameters, without complete data on esophageal physiology [23–26].

Clinical parameters of GERD improvement were assessed with the use of the GERDq, which has already been validated by Allen et al. [27] for the evaluation of symptoms in patients undergoing videolaparoscopic Nissen fundoplication, before the procedure and six months after the procedure. Since then, it has been used in different clinical contexts, including the evaluation of GERD in patients undergoing SG [9, 21]. It is important to clarify that the GERDq applied in this study is not the same as the widely

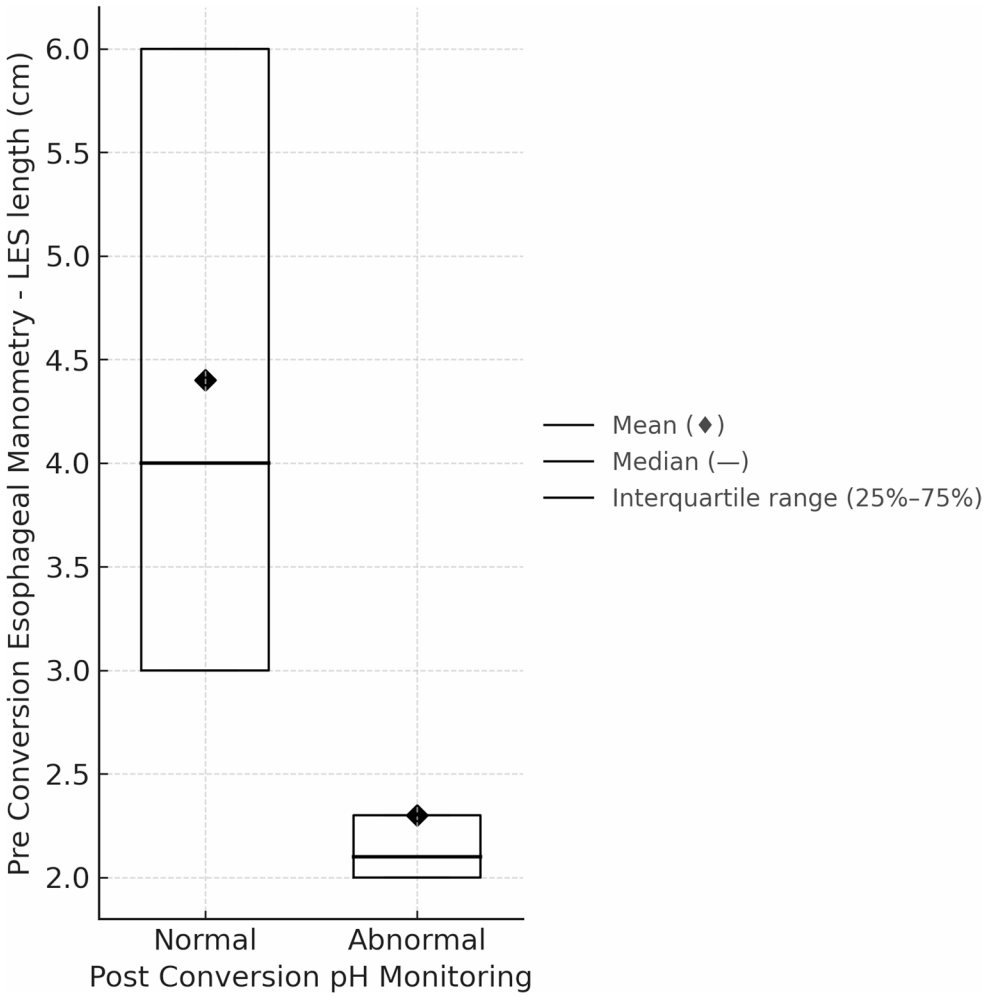


Fig. 1 Comparison of Lower Esophageal Sphincter Length in Esophageal Manometry before Conversion and the DeMeester Result of pH Monitoring after Conversion from Sleeve to Bypass. Note: Analysis includes only patients who performed manometry and pH monitoring pre and postoperatively (N=9)

Table 5 – Comparison between manometric parameters and pH monitoring results after conversion (DeMeester Score)

Result	Normal	Abnormal	*p**
Pre-convesion Manometry – LES Length (cm)	4.4±1.5	2.3±0.5	0.03
Pre-conversion Manometry – LES MRP (mmHg)	6.9±2.7	19.3±19.5	0.81
Post-conversion Manometry – LES Length (cm)	3.3±0.9	4.4±1.4	0.33
Post-conversion Manometry – LES MRP (mmHg)	14.6±4.4	9.5±5.3	0.22

(*) Mann-Whitney U test (nonparametric); $p<0.05$

Note: Comparison was performed in the subgroup of patients who performed manometry and pH monitoring pre and postoperatively (N=9).

known GERD-Q (6–18 points), which also evaluates dyspeptic symptoms in an inverse manner.

