Short-Term Outcomes of Inflammatory Bowel Disease after Roux-en-Y Gastric Bypass vs Sleeve Gastrectomy

Keyvan Heshmati, MD, Tammy Lo, MD, Ali Tavakkoli, MD, FACS, Eric Sheu, MD, DPhil, FACS

BACKGROUND: Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) are the most effective therapies for obesity and may have beneficial effects on the immune system. Therefore, we compared RYGB vs SG outcomes in patients with inflammatory bowel disease (IBD).

STUDY DESIGN: In this retrospective cohort study, we identified 54 patients with either Crohn's disease (CD; n = 31) or ulcerative colitis (UC; n = 23), diagnosed before bariatric surgery, between 2000 and 2017. Nineteen patients underwent RYGB and 35 patients underwent SG.

RESULTS: Patients presenting for RYGB and SG were of similar age (46.2 ± 9.5 years vs 47.2 ± 12.3 years), preoperative BMI (48.5 ± 7.7 kg/m^2 vs 44.9 ± 7.3 kg/m^2) and IBD status, as measured by medications. Both operations led to significant weight loss at 1 year. After RYGB and SG, there were no significant differences in the proportion of patients with UC who had improved (27% vs 8%), unchanged (64% vs 92%), or worse (9% vs 0%) IBD medication requirements, respectively. Similar analysis in the patients with CD showed no significant differences in the proportion who had improved (37.5% vs 44%), or unchanged (25% vs 52%) IBD-medication requirements after RYGB and SG, respectively. However, there was a significant difference in the proportion of patients who had worsened CD after RYGB compared with SG (37.5% vs 4%; p = 0.016). There was a greater rate of surgical complications after RYGB compared to SG (26% vs. 3%; p = 0.02).

CONCLUSIONS: A sizable proportion of patients experienced improvements in IBD post-bariatric surgery. However, in CD patients, RYGB was associated with a significantly greater number of patients with increased IBD-medication requirements. Sleeve gastrectomy led to less weight loss, but had a lower rate of severe complications compared with RYGB. In patients with IBD, and particularly CD, SG may be the safer surgery. (J Am Coll Surg 2019;228:893–901. © 2019 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

The incidence and prevalence of inflammatory bowel disease (IBD) has increased in the past 2 decades.[1,2] The National Health Interview Survey (NHIS) estimated that the incidence of IBD increased from 1.8 million (0.9%) in 1999 to 3.1 million (1.3%) in 2015 among adult Americans.[1] Similarly, obesity has spread globally and affects 39.8% of adult Americans.[3-6] The prevalence of obesity is also rising in the IBD population.[7-10]

Bariatric surgery, in the form of Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG), has been shown to be the most effective and durable therapy for obesity.[11-13] Likewise, bariatric surgery can reverse the systemic inflammatory state by reducing the level of inflammatory biomarkers such as C-reactive protein (CRP), interleukin 6 (IL-6), and tumor necrosis factor alpha (TNF-α).[14,15] Some studies have shown improvements in patients with autoimmune diseases such as psoriasis, systemic lupus erythematosus (SLE), or rheumatoid arthritis (RA) after bariatric surgery.[16-18] Therefore, with the metabolic and immune changes, bariatric surgery may have beneficial effects on IBD.

A few previous studies have shown that in general, bariatric surgery is safe and effective in patients with

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From the Department of Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, MA.

Correspondence address: Eric Sheu, MD, DPhil, FACS, Division of General and Gastrointestinal Surgery, Department of Surgery, Brigham and Women's Hospital, 75 Francis St, ASBII-3rd Floor, Boston, MA 02115. email: esheu@bwh.harvard.edu

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Abbreviations and Acronyms

CD = Crohn's disease
IBD = inflammatory bowel disease
RYGB = Roux-en-Y gastric bypass
SG = sleeve gastrectomy
UC = ulcerative colitis

IBD.[19-22] In these studies, bariatric surgery has led to improvements in IBD in some cases; however, due to a limited number of patients, comparison of different types of bariatric surgery on either ulcerative colitis (UC) or Crohn's disease (CD) was not achievable.[23,24] In this study, we compared the changes in IBD disease course in either UC or CD, as well as bariatric surgery outcomes between patients who underwent RYGB or SG. Our primary outcome was change in IBD disease course, as measured by medication requirements. Secondary outcomes were weight loss, changes in metabolic comorbidities, complications related to surgery and IBD, and vitamin deficiencies.

