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Observations and Research

Exploring the Relationship Between Bariatric Surgery and Inflammatory Bowel Disease: A Systematic Review

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Background: Obesity affects over 40% of Americans. Bariatric surgery is an increasingly popular and well-studied method to achieve weight loss, improve metabolic homeostasis, and resolve obesity-related comorbid conditions. While the impact of bariatric surgery on weight loss and metabolic health has been extensively studied, there is an increasing body of literature characterizing the impact of bariatric surgery on gastrointestinal health and inflammation. Inflammatory bowel disease (IBD) leads to inflammation in both the small and large intestine, and leads to significant patient morbidity. Similar to obesity, the incidence of IBD is also rising. Patients with IBD and obesity may seek bariatric surgery. The impact of bariatric surgery on IBD is not well understood, but critical to understand for optimal patient care. Herein, we review the currently available literature on the impact of bariatric surgery on IBD including common trends, discrepancies in findings, and remaining knowledge gaps in need of further study.

Methods: A systematic review of the PubMed/MEDLINE database using PRISMA guidelines was performed.

Results: We identified 12 manuscripts discussing de novo IBD after bariatric surgery and 16 studying bariatric surgery in patients with pre-existing IBD. Overall, bariatric surgery appears to be safe in patients with pre-existing IBD but may increase the risk of developing de novo IBD.

Conclusions: Further research into optimal surgical approaches, patient selection, and mechanisms on how bariatric surgery impacts IBD is needed.

Lay Summary

We found that patients with obesity who had bariatric weight loss surgery have slightly increased risk of developing new onset inflammatory bowel disease (IBD). In patients with pre-existing IBD who underwent bariatric surgery, overall surgery was safe without worsening IBD.

Key words: bariatric surgery, inflammatory bowel disease, Crohn's disease, ulcerative colitis

Introduction

Bariatric surgery is the most effective long-term treatment for obesity and metabolic disease.[1–3] Bariatric surgery is increasingly common with over 1.5 million Americans undergoing surgery between 2018 and 2021. While its impact on weight loss and metabolic improvement has been extensively studied, it is increasingly apparent that bariatric surgery has important effects on other disease outcomes that deserve closer attention. Bariatric surgery impacts gastrointestinal health and there is a growing body of literature assessing the effect of bariatric surgery on inflammatory bowel disease (IBD). Herein, we review the clinical literature on the impact of bariatric surgery on the risk of de novo IBD development and the effect of bariatric surgery in patients with pre-existing IBD to identify the major clinical trends and knowledge gaps that need to be addressed.

Methods

A systematic review of the existing literature on IBD in relation to bariatric surgery was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All eligible studies published up to September 9, 2021 were included. Review articles, meta-analyses, editorials, and non-English publications were excluded. A thorough review of the existing literature was performed via search of PubMed/MEDLINE database by all authors. The following combinations of search terms were used: "inflammatory bowel disease" or "Crohn's disease" or "ulcerative colitis" and "bariatric surgery" or "gastric bypass" or "sleeve gastrectomy." Reference lists of relevant articles were manually searched for additional eligible studies. Authors J.W. and T.P. screened studies by topic to include only case studies and reports, case–control and cohort studies reporting on outcomes of bariatric surgery in patients with pre-existing IBD and/or development of de novo IBD following bariatric surgery in patients without a prior IBD diagnosis. Any discrepancies in studies to include were evaluated by authors B.P.C. and V.L. All studies meeting criteria were included. Data from included studies were compiled into an aggregate data set to provide additional analysis and insight.

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Ethical Considerations

All authors participated in the research and preparation of the manuscript. Conceptualization: B.P.C. and V.L.; Methodology: V.L.; Data Curation: J.W. and T.P.; Writing—Original Draft Preparation: J.W., T.P., B.P.C., and V.L.; Writing—Review and Editing: B.P.C. and V.L. No authors have conflicts of interest.

Results

Search Results and Characteristics of Included Studies

The PRISMA study flow diagrams are shown in Figure 1. The initial search identified 264 publications. After removing 143 duplicates, 121 records were screened by titles and abstracts. From detailed examination of 56 full texts, 28 studies were included: 12 discussing de novo IBD after bariatric surgery and 16 studying bariatric surgery in patients with pre-existing IBD.

Impact of Bariatric Surgery on Post-Operative Development of IBD

While some studies suggest that bariatric surgery is safe in patients with pre-existing IBD, studies on impact of bariatric surgery on developing IBD post-operatively report varying outcomes.[4–7] Several case reports described the development of IBD after bariatric surgery.[8–10] Additionally, the largest two case series reported that bariatric surgery increases the risk of developing IBD.[11,12] Further, a recent study by Harma et al. found increased gut biomarkers such as fecal calprotectin in patients after bariatric surgery, which is associated with IBD; however, this study did not study actual development of IBD after bariatric surgery.[13] While the literature is limited to case reports and a few cohort studies, analysis of available data reveals trends in risk factors and outcomes that may better inform care and treatment of patients undergoing bariatric surgery. To better discern our understanding of de novo IBD development after bariatric surgery and to identify gaps in knowledge, we review the available literature in detail below.

