



# Roux-en-Y Gastric Bypass as a Treatment for Barrett's Esophagus after Sleeve Gastrectomy

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## Abstract

**Background** Laparoscopic sleeve gastrectomy (SG) is the most frequently performed bariatric procedure today. While an increasing number of long-term studies report the occurrence of Barrett's esophagus (BE) after SG, its treatment has not been studied, yet.

**Objectives** The aim of this study was to evaluate Roux-en-Y gastric bypass (RYGB) as treatment for BE and reflux after SG.

**Setting** University hospital setting, Austria

**Methods** This multi-center study includes all patients ( $n = 10$ ) that were converted to RYGB due to BE after SG in Austria. The mean interval between SG and RYGB was 42.7 months. The follow-up after RYGB in this study was 33.4 months. Gastroscopy, 24 h pH-metry, and manometry were performed and patients were asked to complete the BAROS and GIQLI questionnaires.

**Results** Weight and BMI at the time of SG was 120.8 kg and 45.1 kg/m<sup>2</sup>. Eight patients (80.0%) went into remission of BE after the conversion to RYGB. Two patients had RYGB combined with hiatoplasty. The mean acid exposure time in 24 h decreased from 36.8 to 3.8% and the mean DeMeester score from 110.0 to 16.3. Patients scored 5.1 on average in the BAROS after conversion from SG to RYGB which denotes a very good outcome.

**Conclusions** RYGB is an effective therapy for patients with BE and reflux after SG. Its outcomes in the current study were BE remission in the majority of cases as well as a decrease in reflux activity. Further studies with larger cohorts are necessary to confirm these findings.

**Keywords** Roux-en-Y gastric bypass · Barrett's esophagus · Sleeve gastrectomy · GERD

## Introduction

The number of the morbidly obese is constantly increasing worldwide, and so are bariatric and metabolic surgical procedures to deal with this issue. Laparoscopic sleeve gastrectomy (SG) is the most frequently performed bariatric procedure today, with more than 340,550 surgeries realized globally per annum [1]. While research has shown many times that SG is

highly efficient in achieving weight loss in short- and mid-term follow-up periods [2–4], a few long-term studies quite recently have also found that a significant number of SG patients do suffer from reflux and weight regain in a long-term follow-up. Some of them may develop esophagitis and even Barrett's esophagus (BE) [5–7]. These studies have also shown that a large percentage of patients were in need of a conversion to a different bariatric procedure [8–10]. It has to be noted here that an increase in esophageal cancer after SG has not been detected so far.

A common and efficient way of treating reflux after SG is converting patients to Roux-en-Y gastric bypass (RYGB) [11, 12]. However, reflux symptoms may prevail or recur even after RYGB as Holmberg et al. were able to show in a recent study [13]. While a few studies based on a small number of obese patients have shown that RYGB may cause BE to disappear by curing patients' reflux [14, 15], the question whether the same might go for RYGB performed after SG has not been answered in literature, yet.

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In order to answer this question thoroughly, data gained from gastroscopy, manometry, and 24 h pH-metry with impedance is required. The current study aims at doing exactly that: providing comprehensive data on a number of RYGB patients with BE after SG—as a first step towards an answer.

## Material and Methods

Patients for this study were recruited via the Austrian Society for Bariatric and Metabolic Surgery which contacted all Austrian hospitals performing bariatric procedures. Selection criteria were SG, conversion to RYGB due to reflux and BE. Patients had been treated conservatively initially based on an escalating scheme including lifestyle modifications and proton-pump inhibitors (PPI) but did maintain reflux symptoms. All patients had gastroscopies before both procedures (SG and RYGB). Five patients also had manometries and 24 h pH-metries before the conversion to RYGB.

Participants then all had gastroscopies as well as 24 h pH-metries and manometries at our center as part of the present study. Gastroscopies were performed in accordance with the Seattle protocol, according to which white light endoscopy was used, sampling four-quadrant biopsies every 1–2 cm along the columnar-lined esophagus, starting from the gastro-esophageal junction. Seemingly neoplastic areas were biopsied as well [16]. In agreement with the AGA (American Gastrointestinal Association) guidelines, BE was diagnosed only if biopsies contained both, intestinal metaplasia and goblet cells [17]. Patients were also interviewed about reflux symptoms at all points in time and were asked to complete the GIQLI and BAROS scores at our center.