METHOD

Study group

After obtaining Institutional Review Board (IRB) approval from our institution, we designed a retrospective cohort study to compare the outcomes of bariatric surgery on patients who were diagnosed with IBD before the surgery. We used the Research Patient Data Registry (RPDR) to capture all patients with an IBD diagnosis who underwent bariatric surgery (RYGB or SG) between 2000 and 2017 in the Partners Healthcare.

Inclusion criteria for our study were: age $\geq$18 years, history of bariatric surgery in the form of open or laparoscopic RYGB or SG, and IBD, diagnosed and documented by a gastroenterologist, based on clinical manifestations and confirmed by endoscopy, before bariatric surgery. Of all patients who underwent bariatric surgery between 2000 and 2017, 61 patients were diagnosed with IBD. In 7 patients, IBD was diagnosed after the surgery, leaving a cohort of 54 patients.

Outcomes measures

Pre- and postoperative parameters including demographics, IBD characteristics, and IBD medication requirements, comorbidities, vitamin and micronutrient levels, previous surgical history, postoperative complications, conversion operations, reoperations, and weight measures were collected by a review of prospectively maintained clinical records. The data were obtained from discharge summaries and office notes.

The primary outcome was IBD disease course after the bariatric surgery. Postoperative changes in IBD symptoms were defined based on the changes in the required maintenance therapy as follows: no IBD-medication requirements, increased, stable, or decreased IBD medication requirements. Medications for IBD maintenance therapy were categorized into 3 major groups: amino-salicylic acids (5-ASA) (mesalamine, sulfasalazine), immunomodulators (azathioprine, methotrexate), and biologic agents (infliximab, adalimumab, ustekinumab).[25,26] Preoperative IBD medication requirements were obtained on the day of hospital admission for the bariatric surgery. Postoperative IBD medication requirements were collected at 1 year after bariatric surgery and at the last available medical follow-up visit. Patients who required a higher dose of their IBD medications or next-line treatment due to IBD exacerbation were considered as having increased IBD medication requirements.

Secondary outcomes consisted of weight, surgical and IBD complications, changes in metabolic comorbidities, and vitamin and micronutrient deficiencies after the bariatric surgery. Weight outcomes were collected at 6 months and 12 months after the bariatric surgery. Postoperative complications were categorized into surgical and IBD-related complications. Surgical complications were considered complications secondary to bariatric surgery, such as bleed, leak, or stenosis at the gastro-jejunal or jejuno-jejunal anastomosis or sleeve staple line, gastro-gastric fistula, bile, or other reflux, etc. These complications were categorized into 30-day complications and beyond 30-day complications. The IBD complications were defined as complications associated with clinical manifestations of IBD or accompanied with IBD flares that required surgical or medical interventions, between the time of bariatric surgery and last available follow-up visit.

Statistical analysis

Continuous variables with normal distribution were reported as means $\pm$ SD. Categorical variables were presented as counts or percentages. Comparisons between groups were performed using independent-samples *t*-test or Fisher's exact tests, as appropriate. Two-sided p values were calculated for each pairwise comparison and adjusted for multiple comparisons by Bonferroni correction. Two-sided values of $p < 0.05$ were considered statistically significant. Statistical analyses were performed using R, version 3.5.0 and, GraphPad Prism version 7.00 for Windows (GraphPad Software).

Table 1. Demographics, Baseline Weight, and BMI

Demographic	Roux-en-Y gastric bypass (n = 19)	Sleeve gastrectomy (n = 35)	p Value*
Age, y ± SD	46.2 ± 9.5	47.2 ± 12.3	NS
Sex, female male	16:3	31:4	NS
Race (Caucasian), n (%)	19 (100)	31 (91)	NS
Preoperative weight, lb ± SD	289.9 ± 45.9	266.3 ± 48	0.08
Preoperative height, in ± SD	64.9 ± 3.7	64.5 ± 2.8	NS
Preoperative BMI, kg/m^2 ± SD	48.5 ± 7.7	44.9 ± 7.3	0.1
Smoking, n (%)	3 (16)	3 (9)	NS

*Comparison between Roux-en-Y gastric bypass and sleeve gastrectomy.