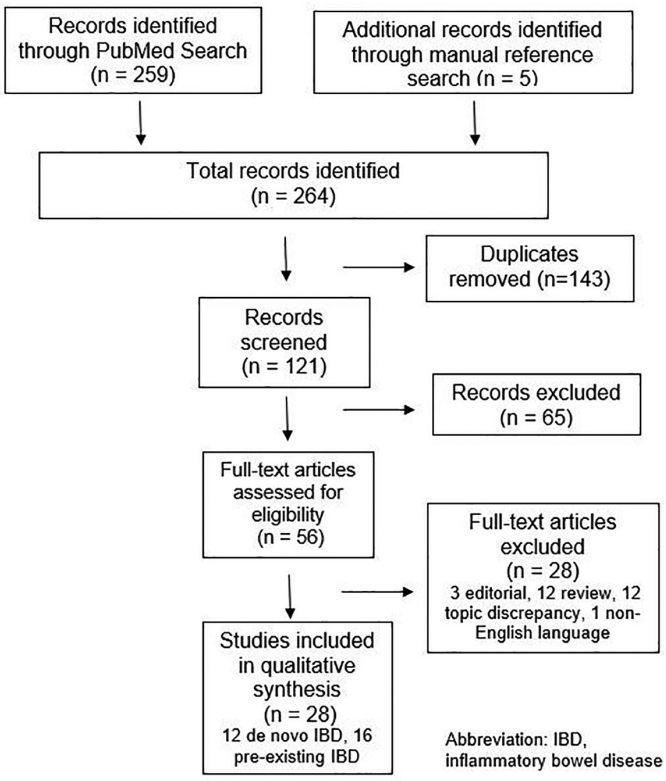

Figure 1. Flow diagram identifying included studies on IBD and bariatric surgery.

Effect of Bariatric Surgery on de novo IBD Development as Assessed by Case Reports and Case Series Studies

Eight case reports describe de novo IBD following bariatric surgery in 16 patients[8–10,14–18] (Table 1). Analyzed collectively, 69% were women and average age at IBD diagnosis was 44.9 years. Ninety-four percent of cases involved de novo Crohn's disease (CD) and 69% of cases followed RYGB. Most presented with diarrhea (86%) and abdominal pain (57%) with some experiencing unintentional weight loss, vomiting, and bloody stools. On average, symptom onset occurred 41.5 months following surgery. Four cases required surgical intervention due to medical treatment failure. The aggregate data align with findings observed in the cohort studies discussed below.

Several larger case series studies have provided critical insight into the risk factors, trends, and outcomes for de novo IBD development after bariatric surgery. Ungaro et al. published the first multi-institutional case series and matched case-control study on de novo IBD following bariatric surgery.[12] They identified 15 patients with IBD development post-bariatric surgery; 87% were female and most had undergone RYGB (67%) (Table 1). The average time between surgery and IBD diagnosis was 5.7 years and IBD sub-types included 67% CD, 27% ulcerative colitis (UC) and 6% IBD-unclassified (IBD-u) (Table 1). Most patients had mild-moderate disease (67%), did not require hospitalization (53%), and 2 had IBD-related complications. Using the Symphony Health Solutions Integrated Dataverse, they found that bariatric surgery conferred 1.45 increased odds of developing IBD. They found a significant increase in odds of UC (OR 2.12) in bariatric surgery patients compared to adjusted controls. However, the increase in risk of CD (OR 1.86) did not reach significance.

Braga Neto et al. published a case review of 44 patients evaluating de novo IBD following bariatric surgery at two tertiary referral centers.[11] Patients were primarily female (88.6%) and symptom onset occurred, on average, 7 and 6.5 years following bariatric surgery for CD and UC, respectively. The median age at IBD onset did not differ significantly between IBD subtype and 68% of cases occurred following RYGB (Table 1). Of the 30 cases following RYGB, 24 were CD and 6 were UC. The remaining patients underwent Adjustable Gastric Banding (AGB) (4), stapling (1), "other" (2), and unknown (6) surgery types (Table 1). Most presented with abdominal pain and/or diarrhea, and 90.9% had no family history of IBD. While the incidence of CD was significantly higher than the overall annual incidence of CD in the United States (22.3 vs. 8.7/100,000 person-years), the incidence of UC was lower (4.5 vs. 10.7/100,000 person-years), contradicting the findings of Ungaro et al.[12]