All patients provided their informed consent in written form. The Ethics Committee approval of the Medical University of Vienna was obtained for this study (reference number 1430/2019).

## Surgical Technique

### SG

SG in this study was performed in the following ways. First, the stomach is mobilized along the greater curvature from 2 cm above the pylorus up to the angle of His, preserving the gastroepiploic arcade. A visualization of the left crus of the diaphragm is mandatory at this point to reveal undiagnosed hiatal hernia. Then, the stomach is resected using a 12-mm (36 Fr) bougie and 5–7 cartridges. The starting point for stapling is approximately 2–4 cm above the pylorus. The entire fundus is resected and the gastro-colic/gastro-splenic ligament is now reattached to the staple line of the sleeve to prevent a migration of the sleeve to the posterior mediastinum and minimize the chance of the sleeve twisting.

### RYGB

RYGB in this study was performed as follows. The lesser sack is entered above the incisura angularis at the lesser curvature and the sleeve is transected, creating a 6–9-cm-long pouch. The pouch width is resized using a 36 Fr bougie after dissecting free the greater curvature of the sleeve and preparing the angle of His. In the case of hiatal hernia, they are treated with hiatoplasty intraoperatively. Hiatoplasty consists of a complete circular preparation of the esophagus and of both crura of the diaphragm, and posterior closure with V-Loc™ by Medtronic (size 2-0, non-absorbable polybutester; barbed monofilament, v-20 needle) running suture.

Then, a gastrojejunostomy and jejuno-jejunostomy are created, the alimentary limb measuring a length of at least 70 cm. The length of the biliopancreatic limb may vary up to a maximum length of 150 cm. Both internal hernia sites are also closed with V-Loc™ by Medtronic (size 2-0, non-absorbable polybutester; barbed monofilament, v-20 needle) running suture.

### Follow-up

The follow-up of this study was  $33.4 \pm 21.1$  months with a minimal follow-up period of 6 months after the conversion to RYGB.

Patients were recruited via the Austrian Society for Bariatric and Metabolic Surgery, sending out a call to all Austrian hospitals offering bariatric surgery. Participants were then invited to the Medical University of Vienna for interviews, gastroscopy, 24 h pH-metry, and manometry.

### Statistical Analysis

The number of patients in this retrospective survey with prospective examinations is limited by the sum of conversions from SG to RYGB due to BE in Austria. Descriptive statistics was used in this study as it is based on quite a small patient collective. Data are presented within the median and range, by mean and standard deviation, or as percentages (where appropriate). %EWL was calculated based on an ideal BMI of 25 kg/m<sup>2</sup>. Statistical calculations were performed using SPSS® v24 for Windows®.

## Results

The present multi-center study includes a total of 10 patients (100% female), all of whom had SG in an Austrian hospital. One additional patient had adjustable gastric banding before SG and was thus excluded from this study. Weight and BMI at the time of SG were  $120.8 \pm 20.4$  kg and  $45.1 \pm 9.2$  kg/m<sup>2</sup>, respectively. None of the patients had symptomatic reflux at

that time. The interval between SG and RYGB was  $42.7 \pm 14.9$  months on average. Two patients had RYGB combined with hiatoplasty (Table 1).

### Gastroscopy

This study’s participants had at least 3 gastroscopies at the following stages: before and after SG and after RYGB, the last one as part of the examinations done specifically for this study.

Gastroscopies done before SG did not reveal any abnormalities (i.e., no hiatal hernias, esophagitis, BE, helicobacter pylori, active gastritis, or ulcers were found).

The gastroscopies after SG were performed due to symptomatic reflux in all patients. Two (20.0%) had hiatal hernias, 8 (80.0%) had esophagitis, and BE was found in all 10 patients. Eight patients had short-segment Barrett’s and 2 were found to have long-segment Barrett’s. One patient had small areas of low-grade dysplasia (in the short-segment group). None of the patients was found to be helicobacter pylori positive.