RESULTS

Preoperative demographics and irritable bowel disease characteristics

We identified 54 patients with IBD who underwent bariatric surgery between 2000 and 2017; 19 (11 UC and 8 CD) patients had RYGB (4 open; 15 laparoscopic) and 35 (12 UC and 23 CD) had SG (all laparoscopic). Demographics, preoperative weight, and BMI are listed in Table 1. There were no significant differences in age (46.2 ± 9.5 years vs 47.2 ± 12.3 years), sex (84% vs 89% female), race (100% vs 91% Caucasian), height (64.9 ± 3.7 inches vs 64.5 ± 2.8 inches), and smoking status (16% vs 9%) between RYGB and SG groups, respectively ($p > 0.1$). However, patients who underwent RYGB presented with trends toward greater preoperative weight (289.9 ± 45.9 lb vs 266.3 ± 48 lb; $p = 0.08$) or BMI (48.5 ± 7.7 vs. 44.9±7.3 kg/m^2; $p = 0.1$) as compared with SG.

In RYGB and SG groups, 2 (CD) and 6 (3 UC and 3 CD) patients underwent small and/or large bowel resection before their bariatric surgery, respectively. The median durations of IBD diagnosis were 11 and 9.5 years in the RYGB and SG groups, respectively. All patients were clinically stable either with or without medications before bariatric surgery. At baseline, in the RYGB and SG groups, 11 and 19 were on IBD medications, including 11 and 14 patients on 5-ASA (mesalamine, sulfasalazine), 2 and 4 on immunomodulators (methotrexate, azathioprine), and 1 and 8 on biologic agents (infliximab, adalimumab, ustekinumab), respectively. Further, in the RYGB and SG groups, 1 (UC) and 3 (CD) patients presented with extra-intestinal manifestations of IBD (skin rash, arthritis, or oral lesions), and 3 (2 UC and 1 CD) and 6 patients (3 UC and 3 CD) were diagnosed with rheumatologic disorders (rheumatoid arthritis, systemic lupus erythematosis, polyarthritis nodosa [PAN], ankylosing spondylitis [AS], and psoriasis) before the bariatric surgery, retrospectively (Table 2).

Weight loss after Roux-en-Y gastric bypass and sleeve gastrectomy

Patients with IBD showed significant weight loss after both RYGB and SG at 6- and 12-month follow-up. There was a trend toward greater preoperative BMI in patients who underwent RYGB compared with SG. The reduction of BMI was greater after RYGB at 6 months (-12.4 vs -8.4, respectively; $p < 0.01$); however, it was not significantly different between RYGB and SG at 12 months (-15 vs -11.5, respectively; $p = 0.2$) (Fig. 1A). The percent total body weight loss was significantly greater at 6 months (26% vs 19%; p

Table 2. Inflammatory Bowl Disease Characteristics and Associated Outcomes

Characteristic	Overall (n = 54)	Roux-en-Y gastric bypass (n = 19)	Sleeve gastrectomy (n = 35)	p Value*
UC:CD, n	23:31	12:8	11:23	NS
Small/large bowel resection, UC:CD, n	3:5	0:2	3:3	NS
Median IBD duration, y	10	11	9.5	
Preoperative medication use, n (%)	30 (56)	11 (58)	19 (54)	NS
5-ASA	25 (46)	11 (58)	14 (40)	NS
Immunomodulator	6 (11)	2 (11)	4 (11)	NS
Biologic agent	9 (17)	1 (5)	8 (23)	NS
IBD extra intestinal manifestation, n (%)	4 (7)	1 (5)	3 (9)	NS
Rheumatologic disorder, n (%)	9 (17)	3 (16)	6 (17)	NS

*Comparison between Roux-en-Y gastric bypass and sleeve gastrectomy.
5-ASA, 5-aminosalicylic acid; CD, Crohn's disease; IBD, inflammatory bowel disease; UC, ulcerative colitis.

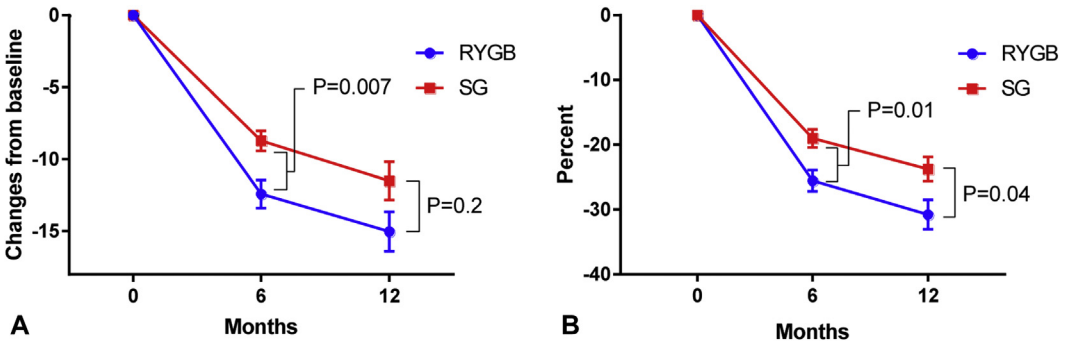

Figure 1. Changes in BMI (A) and percentage of total body weight loss (B) over 1 year after Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG).