Effect of Bariatric Surgery on de novo IBD Development as Assessed by Database Studies

Several cohort studies have further expanded upon this topic (Table 1). Using the Explorys database, Kochhar et

Table 1. Prior case studies, case series, and cohort studies of de novo IBD following bariatric surgery

Year	Study	Type	Sample	IBD subtype	Sex	Average IBD onset age in years (range)	Surgery type	Average duration from surgery to diagnosis in months (range)
Case studies								
1999	Papakonstantinou et al.[14]	Case Study	1	UC	M	46	VBG	3
2005	Ahn et al.[8]	Case Report	3	CD	F 3	37 (28–46)	RYGB	30 (11–60)
2011	Janczewska et al.[9]	Case Report	2	CD	M 1 F 1	59 (48–69)	RYGB, jejunoileal shunt	10 (2–18)
2012	Dodell et al.[10]	Case Study	1	CD	F	44	RYGB	48
2014	Kotze et al.[15]	Case Study	1	CD	F	53	RYGB	72
2017	Bernstein et al.[16]	Case Report	2	CD	M 1 F 1	58 (57–59)	RYGB	108 (96–120)
2018	Korelitz et al.[17]	Case Report	5	CD	M 2 F 3	41 (23–58)	4 RYGB, 1 SG	36 (1–60)
2019	Yildizhan et al.[18]	Case Study	1	CD	F	29	SG	12
Case series and cohort studies								
2018	Ungaro et al.[12]	Retrospective case series with matched case control cohort	15	CD 10 UC 4 IBD-U 1	M 2 F 13	44 (28–58)	RYGB (10) AGB (3) SG (1) Other (1)	68.7 (6–192)
2018	Braga Neto et al.[11]	Retrospective case series	44	CD 31 UC 12 IBD-U 1	M 5 F 38	UC: 46 (33–52) CD: 43 (37–53)	RYGB (30) AGB (4) Stapling (1) Other (2) Unknown (6)	UC: 78 (30–96) CD: 84 (36–144)
2020	Kochhar et al.[19]	Retrospective cohort study with weight loss medication and obese control cohorts	470	CD 260 UC 210	M 100 F370	–	Mix of RYGB, AGB, SG	–
2021	Allin et al.[20]	Nationwide population-based prospective cohort study	100	–	M 10 F 90	–	RYGB (13,827), AGB (583), SG (937)	[a]UC: 42 (20.4–75.6) [a]CD: 50.4 (25.2–75.6)

Abbreviations: M, male; F, female; CD, Crohn's disease; UC, Ulcerative Colitis; IBD-U, Inflammatory bowel disease–unclassified; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy; AGB, adjustable gastric band, VBG, vertical banded gastroplasty;.

[a]Average onset age, distribution among surgery types, and average duration from Surgery to Dx not specified in Kochhar et al.[19]

al. compared three cohorts and found that IBD prevalence was comparable for bariatric patients and those on weight-loss medication (7.72/1000 vs. 7.22/1000, respectively), and lower when compared with obese controls (11.66/1000).[19] Compared to the obese control cohort, de novo UC after bariatric surgery and in those on weight-loss medications occurred more often in middle-age people, women, and patients with diabetes. Interestingly, bariatric surgery appeared to lower risk for development of de novo UC after all three surgery types studied (SG, gastric banding, Roux-en-Y gastrojejunostomy), while lower risk for de novo CD was only observed after SG and gastric banding.

Most recently, Allin et al. analyzed the risk of de novo IBD following bariatric surgery in a national Danish population-based prospective cohort study.[20] Seventy-six percent of the bariatric cohort was female and 90% of IBD cases following surgery occurred in females (Table 1). The median time between bariatric surgery and IBD diagnosis was 4.2 years (IQR: 2.1–6.3 years) for UC and 3.5 years (IQR: 1.7–6.3) years for UC. Median postoperative follow-up was 8 years (IQR: 4.4; 9.2). They calculated a multi-factor de novo IBD hazard ratio (HR) adjusted for age, sex, birth cohort, education, and number of obesity-associated comorbidities of 1.15 (95% CI, 0.94–1.40). When calculated by IBD subtype, bariatric surgery was associated with an increased risk of CD (HR: 1.85; 95% CI, 1.40–2.44), but not UC (HR: 0.81; 95% CI, 0.61–1.08). Notably, HR of de novo IBD for women was 1.31 (95% CI, 1.06–1.61) and 0.59 (95% CI, 0.32–1.09) for men. Stratification by IBD subtype within women revealed an even greater difference in HR, with a 2.18 HR for CD (95% CI, 1.64–2.90) and a 0.86 HR for UC (95% CI, 0.63–1.18). Analysis of risk in overweight and obese individuals revealed similar trends as found in the aggregate experimental and control cohorts.