**Table 1** Patient characteristics

	All patients (n = 10)
Sex (female) (%)	100
Before SG	
Median age OP (years)	$45.8 \pm 14.8$
Weight (kg)	$120.8 \pm 20.4$
BMI (kg/m <sup>2</sup> )	$45.1 \pm 9.2$
Symptomatic reflux (%)	0
Interval SG – RYGB (months)	$42.7 \pm 14.9$
Before RYGB	
Median age OP (years)	$49.4 \pm 14.7$
Weight (kg)	$97.3 \pm 27.2$
BMI (kg/m <sup>2</sup> )	$37.3 \pm 9.2$
Symptomatic reflux (%)	100
After RYGB	
Mean follow-up (months)**	$33.4 \pm 21.1$
Weight (kg)	$72.4 \pm 10.4$
BMI (kg/m <sup>2</sup> )	$27.9 \pm 4.0$
Symptomatic reflux (%)	20.0
EWL (%)*	$91.3 \pm 20.0$
Change BMI (kg/m <sup>2</sup> )*	$17.2 \pm 6.3$
GIQLI (n = 8)	$113.5 \pm 22.1$
BAROS (n = 8)	$5.1 \pm 2.1$

OP, operation; BMI, body mass index; EWL, excess weight loss; SG, sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass

\*Referring to SG

\*\*Referring to RYGB

The gastroscopies after RYGB as part of the present study were performed at our center according to the Seattle protocol (4 quadrant biopsies are taken at every cm with additional biopsies taken from areas of mucosal abnormalities). The gastroscopies revealed hiatal hernia in 0 and esophagitis in 2 patients (20.0%). Interestingly, BE was found in only 2 patients (20.0%), a short- and a long-segment one. The patient who had small areas of dysplasia before RYGB was not found to have BE any more, either (Table 2). The Prague classification for each patient may be found in Table 3.

The excluded patient with gastric banding before SG was converted to RYGB with hiatoplasty and had full remission of short-segment BE.

### Manometry and 24 h pH-metry

Five patients (45.5%) had a manometry and 24 h pH-metry before being converted to RYGB. Nine participants (81.8%) had both examinations after their conversion, specifically done for the purpose of this study.

Patients’ manometry results before and after the conversion to RYGB were not significantly different. The lower esophageal sphincter pressure was  $10.6 \pm 6.7$  mmHg before and  $16.3 \pm 4.1$  mmHg after the conversion on average and bolus transit was normal (p value 0.34).

The 24 h pH-metry results, however, improved considerably after the conversion to RYGB. Patients’ acid exposure time in 24 h was  $36.8 \pm 21.6\%$  before and  $3.8 \pm 4.6$  after the procedure on average (p value 0.004). The number of refluxes was a mean  $162 \pm 113$  before and  $49 \pm 35$  after RYGB (p value 0.04) and the DeMeester score was significantly lower after RYGB (before  $110 \pm 51.1$ ; after  $16.3 \pm 14.2$ ; p value 0.005) (Table 4).

### Outcome Score and Questionnaires

Patients were asked to complete the Bariatric Outcome Score (BAROS) and the Gastro-Intestinal Quality of Life Index (GIQLI) during the course of the examinations performed

**Table 2** Gastroscopies (n = 10)

	Gastroscopy before SG (n = 10)	Gastroscopy before RYGB (n = 10)	Gastroscopy after RYGB (n = 10)
Hiatal hernia	0%	20.0*%	0%*
Esophagitis	0%	80.0%	20.0%
Barrett’s esophagus	0%	100%	20.0%
Helicobacter pylori	0%	0%	0%

SG, Sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass

\*2 patients had RYGB with hiatoplasty

**Table 3** Gastroscopy before RYGB / Prague classification (n = 10)

	Prague classification
Patient 1	C0M1.0
Patient 2	C1M1.0
Patient 3 (+ low-grade dysplasia)	C0M2.0
Patient 4	C0M4.0
Patient 5	C1M2.0
Patient 6	C1M4.5
Patient 7	C0M1.5
Patient 8	C0M1.0
Patient 9	C0M2.5
Patient 10	C0M1.0

RYGB, Roux-en-Y gastric bypass

after the conversion to RYGB. In total, the scores were completed by 8 (80.0%) participants. They scored  $5.1 \pm 2.1$  on average in the BAROS, which denotes a very good outcome. An average of  $113.5 \pm 22.1$  points was scored in the GIQLI, equaling a normal outcome (Table 1).

## Discussion

The current report presents the results of gastroscopy, manometry, and 24 h pH-metry performed in SG patients who were converted to RYGB due to reflux and BE. Remission of BE was found in the majority of patients included. The occurrence of BE after SG and its treatment have both still been hardly studied at all—only a small number of reports on BE after SG may be found in literature today.