< 0.01) and 12 months (31% vs 23%; $p < 0.01$) after RYGB compared with SG (Fig. 1B).

Comorbidities

Patient who underwent RYGB and SG had similar baseline comorbidities including type 2 diabetes (T2D) (32% vs 40%), hypertension (HTN) (63% vs 57%), dyslipidemia (53% vs 43%), and obstructive sleep apnea (74% vs 31%). At 1 year, there was an 11% vs 22% improvement in type 2 diabetes, a 26% vs 28% improvement in hypertension, 6% vs 22% improvement in dyslipidemia, and a 53% vs 16% in obstructive sleep apnea after RYGB and SG, respectively (eTable 1, online only).

Pre- and postoperative inflammatory bowel disease medication requirements

The median follow-up times after RYGB and SG were 96 and 26 months, respectively. Changes in UC and CD status after RYGB and SG were compared separately. As seen in Table 3, in the UC group, 13 patients (6 RYGB and 7 SG) were on no medications and 10 patients (5 RYGB and 5 SG) required pharmacotherapy at the time of bariatric surgery. At the last follow-up visit, 15 patients (7 RYGB and 8 SG) were on no medications, 2 patients (both RYGB) had decreased medication requirements, 5 (1 RYGB and 4 SG) were stable, and 1 patient (RYGB) had increased IBD medication requirements. There were no significant differences in the proportion of patients with UC who were on no medications, had increased, had decreased, or had stable IBD medication requirements after RYGB compared with SG.

In the CD group, 11 patients (2 RYGB and 9 SG) were not on any medications and 20 patients (6 RYGBs and 14 SGs) required pharmacotherapy at the time of bariatric surgery. In the last follow-up visit, 18 patients (3 RYGB and 15 SG) were not on any medications, 6 patients (2 RYGB and 4 SG) had decreased medication requirements, 3 (SG) were stable, and 4 (3 RYGB and 1 SG) increased IBD medication requirements (Table 4). There were no significant differences in the proportions of patients with CD who were on no medications, or had decreased or stable IBD medication requirements. However, there was a significantly greater proportion of patients who had increased IBD medication requirements after RYGB compared with SG (37.5% vs 4%; $p = 0.04$).

When comparing preoperative to 1-year postoperative IBD disease in UC patients, as measured by medication requirement after RYGB and SG, 18% and 17% had improved, 73% and 83% were unchanged, and 9% and 0% had worsened IBD, respectively. In a similar comparison in CD patients, 25% and 39% had improved, 37.5% and 57% were unchanged, and 37.5% and 4% had worsened IBD, respectively (Fig. 2A). When looking at IBD disease course as measured by medication requirement at last follow-up, similar results were seen. After RYGB and SG in UC patients, 27% and 8% had improved, 64% and 92% were unchanged, and 9% and 0% had worsened IBD disease, respectively. After RYGB and SG in CD patients, 37.5% and 44% had improved, 25% and 52% were unchanged, and 37.5% and 4% had worsened IBD, respectively (Fig. 2B).

Surgical and inflammatory bowel disease-related complications and reoperations after Roux-en-Y gastric bypass and sleeve gastrectomy

As shown in Table 5, the mean lengths of hospital stay were 3.3 ± 1.7 days and 2.1 ± 1 days after RYGB and SG, respectively ($p = 0.004$). In the SG group, all procedures were performed laparoscopically; in the RYGB group, 4 patients underwent open operations. In the SG group, 3 operations were conversions of laparoscopic adjustable gastric banding to SG for inadequate weight loss.