Together, cohort studies report an average age of de novo IBD onset at 44 years old in a predominantly female patient population (81.4%). Furthermore, they reveal increased prevalence of CD versus UC following bariatric surgery (57%), with ileocolonic subtypes appearing slightly more frequently. While most de novo IBD cases were reported as initially mild-moderate, nearly half of patients required hospitalization due to IBD complications.

While both prior case and cohort studies reveal several potential demographic-specific risk factors, it is important to consider both the population served by bariatric surgery and the confounding effects of pre- versus post-surgery conditions. Although all prior studies suggest female predominance among de novo IBD cases, nearly 80% of patients undergoing bariatric surgery are female.[1] Thus, while sex-specific risk factors for de novo IBD post-bariatric surgery may exist, further research that considers this demographic disparity inherent to most study cohorts is needed to reveal true sex-specific differences in de novo IBD risk and prevalence.

While increased risk of de novo IBD post-bariatric surgery has been associated with several pre-existing conditions, including diabetes (associated with UC and CD), hypertension (associated with CD), and hyperlipidemia (associated with CD), most patients within prior study cohorts present with a variety of pre-existing conditions and lifestyle habits that may additionally predispose or contribute to the development of IBD after surgery. Historically, cohort studies have utilized cohorts adjusted for age, sex, body mass index (BMI) and/or medication usage. Interestingly, when comparing the findings of Ungaro et al. and Kochhar et al., both of which utilized an obese control cohort, one study found no change in UC risk following bariatric surgery and another found lower UC risk after all studied bariatric surgery types.[12, 19] Thus, control and cohort characteristics appear to significantly influence findings. While difficult to eliminate all confounding variables, further research utilizing control cohorts adjusted separately for pre-existing conditions may help delineate other potential predisposing factors for de novo IBD that may influence risk following bariatric surgery. Despite the small potential risk of de novo IBD after bariatric surgery, providers must weigh the other dramatic health benefits of bariatric surgery when considering referral of patients for surgery.

Effect of Bariatric Surgery on Pre-Existing IBD

Obesity is increasingly common in patients with IBD, affecting between 24% and 40% of patients.[21, 22] Patients seeking bariatric surgery will inevitably include patients with IBD and understanding the impact of bariatric surgery on intestinal inflammatory diseases is important for optimal patient counseling and management. Our review identified 14 case series or retrospective studies and two database studies examining outcomes in 326 patients with IBD who underwent bariatric surgery, as summarized in Table 2. In total, 128 had UC (39.3%), 193 had CD (59.2%), and 5 had IBD-u, and patients had varying types of bariatric surgery, with information on IBD-type and type of surgery only available for 242 patients (Figure 2).

Effect of Bariatric Surgery on Existing IBD Development as Assessed by Case Reports and Case Series Studies

Eight case reports or small case series from 2006 to 2019 described weight loss outcomes and operative complications in 44 patients with pre-existing IBD undergoing bariatric surgery: 9 patients with UC and 35 with CD collectively underwent 13 RYGB, 27 SG, 3 AGB, and 1 vertical-banded gastroplasty.[5, 6, 12, 23, 24, 26–28] Weight loss was generally successful with excess weight loss (EWL) between 56% and 80% and average BMI drops between 10.6 and 26 kg/m^2. Complications were generally within range of typical post-bariatric complications (Table 2).

Of the larger cohort studies, Aminian et al. reviewed institutional experience of performing RYGB, SG, and AGB bariatric surgery in 20 patients with IBD: 7 with CD and 13 with UC. Eleven were on IBD medications and 9 had inactive disease or already underwent definitive total proctocolectomy.[7] The majority receiving RYGB had UC and one patient with inactive CD received RYGB, while UC and CD were mixed in patients who had SG or AGB. For the 11 patients on baseline pharmacotherapy, excluding one death, two with UC had acute postoperative flairs (one RYGB, one SG). Nine patients had improvement of their IBD (decreased medications and/or symptoms), while another improved but had acute flares coinciding with weight regain after AGB. Aelfers et al. performed a large retrospective study of 45 patients also undergoing RYGB, SG, and AGB in the Netherlands with IBD (15 UC, 27 CD, 3 IBD-u), of whom 27 patients were actively on therapy and 9 had undergone IBD-related surgery.[4] Weight loss did not significantly differ in patients with UC versus CD. Three patients (1 UC, 2 CD) developed IBD "exacerbations" more than 1 year after surgery. However, they did not report long-term impact of bariatric surgery on IBD status.