The epidemiological profile of sex and age was similar to the pattern observed in candidates for primary bariatric surgery at the study site. Weight loss and RWG rates after SG were also within expectations.

Conversion occurred, on average, 6.1 years after SG, an interval slightly longer than that described in the literature, which ranges from 1.3 to 4.2 years [23, 24, 26]. The average additional weight loss of 14.1% after conversion was also consistent with previously published results [23].

The clinical efficacy of conversion to RYGB in controlling GERD was evident, with a significant reduction in the GERDq score (35.4 to 8.3), significant improvement in most symptoms and a reduction in PPI use. This corroborates with studies that indicate symptom improvement rates between 74% and 93% of cases [23–26].

With pH monitoring, this study documented a decrease in acid reflux, through a reduction in the DeMeester score (70 to 34), and in the total number of distal (43.8 to 19.1) and proximal (7.8 to 2.2) reflux episodes. Such findings are consistent with a retrospective analysis of this conversion [24] and also with a prospective follow-up of patients undergoing primary RYGB [28], which also observed a significant decrease in acid exposure when comparing preoperative and postoperative pH monitoring.

Among the 11 patients included, two presented small hiatal hernias (approximately 2.5 cm each) identified on preoperative endoscopy. These patients did not show shorter LES length on manometry before or after conversion. Nevertheless, the presence of small or subdiagnosed hiatal hernias could represent a potential confounding factor contributing to shorter LES length and, consequently, to persistent reflux or less favorable pH outcomes after conversion. Furthermore, the absence of the gastric fundus after sleeve gastrectomy may also play a role in this anatomical and functional alteration.

Despite clinical improvement in most cases, four of the eleven patients remained severely symptomatic, and three continued taking PPIs. Similarly, although eight of the nine patients that were evaluated showed a reduction in DeMeester levels, six still maintained altered values. These results indicate that the conversion provides a partial remission rate for GERD, although the need for drug treatment may persist.

Manometric analysis demonstrated a high prevalence of esophageal motor disorders but did not reveal significant changes in global parameters after conversion, which was expected. Patients with obesity have a higher rate of dysmotility than patients without obesity, and this surgery does not aim to restore esophageal motor function but rather to reduce intragastric pressure and the esophagogastric gradient [28–32].

Furthermore, an association was observed between shorter LES length and persistent reflux after conversion (2.3 cm versus 4.4 cm), a finding consistent with the pathophysiology of GERD and the relevance of this mechanism in antireflux control [33]. Factors such as HH, RWG, and previous use of PPIs, although considered risk factors, did not influence the outcomes in this study [23]. Various strategies to prevent GERD and other complications after SG have been described however GERD after SG is commonly prevalent [32, 34–39]. Different MBS including One anastomosis gastric bypass (OAGB) are becoming popular for conversion after SG [40, 41] however RYGB is considered the most popular option at the moment. Our study with objective testing helps prove this notion.

Given the impact of reflux on the choice of bariatric procedure, we recommend that all candidates for primary sleeve gastrectomy or alternative procedures such as duodenal switch or SADI be actively screened for gastroesophageal reflux disease. Standard preoperative upper endoscopy should be performed, and manometric and pH studies may also be useful in selected cases to better guide surgical planning and ensure the most appropriate procedure is chosen.

This study has some limitations, such as a small sample size, relatively short follow-up (9 months), and the absence of a control group undergoing optimized clinical treatment. In addition, due to the small sample size, the study was underpowered to draw definitive conclusions regarding changes in esophageal manometry before and after conversion. With a larger sample size, it might be possible to better identify the potential influence of small or undetected hiatal hernias on lower esophageal sphincter length and postoperative reflux outcomes. Another limitation is that impedance-pH monitoring was not performed; therefore, the present analysis was limited to acid reflux events detected by conventional pH monitoring. Future research may consider multicenter, randomized trials with larger samples, longer follow-up, and assessment of alkaline reflux using esophageal impedance pH monitoring.

Conclusion

SG to RYGB conversion may lower GERD, but it does not always resolve it. Although pH monitoring changes persisted, there was an improvement in the DeMeester score. These findings support RYGB as the standard treatment for GERD refractory to medical therapy after SG but emphasize that the procedure should be viewed as a strategy to reduce symptoms and acid exposure rather than a definitive resolution of GERD in all cases. Lower esophageal sphincter length may be associated with persistent reflux after conversion.

Author Contributions A.N. wrote the main manuscricpt and all authors reviewed the manuscript.

Data Availability No datasets were generated or analysed during the current study.

Declarations

Competing Interests The authors declare no competing interests.

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