Table 3. Ulcerative Colitis Medication Requirements Pre- and Post-Bariatric Surgery

Medication requirement	Overall (n = 23)	Roux-en-Y gastric bypass (n = 11)	Sleeve gastrectomy (n = 12)	p Value*
IBD status at the time of bariatric surgery, n (%)				
No medication	13 (57)	6 (55)	7 (58)	NS
Pharmacotherapy	10 (43)	5 (45)	5 (42)	NS
IBD status at the last follow-up visit, n (%)				
No medication	15 (65)	7 (64)	8 (67)	NS
Decreased medication	2 (9)	2 (18)	0 (0)	NS
Stable medication	5 (22)	1 (9)	4 (33)	NS
Increased medication	1 (4)	1 (9)	0 (0)	NS

*Comparison between Roux-en-Y gastric bypass and sleeve gastrectomy.
IBD, inflammatory bowel disease.

In the RYGB group, 2 patients developed postoperative complications in their hospital course; one had a gastrointestinal leak, most likely from a gastro-jejunal anastomosis that required percutaneous drainage, and 1 developed hypoventilation and hypoxemia requiring ICU care for a week and was managed with noninvasive ventilator support. Two patients (both CD) developed chronic abdominal pain after RYGB and had multiple hospital admissions; 1 patient improved after 6 months without requiring any interventions; however, the other patient underwent reversal surgery 2 years after RYGB. Later, after RYGB, 1 patient with CD developed multiple complications including peri-rectal abscesses, gastro-gastric fistula, and severe reflux, which required 2 reoperations: RYGB revision for gastro-gastric fistula and lengthening of the Roux limb for severe bile reflux. One CD patient with a previous ileo-colonic resection, diagnosed with stenosis and fistula at the ileo-colonic surgical anastomosis by colonoscopy, was treated with biologic agents. Both patients with CD who developed IBD-related complications had a history of small/large bowel resection and underwent open RYGB. One patient with UC developed gastro-gastric fistula and bile reflux that was controlled with medications.

In the SG group, 1 patient was diagnosed with omental infarct/phlegmon 2 weeks after the surgery and was managed medically. Another patient developed perianal abscesses and fistula secondary to CD and underwent fistulotomy and placement of a cutting seton. One patient who had complicated CD, with a history of small/large bowel resection and refractory rectovaginal fistula before SG, underwent abdominoperineal resection with end colostomy 1 year after SG. One unrelated death occurred 2 years after SG.

The nutrient panels from all the patients were reviewed. Those who had at least 1 abnormal value were selected and further analyzed (eTable 2). Within the RYGB and SG groups, there were no significant differences in the proportions of patients who experienced deficiencies in vitamin D (43% vs 27%), B12 (6% vs 3%), or folate (7% vs 0%), respectively. However, more patients experienced iron deficiency after RYGB compared with SG (57% vs 21%; p = 0.03).

DISCUSSION

After both RYGB and SG, more than 30% of patients had an improvement in CD, as measured by medication

Table 4. Crohn's Disease Medication Requirements Pre- and Post-Bariatric Surgery

Medication requirement	Overall (n = 31)	Roux-en-Y gastric bypass (n = 8)	Sleeve gastrectomy (n = 23)	p Value*
IBD status at the time of bariatric surgery, n (%)				
No medication	11 (35)	2 (25)	9 (39)	NS
Pharmacotherapy	20 (65)	6 (75)	14 (61)	NS
IBD status at the last follow-up visit, n (%)				
No medication	18 (55)	3 (37.5)	15 (65)	NS
Decreased medication	6 (20)	2 (25)	4 (17)	NS
Stable medication	3 (10)	0 (0)	3 (13)	NS
Increased medication	4 (13)	3 (37.5)	1 (4)	0.04†

*Comparison between Roux-en-Y gastric bypass and sleeve gastrectomy.
†Significant.
IBD, inflammatory bowel disease.