Table 2. Detailed weight and postoperative outcomes in patients undergoing bariatric surgery with pre-existing IBD

Year	Study	No. of patients with disease	Operation				Mean follow-up length	Mean EWL%	BMI change (mean ± sd if available)	Complications
			RYGB	SG	AGB	OTHER				
2006	Lascano et al.[23]	1 UC	1 UC				2 yrs	80% EWL at 2 years	57 to 31	None reported
2010	Moum et al.[24]	1 CD	1CD				8 yrs	–	45 to 32.4	None reported
2013	Ungar et al.[25]	4 CD		4 CD			1.9 ± 1.5 yrs	60.3%±13.7EWL at 6-12 months 2 regained all lost weight	45 ± 5.3 to 32.9 ± 4.3 at 6–12 months	1 Bleeding requiring takeback
2014	Colombo et al.[6]	1 UC 5 CD		1 UC 4 CD		1VBG in CD	57.8 ± 29.8 mo	74.5% ± 11.2 EWL	40.6 ± 13.7 to 26.8 ± 1.1	1 gastric suture line bleed 1 Recurrent nausea & dysphagia after VBG requiring conversion to RYGB at 5 years
2014	Del Prado et al.[26]	1 UC			1 UC		54 mo	–	–	1 gastric suture line bleed 1 Recurrent nausea & dysphagia after VBG requiring conversion to RYGB at 5 years
2015	Keidar et al.[5]	2 UC 8 CD		2 UC 7 CD	1 CD		37.1 ± 24 mo	71.4 ± 5.9%	42.6 to 29	1 complication (VSG leak)
2018	Honoré et al.[27]	8 CD	8 CD				311.25 ± 2.1 mo	56.5% ±25.2 at 1 year	43.8 ± 10.1 to 33.2 ± 8.7 at 1 yr	None
2019	Hudson et al.[28]	4 UC 9 CD	2 UC 1 CD	1 UC 8 CD	1 UC		52 ± 28 wks	EWL of 62.9% ±27.2 at 12 months 62.9% ±31.0 at 24 mo	–	Early complications included 5 cases of nausea/vomiting, Late complications: 1 nausea/vomiting, 1 band slippage, 1 wound infection
2016	Aminian et al.[7]	13 UC 7 CD	7 UC 1 CD	5 UC 4 CD	1 UC 2 CD		34.6 ± 21.7mo	58.9 ± 21.1% at 1 yr	50 ± 9.0 to 35.7 ± 6.9 at 1 yr	0 intraop complications, 2 conversions to open. 7 early postop complications (5 dehydration, 1 PE, 1 wound infection) Entire follow-up period 5 complications: 2 pancreatitis, 2 VH, 1 M ulcer, 1 unrelated death
2017	Aelfers et al.[4]	15 UC 27 CD 3 IBD-u	7 UC 5 CD 1 IBD-u	6 UC 18 CD 2 IBD-u	1 UC 5 CD		3.9 ± 3.0 yrs	62.9 ± 27.1% at 1 yr 62.9 ± 31.0% at 2 yrs	50 ± 9.0 to 35.7 ± 6.9	8 early complications: bleeding from gastrojejunal anastomosis, kidney failure, 3 passage complaints, 1 wound infection, 1 hemoglobin drop, 1 nausea/vomiting 7 late complications: 1 pyelonephritis with pancreatitis, 2 passage complaints, 1 hypokalemia, 1 nausea/diarrhea, 1 dehydration, 1 recurring urolithiasis 7 patients required reoperations: 2 internal hernia closure and 5 cholecystectomy

Table 2. Continued

Year	Study	No. of patients with disease	Operation				Mean follow-up length	Mean EWL%	BMI change (mean ± sd if available)	Complications
			RYGB	SG	AGB	OTHER				
2019	Braga Neto et al.[29]	29 UC 18 CD	16 UC 12 CD	5 UC 3 CD	6 UC 2 CD	JIB 1 UC B2 1 UC staple 1 CD	Median 7.69 yrs	37.9%± 21.2 for UC 50.4% ±31 for CD		5 patients had early readmission and 4 required reoperations, 3 patients had anastomotic leaks
2019	Heshmati et al.[30]	23 UC 31 CD	12 UC 8 CD	11 UC 23 CD			96mo after RYGB and 26 for SG	–	−12.4 after RYGB and −8.4 after VSG at 6 mo −15 after RYGB and −11.5 after SG at 12 mo	6 complications occurred, including 3 early cases of 1 leak, 1 hypoxemia, and 1 omental infarct. 3 late complications include 1 gastrogastric fistula and 2 chronic abdominal pain of which 1 required RYGB reversal
2020	Mckenna et al.[31]	20 UC 11 CD 1 IBD-u	9 UC 4 CD 1 IBD-u	7 UC 7 CD	4 UC		Median 2.7 yrs (range 1 mo–10 yrs)	62.9% ±33.8 at 12 mo, and 57.4 ± 27.5 at 24 mo	44.6 ± 7.7 to 34.8 ± 6.2 at 6 months	4 patients had early infectious complications, 5 required early readmission, 1 required reoperation within 30 days, and 6 operations in the long term
2021	Reenaers et al.[32]	20 UC 64 CD	73	3	12		34 mo	Total weight loss 23.9% ±12.7	Mean weight loss of 29.3 ± 16kg from mean baseline of 88.6 ± 22.4 kg	8 complications occurred, 4 early leaks, stricture, and mesenteric ischemia requiring reoperation, 1 wound infection on anti-TNF therapy, 1 nephrolithiasis, 1 PVT, 1 hemorrhage, 1 severe dehydration; Two late complications included AGB erosion and stricture requiring reoperation
		1 IBD-u	IBD type was not provided in the breakdown of bariatric surgery types							