### Barrett's Esophagus After Sleeve Gastrectomy

A few mid- and long-term SG studies report the occurrence of BE found in gastroscopy. Braghetto et al. included 231 SG patients in their study, 66 of them had a follow-up of over 5 years and BE was found in 2 cases (3%) [18]. Felsenreich et al. detected BE in 6 (14%) of their 44 SG patients who

had gastroscopy after 11 years. None of them had reflux preoperatively. It should be noted here that none of these 6 patients was included in the present study as they chose close monitoring at regular intervals via gastroscopy over a conversion [6]. In a study of 110 SG patients who had gastroscopies after 58 months, Genco et al. found BE in 19 patients (17%). While 33.6% had symptomatic reflux preoperatively, none of their patients had BE before SG [5]. In an update of this study, Soricelli et al. included 144 SG patients and found BE in 19 (13%) cases via gastroscopy. Interestingly, 4 patients had developed BE without any reflux symptoms and the authors conclude that symptom detection only is not reliable in BE diagnosis. They recommend more objective testing such as gastroscopy instead [19]. In a multi-center study by Sebastianelli et al., 90 patients had gastroscopies 78 months after SG and BE was found in 17 cases (19%). Nineteen patients were suffering from preoperative symptomatic reflux. The authors report weight loss failure to have been significantly linked to BE and suggest providing systematic endoscopy in SG patients [7]. A very early occurrence of BE was found in the present study as well, with BE diagnosed after a mean 40.1 months after SG. One may thus consider performing regular gastroscopies 3 to 5 years postoperatively to detect an early appearance of BE in time. Finally, a meta-analysis on reflux and BE after SG has shown an occurrence of BE in 6% (8% in studies > 24 months follow-up) of SG patients [20]. One should add that Barrett's metaplasia can be found in only 1.6% of the average population [21].

Esophageal adenocarcinoma after SG has been reported in a small number of cases [22, 23]. For instance, El Khoury et al. published a case report of esophageal adenocarcinoma in BE found even 3 years after SG [24]. It should be added here that the annual cancer transition rates for long- and short-segment BE to esophageal adenocarcinoma are only 0.22% and 0.03% [25]. This may seem very low indeed; however, the lifelong cancer risk is of course much higher, especially when talking about relatively young bariatric patients. A large English population-based cohort study by Markar et al. has shown that the absolute reduction in the risk of esophageal cancer in reflux patients who had antireflux surgery is

**Table 4** Manometry/24 h-pH-metry (impedance) (n = 9)

	Manometry 24 h-pH-metry before RYGB (n = 5)	Manometry 24 h-pH-metry after RYGB (n = 9)	p value
LESP (normal 10–35 mmHg)	$10.6 \pm 6.7$	$16.3 \pm 4.1$	0.34
Acid exposure time (%) in 24 h (normal < 4.2%)	$36.8 \pm 21.6$	$3.8 \pm 4.6$	0.004
Total number of refluxes in 24 h (normal < 73)	$162 \pm 113$	$49 \pm 35$	0.04
DeMeester score (normal < 14.72)	$110.0 \pm 51.1$	$16.3 \pm 14.2$	0.005

SG, sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass; LESP, lower esophageal sphincter pressure

relatively small, which is why the authors conclude that antireflux surgery remains a means of symptom relief. Thus, the need for ongoing surveillance of these patients should be stressed [26].

As the results of the studies mentioned above suggest, BE seems to be an issue occurring years after SG. One might assume that with an increasing number of long-term studies of SG being published, the number of BE cases reported after the procedure may rise as well. Hence, BE is certainly a problem to be addressed in the near future. Another point of discussion has been the question whether BE should be treated as a contraindication to SG, which has not yet been concluded [27].

### Roux-en-Y Gastric Bypass in Patients with Barrett's Esophagus

There is a limited number of studies on the outcome of RYGB as a treatment for BE with small patient collectives available today. Patients in these studies did not have SG before RYGB.

First, Gorodner et al. included 11 patients with BE (9 short-segment and 2 long-segment BE) before the RYGB operation in their study with a mean follow-up of 41 months. Four patients (36%) had BE remission; none of the participants showed any signs of progression to dysplasia [15]. Second, in a study of 14 patients with RYGB for BE (5 also had hiatal hernia repair), Andrew et al. found remission of BE in 6 (43%) of them after a minimum follow-up of 1 year [14]. In their review article, Kindel and Oleynikov [28] recommended RYGB for patients with BE based on its superiority in reflux control (acid and non-acid events) compared with other bariatric procedures. Braghetto and Csendes come to a similar conclusion, being that RYGB is the procedure of choice for BE patients [29].