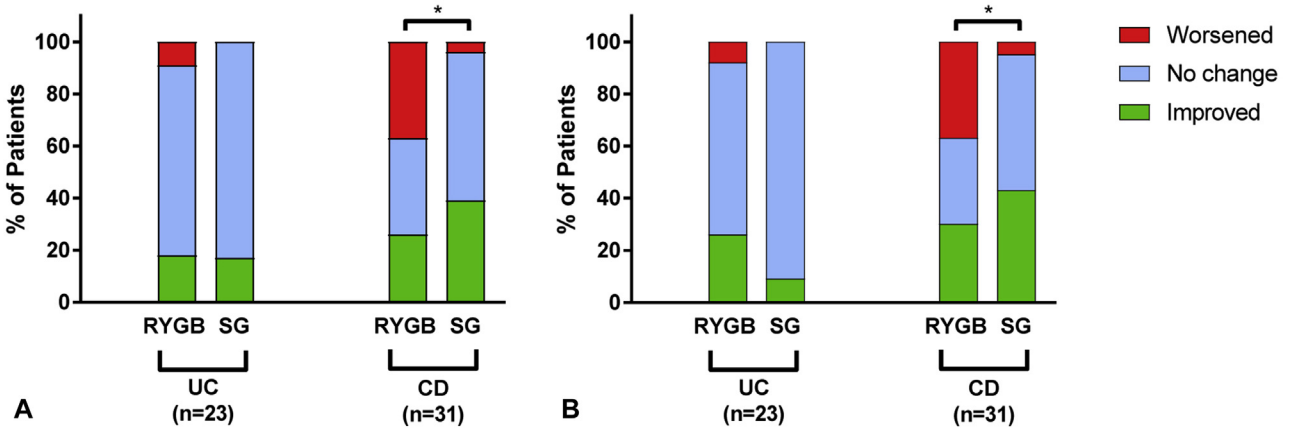

Figure 2. Changes in inflammatory bowel status (IBD) status as measured by IBD medication requirements after bariatric operations at 1 year (A) and the last follow-up visit (B) in patients with ulcerative colitis (UC) and Crohn's disease (CD). SG, sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass. *$p < 0.05$.

requirements. However, there was a greater risk of CD flare-up with increased medication requirements and consequent complications after RYGB. Our results showed that SG is a safe and feasible procedure for obese patients with either UC or CD. Among all CD patients who underwent SG, only 1 patient experienced a CD flare with increased IBD medication requirements. The remaining CD patients either experienced improvement or had no changes in their medication requirements after SG. For UC patients, SG and RYGB had comparable impacts on IBD medication requirements.

Our results are consistent with those from previous literature. Two earlier case series have shown that bariatric surgery is a safe and feasible option for IBD patients with obesity and may help mitigate IBD symptoms. Keidar and colleagues[27] reported a case series of 10 patients, with no IBD exacerbation and 1 complication unrelated to IBD after bariatric surgery. Aminian and associates[21] studied 20 patients with IBD who underwent bariatric surgery. Nine of 10 patients who were on pharmacotherapy for IBD experienced improvement of their symptoms. In a larger case series, Aelfers and coworkers[22] reported a study of 45 post-bariatric surgery patients with IBD and found all operations to be safe and effective in both UC and CD populations for at least up to 2 years postoperatively; however, they did not assess IBD clinical course during this time. In a recently published population study by Sharma and coauthors,[20] bariatric surgery in patients with IBD was associated with reduced risk of renal failure, malnutrition, and fistulae. In summary, these studies showed that not only is bariatric surgery an effective therapy for weight loss in this patient population, but it may have beneficial effects on IBD. Our study extends previous studies by comparing the outcomes between RYGB and SG on IBD, as well as their effects on the IBD clinical course in both UC and CD subgroups.

Recent case series have reported de-novo IBD development after bariatric surgery.[28,29] In the largest case series reported by Neto and colleagues,[28] 30 patients developed new IBD (6 UC and 24 CD) after RYGB, and none after SG. In another case series by Bernstein and associates,[29]

Table 5. Postoperative Outcomes and Complications

Outcome or complication	Overall (n = 54)	Roux-en-Y gastric bypass (n = 19)	Sleeve gastrectomy (n = 35)	p Value*
Length of stay, mean, d ± SD	2.5 ± 1.4	3.3 ± 1.7	2.1 ± 1	0.004†
Bariatric surgery complication, n (%)	6 (11)	5 (26)	1 (3)	0.02†
Within 30 d, n (%)	3 (6)	2 (10)	1 (3)	NS
Beyond 30 d, n (%)	3 (6)	3 (16)	0 (0)	0.04†
IBD-related complication, n (%)	5 (9)	3 (16)	2 (6)	NS
Reoperation, n (%)	3 (6)	2 (11)	1 (3)	NS
Death, n (%)	1	0 (0)	1 (3)	NS

*Comparison between Roux-en-Y gastric bypass and sleeve gastrectomy.
†Significant.
IBD, inflammatory bowel disease.