Abbreviations: UC, ulcerative colitis; CD, Crohn's disease; IBD-u, IBD-unclassified; RYGB, Roux-en-Y gastric bypass; VSG, vertical sleeve gastrectomy; AGB, adjustable gastric banding; EWL, excess weight loss; BMI, body mass index, PVT, portal vein thrombosis.
EWL: at longest follow-up unless otherwise stated.

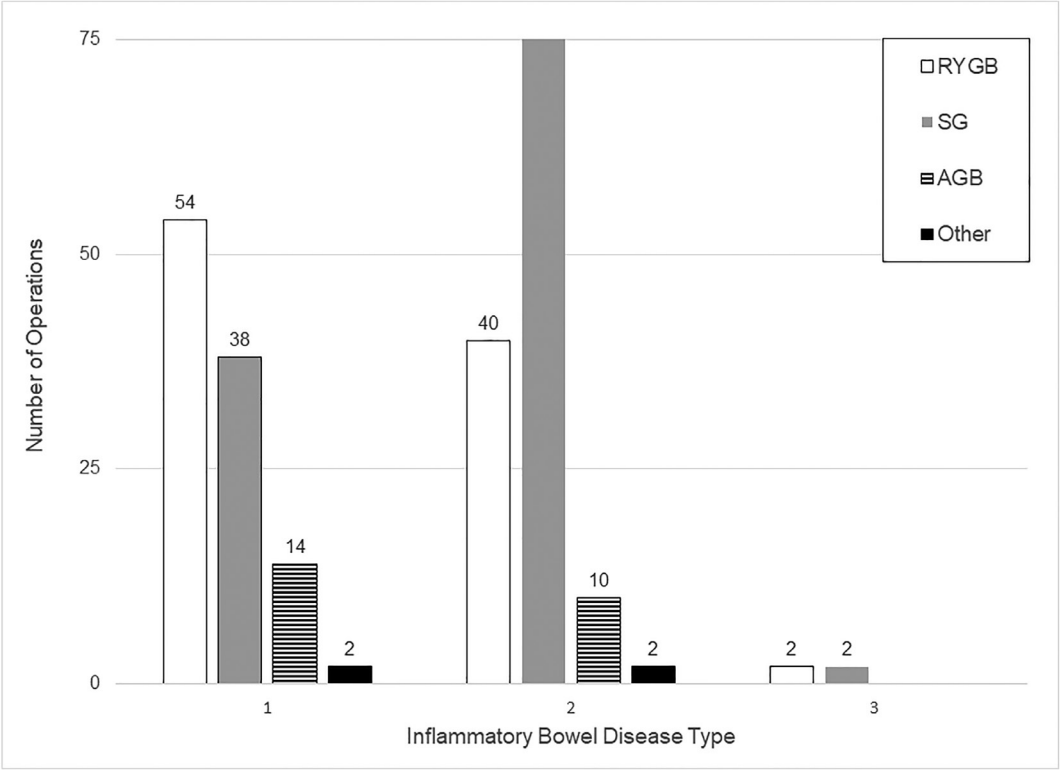

Figure 2. Bariatric surgeries performed in patients with IBD subtypes.

Braga Neto et al. performed a matched case-control study of 47 patients with IBD (29 UC, 18 CD).[29] Thirty-six patients were on IBD medications and 16 underwent prior IBD-related surgery. Of 25 patients in their case control analysis (excluding UC patients after definitive colectomy), 8% had improvement of disease based on cessation of biologics, 16% required new biologic therapy for IBD, and 8% had progression of their disease based on colonoscopy. Acute flairs or complications occurred in 48% of patients, with 36.5% requiring hospitalization, 24% requiring steroids, and 12% requiring IBD-related surgery. In their case control, they found that bariatric patients had a trend towards fewer IBD-related complications compared to patients without prior bariatric surgery (OR 0.44), especially the need for steroids (0.36) and IBD-associated surgery (OR 0.2), though these findings did not reach significance.