Finally, there are a couple of more dated reports of RYGB in patients with BE. Csendes et al. were the first to describe remission of BE after RYGB and presented a remission rate of 57% (4 out of 7) in patients with short-segment BE and 20% (1 out of 5) in patients with long-segment BE in 2002 [30]. Cobey published a case study of one patient who had gone into BE remission after RYGB in 2005 [31]. Houghton et al. presented a study on 5 patients with long-segment BE and a mean follow-up of 34 months. The authors reported full remission in 2 patients. Three patients also had dysplasia, 2 of whom were free of dysplasia after RYGB [32].

By comparison, the remission rate reported in the current study was slightly higher (80.0%, refer to Table 2). The reason for this might be that the period of time patients had BE was relatively short as it was not diagnosed at the time of their SG surgery. One may speculate that the chances of BE remission are higher the shorter the duration of time a patient suffers

from it. Besides, the present study has shown that a conversion to RYGB caused a fair amount of additional weight loss.

One of the present study's additional strengths is certainly that it is not only based on information gained from gastroscopies but also from 24 h pH-metry, which revealed a decrease in reflux activity and lower DeMeester score after the conversion to RYGB. However, these results may not last: Holmberg et al. found that reflux may remain or recur after RYGB as 50% of their patients are suffering from reflux 10 years after the procedure and maintain antireflux medication [13].

A final point can be made here on the improvement of SG patients' quality of life after RYGB as treatment for BE. Comparing the BAROS and GIQLI scores of the current study's collective with those of patients suffering from reflux after SG in a study published earlier, a distinct improvement may be noted: 1.6 and 104.6 [6] vs. 5.1 and 113.5 in the current study.

### Esophageal/Gastric Cancer After Bariatric Surgery

A systematic review by Musella et al. has shown that esophageal cancer after primary RYGB and SG is rare (0.02% or 8 out of 42,508 after RYGB and 0.003% or 1 out of 39,137 after SG) [33]. Also, Maret-Ouda et al. in a register-based cohort study found no evidence that bariatric surgery (74% of patients had RYGB) may lower the risk of esophageal adenocarcinoma [34].

There is a risk to miss remnant gastric cancer in primary RYGB patients as the remnant cannot be visualized during classic gastroscopy. Tornese et al. collected 17 cases of remnant gastric cancer after primary RYGB, which is of course irrelevant for SG patients converted to RYGB as this part of the stomach is resected during SG [35].

### Non-surgical Treatments of Barrett's Esophagus

According to the AGA guidelines, patients with BE should have surveillance gastroscopies every 3 to 5 years at least [17]. Even shorter intervals may be advisable as the progression of BE after SG might be faster or more aggressive than BE in non-SG patients [36]. In any case, patients suffering from both reflux and BE should have symptomatic reflux therapy using PPI [17].

For patients with low- or high-grade dysplasia in BE, there are different endoscopic methods of therapy available, which may be selected individually. These are ablative therapy (e.g., radio-frequency ablation, photodynamic therapy, cryo-ablation, argon-plasma treatment) or resective therapy (such as endoscopic mucosal resection, endoscopic submucosal dissection) [37].

## limitations of this Study

First of all, the current study is based on a relatively small number of patients. However, it is the first study on RYGB as BE treatment after SG and includes patients from bariatric centers all over Austria. Thus, SG and RYGB were performed at different hospitals in Austria, which in turn was necessary to include as many cases as possible. Finally, pre-SG manometry and pH-metry data were unfortunately not available as these examinations were not standard at the time. However, pre-SG gastroscopy data could be included for all patients in this study.

## Conclusions

RYGB is an effective therapy for patients with BE and reflux after SG. Its outcomes in the current study were BE remission in the majority of cases as well as a decrease in reflux activity. Further studies with larger cohorts are necessary to confirm these findings.

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## Compliance with Ethical Standards

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

**Human and Animal Rights** All procedures performed in studies involving human participants were in accordance with the ethical standards of the research committee of the Vienna Medical University (EK 1430/2019) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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

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