15 cases of new IBD (14 CD and 1 UC) after bariatric surgery (90% RYGB) were reported. We also found 7 patients (1 UC; 5 CD; 1 unknown) with de-novo IBD, all after RYGB. This suggests a potential association between RYGB and de-novo IBD, particularly CD.

Similar to non-IBD patients undergoing bariatric surgery,[30] we observed a higher risk of surgical complications after RYGB compared with SG. In theory, RYGB in CD patients also carries a risk of CD flare or recurrence at a surgical anastomosis, which may increase the risk of stenosis or fistula. Moreover, an RYGB complicates and limits surgical options in IBD patients who may need further operations—eg bowel resection, ileal pouch, or ileoanal pullthrough for UC patients.[23,31] Sleeve gastrectomy, by not manipulating the small bowel, should not influence future IBD operative options or be affected by intestinal IBD flares. In our study, we did not see any of these issues arise, but this may be due to the relatively short length of follow-up.[32]

From a weight loss perspective, both SG and RYGB were effective operations in IBD patients. Overall, our cohort saw weight loss similar to that reported by others, with the RYGB leading to overall greater weight loss.[33] Resolution of metabolic comorbidities were similar after both operations; however, rates of vitamin deficiency were greater after RYGB. These data are similar to data in the previous literature and suggest that RYGB and SG have safety and efficacy profiles that are similar to those in obesity treatments in IBD patients.[34,35]

Obesity is known to induce a systemic, chronic inflammatory state.[36-39] This may originate from the interaction of gut microbiota, bile acids, intestinal hormones, and the immune system.[40-43] Bariatric surgery influences each of these factors and may reverse obesity-associated immune dysfunction.[44-47] In an animal study, bariatric surgery was associated with the reduced severity of chemically induced colitis in obese mice.[43] Moreover, their data suggested that bariatric surgery induces changes in the gut microbiota that may contribute to ameliorating colitis independent of weight loss. Future studies are necessary to investigate how RYGB and SG might influence gut microbiota, bile acid composition, and the immune system, and therefore, affect IBD pathogenesis.

This retrospective study has several limitations. Although this is the largest and most detailed study to date of IBD outcomes after bariatric surgery, our sample size remains modest. Given that RYGB is an older procedure than SG, patients who underwent RYGB had longer follow-ups; however, most of the changes in medication requirement and postoperative complications occurred in the first 2 years post-surgery. In this study, we used medication requirements as a surrogate for IBD severity. Other important markers to help define IBD severity, including nature of symptoms, imaging, number of flares, and subsequent hospitalizations, were not available to review for all patients. This may lead to an underestimation of IBD severity. Moreover, absorption of IBD medications may be differentially altered after RYGB and SG, which may have influenced our findings.[34] It is important to mention that there is inherently a level of selection bias, and it is likely that only patients with mild IBD were offered bariatric procedures, particularly RYGB. This is interesting because it further highlights our significant findings with worsened CD after RYGB in a mild CD patient cohort.

CONCLUSIONS

Both SG and RYGB are effective for weight loss in IBD and appear to lead to reduction in IBD severity in a sizable proportion of patients. However, RYGB was also associated with higher IBD requirements in CD patients and had a higher overall rate of severe complications. Both SG and RYGB had similar safety profiles and influence on IBD medication requirements in UC patients. Therefore, SG may be the safer bariatric surgery in IBD patients, particularly those with CD.

Author Contributions

Study conception and design: Heshmati, Lo, Tavakkoli, Sheu
Acquisition of data: Heshmati
Analysis and interpretation of data: Heshmati, Lo Tavakkoli, Sheu
Drafting of manuscript: Heshmati, Sheu
Critical revision: Heshmati, Lo, Tavakkoli, Sheu

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Invited Commentary

John R Romanelli, MD, FACS
Springfield, MA

Dr Heshmati and colleagues looked retrospectively at the outcomes of bariatric surgery (BS) in patients with concurrent inflammatory bowel disease (IBD). Our overall knowledge of the relationship between obesity and the immune system, particularly looking at inflammation and gut microbiota, is still quite limited, but we can begin to learn about these relationships with retrospective reviews such as this one.

I agree with the authors that the few papers examining the outcomes of BS in IBD patients are limited in sample size, and this study is no exception. Given that difficulty, it is hard to draw definitive conclusions from these publications. The complication rate in Roux-en-Y gastric bypass (RYGB) patients is relatively high, at 26%, perhaps more than expected given only 1-year follow-up. I do note that some of these patients underwent open RYGB though, and it is hard to understand what to make of these data when comparing such different operative approaches with a known difference in overall complication rate (open vs laparoscopic). None of the sleeve gastrectomy (SG) patients underwent open approaches, so perhaps the complication rate comparison is unfair in that regard.