Heshmati et al. reviewed their 54 patients with IBD (23 UC, 31 CD) who underwent RYGB (20) and SG (34).[30] Most were on IBD medications (30) and some had prior IBD-related surgery (8), all with clinically stable disease. IBD improved in 31.5%, 59.3% had no change, and 9.3% had worsening based on medication changes. IBD-related complications or flairs that required surgery occurred in 9.3% of cases, and 11.1% had post-bariatric complications. McKenna and colleagues retrospectively reviewed 31 patients (20 UC, 10 CD, and 1 IBD-u) who had RYGB (14), SG (14), or AGB (3), of whom 11 had prior IBD-related surgery and 9 were on therapy.[31] After bariatric surgery, no patients had flairs requiring surgery. Two of 9 patients on IBD therapy stopped medications, and only one patient required initiation of medication. One patient had an early reoperation for an obstruction and 15% required early readmission.

Most recently, Reenaers et al. published the largest case-control study comparing bariatric surgery outcomes in 85 patients (20 UC, 64 CD, 1 IBD-u) who underwent 88 operations (2 RYGB, 73 SG, 12 AGB).[32] Twenty-five patients (30.6%) were on no medications at the time of bariatric surgery, 12 (22%) had undergone prior intestinal resection, and data were not provided on those who had definitive colectomy for UC. Most patients (75%) had no changes in their IBD medication regimen, while 18% required escalation, and 3.5% had improved disease. Additionally, those undergoing AGB were at significantly higher risk for severe complications or IBD flairs requiring hospitalization compared to RYGB or SG. Notably, AGB is no longer offered as a routine bariatric surgical option.

Taken together, these studies suggest that bariatric surgery results in significant weight loss in patients with IBD and has an acceptable risk profile for postoperative complications related to their bariatric surgery (Table 2). Of the 13 studies that provided data in 290 patients,[4–7, 11, 23–25, 27, 28, 30–32] 11.7% of patients experienced an IBD flair or IBD-related complication that required surgery or hospitalization (Table 3). In comparison, Braga Neto's case control study found that 48% of patients experienced an IBD-related complication (12% surgery, 36% hospitalization, and 24% corticosteroid use), though high, was lower when compared with 72% of obese matched controls (28% surgery, 36% hospitalization, and 52% corticosteroid use; though all not significantly different).[11] In the 11 studies that reported long-term outcomes,[5–7, 11, 23, 25, 27, 28, 30–32] nearly a fifth of the 242 patients had improvement in their IBD (18.6%), while 71.5% had no change and only 10.7% a worsening of their disease (Table 3). Moreover, Aminian described improvement of IBD based on fewer medications after weight loss and worsening IBD after weight regain, suggesting that the weight loss confers protective effects on patients' IBD.[7]

Table 3. IBD outcomes and flairs bariatric surgery

Year	Study	No. of patients with disease	IBD outcome			IBD flair	Additional notes
			Improved	Worsened	No Change		
2006	Lascano et al.[23]	1 UC	1			0	
2010	Moum et al.[24]	1 CD		Unknown		1	Flair at 6–8 weeks postop
2013	Ungar et al.[25]	4 CD			4	0	No escalation of meds or need for surgery
2014	Colombo et al.[6]	1 UC 5 CD	6			0	All able to decrease or stop medications; reduction in CRP, and 4 of 5 with CD had endoscopic remission
2014	Del Prado et al.[26]	1 UC		unknown			
2015	Keidar et al.[5]	2 UC 8 CD	3	1	6	3	3 with CD to stop medications all, 1 with new initiation of medication was for mild exacerbation; all flairs mild
2016	Aminian et al.[7]	8 UC 2 CD	9	0	1	2	1 patient with initial improvement developed worsening disease after weight regain; 2 flairs occurred early postop
2017	Aelfers et al.[4]	15 UC 27 CD 3 IBD-u		Unknown		3	Flairs occurred more than 1 year postop
2018	Honoré et al.[27]	8 CD			8	0	
2019	Braga Neto et al.[29]	25	2	4	19	12	Flairs: 3 required surgery and 9 hospitalizations
2019	Heshmati et al.[30]	23 UC 31 CD	4 13	1 4	18 14	5	No difference in UC outcomes after RYBG vs SG but higher rate of CD worsening after RYGB than SG
2019	Hudson et al.[28]	4 UC 9 CD	2		11	0	
2020	Mckenna et al.[31]	20 UC 10 CD 1 IBD-U	2	1	28	0	
2021	Reenaegers et al.[32]	20 UC 64 CD 1 IBD-u	*3* IBD outcomes only available for 82/85 patients	*15*	*64*	*8*	Flairs included 1 salvage colectomy 4mo postop for severe UC, 2 new perianal disease 2yr after surgery, and 5 non-operative flairs requiring hospitalizations
Total	242 with IBD outcome data 290 with flair data		18.6% 45/242	10.7% 26/242	71.5% 173/242	11. 7% 34/290	

Abbreviations: UC, ulcerative colitis; CD, Crohn's disease; IBD, inflammatory bowel disease; IBD-u, inflammatory bowel disease unclassified.