The complications noted in Crohn's disease (CD) patients who underwent RYGB were quite severe, and one wonders whether the pathology of CD at the microscopic level could have played a role. Certainly, abdominal pain of unexplained cause can be seen in both CD and in patients who underwent previous RYGB. But the degree of operative revisions that were ultimately necessary, a gastrojejunal leak, a gastrogastric fistula, and lengthening of the Roux limb for severe bile reflux—all in CD patients—were serious reoperations that fortunately did not lead to mortality. Again, it is important to note that the follow-up was only 12 months, which makes one wonder how high this rate could climb as the follow-up is extended to a longer period. The conclusion by the authors favoring SG over RYGB, especially in the CD population, is a sound one given the severity of these complications. It also follows the surgical dictum of not shortening the gastrointestinal tract in CD patients, as SG preserves small bowel length.

I do find it curious that the authors did not delve into the results of laparoscopic adjustable gastric banding (LAGB) in IBD patients during this interval. Given that the 17-year period coincided with the rise and fall of the gastric banding era, I would be curious to know if there was a relative increase in complications in a LAGB/IBD patient cohort, which might again imply that the process was a biological one related to the underlying IBD pathology. Many stated that IBD was a relative contraindication to the placement of an LAGB; however, we know from this work that 3 of the SG patients were conversions from LAGB. Perhaps it was possible that the IBD diagnosis occurred after the placement of the LAGB and before the SG. Nonetheless, omission of the third frequently performed BS procedure during the stated time period is an interesting one, and I wonder if the authors could comment on that decision. Was it an institutional bias against LAGB? Were the numbers too few to consider?

It would also be interesting to note which procedures were chosen over time, and whether the choice of procedure was influenced by trends in bariatric surgery (RYGB earlier in the series and SG later in the series) or whether deliberate decisions were made based on the patients' BMIs and comorbidities, or even a deliberate procedure choice made due to the IBD. Given that this manuscript is a retrospective analysis at a single health care system, it is difficult to understand the motivations of the choices made by surgeons and patients, but if there was a specific trend over time (either mirroring what was happening in BS at the time in the US or different from the national trend) during this 17-year period, it was not noted by the authors. Certainly, surgeons are often biased by their own experiences, and the disturbing operative revisions that were required in the CD/RYGB group may have led to a trend toward offering SG in this challenging group.

I would like to credit the authors for noting a relative increase in the medication requirements in CD patients who underwent RYGB. This study is novel in that the authors were able to follow what happened to the pharmacologic treatment of IBD in these patients during the 1-year follow-up period. The trend of needing higher dosages or more medication to treat CD after RYGB is a disturbing one, and I would suppose is reason enough to avoid offering RYGB to CD patients despite the small sample size.

eTable 1. Comorbidities Pre- and Post-Bariatric Surgery

	Roux-en-Y gastric bypass (n = 19)			Sleeve gastrectomy (n = 35)		
Variable	**Preoperative**	**At 1 y**	**p Value***	**Preoperative**	**At 1 y**	**p Value***
Type 2 diabetes, n (%)	6 (32)	4 (21)	NS	14 (40)	6 (18)	NS
Hypertension, n (%)	12 (63)	7 (37)	NS	20 (57)	10 (29)	<0.05†
Dyslipidemia, n (%)	10 (53)	9 (47)	NS	15 (43)	7 (21)	NS
Obstructive sleep apnea, n (%)	14 (74)	4 (21)	<0.01†	10 (31)	5 (15)	NS

*Comparison between preoperative and 1 year within each group.
†Significant.

eTable 2. Post-Bariatric Surgery Patients with Inflammatory Bowel Disease Experiencing Nutrient Deficiencies

Nutrient	Roux-en-Y gastric bypass (n = 19)	Sleeve gastrectomy (n = 35)	p Value*
Vitamin D, n (%)	6/14 (43)	7/26 (27)	NS
Vitamin B12, n (%)	1/16 (6)	1/34 (3)	NS
Folate, n (%)	1/14 (7)	0/30 (0)	NS
Iron, n (%)	7/14 (50)	5/28 (18)	0.07

*Comparison between Roux-en-Y gastric bypass and sleeve gastrectomy.