Effect of Bariatric Surgery on Existing IBD Development as Assessed by Database Studies

Two studies used the Nationwide Inpatient Sample (NIS) database to examine the relationship between bariatric surgery and IBD. Bazerbachi et al. used data from 2011 to 2013 to study hospitalizations for patients undergoing bariatric surgery with or without IBD.[33] Of 314,864 patients who underwent bariatric surgery, 0.25% had IBD: 459 with CD and 331 with UC. Those with IBD had an average one-day longer length of stay and an adjusted OR of 4 for developing perioperative bowel obstruction. They found no differences in operative complications such as leak, anastomotic complications, fistula formation, bleeding, or wound complications or major systemic complications. After sensitivity analysis, they compared 106 patients with IBD to 36,449 patients without IBD who underwent bariatric procedures. IBD was not significantly associated with bowel obstruction or any other complications. From this, we can conclude that the diagnosis of IBD does not incur added risk to index bariatric operations or hospitalizations

Sharma took a different approach by comparing hospitalization data and trends from 2004 to 2014 for IBD patients with obesity versus those with obesity who previously underwent bariatric surgery.[34] Of the 15,319 patients identified with obesity and IBD, 3.2% underwent prior bariatric surgery. Over the 10-year period, there was a 3.4-fold increase in bariatric operations performed in patients with IBD and obesity, with 35% having RYGB, 48% SG, and 15% AGB. Patients with IBD who had bariatric surgery had lower rates of renal failure, under-nutrition, fistulae formation, shorter hospital stay, and lower hospitalization costs compared to patients without obesity who did not have bariatric surgery. Mortality rates were similar. Patients with UC and prior bariatric surgery had higher rates of strictures, without similar findings in patients with CD. When patients with UC and CD were combined, bowel stricture rates were similar regardless of bariatric history. This study suggests that bariatric surgery reduces morbidity in patients with obesity and IBD who require hospitalization.

In conclusion, bariatric surgery appears to be safe in patients with IBD and may improve IBD. Patients achieve significant weight loss, which has inherent long-term benefits through resolution of obesity-related comorbidities and decreased premature mortality. Further research into optimal surgical approaches, patient selection, and mechanisms on how bariatric surgery may decrease IBD can additionally optimize outcomes.

Conclusions

With the rising global prevalence of obesity affecting 600 million people,[35] there is also a parallel rise in IBD incidence and prevalence.[36] While there is conflicting data, obesity and its associations with chronic inflammation may contribute to the pathogenesis, risk, and severity of IBD.[36, 37] Given the epidemiologic trends, management of patients with concurrent obesity and IBD will become increasingly common and thus understanding the relationship between bariatric surgery and IBD is paramount.

Our findings suggest that bariatric surgery may be a risk factor for development of de novo IBD post-surgery, though further research is needed to examine the potential influence of confounding comorbidities, medication usage, and other characteristics of study cohorts. While a relationship between bariatric surgery and new onset IBD may exist, our review of the literature suggests that bariatric surgery in patients with preexisting IBD is generally safe with low risk for disease progression, and potential for IBD improvement.

It will also be valuable to understand the potential mechanisms by which bariatric surgery influences IBD risk. IBD pathogenesis is driven by a conglomeration of factors, some of which are dramatically impacted by bariatric surgery. In particular, alterations in the gut microbiome and bile acid metabolism have both been implicated in IBD development and progression and are robustly altered by bariatric surgery. While shifts in the gut microbiome have been suggested to play an important role in the metabolic benefits of bariatric surgery,[38, 39] the changes in gut microbial composition include increases in bacterial genera associated with the development of IBD. For example, bariatric surgery is often reported to increase Gammaproteobacteria, and its associated family, Enterobacteriaceae.[38–42] *Escherichia* and *Shigella*, subdivisions of Enterobacteriaceae, are increased in patients with IBD and treatment with anti-inflammatory drugs decreases the relative abundance of these genera.[43–45] Therefore, while metabolically beneficial, these gut microbial changes may increase colitis risk after bariatric surgery.

Bile acids are elevated after bariatric surgery and work in preclinical models suggest that increased bile acid signaling through TGR5 and FXR contributes to improved glucose regulation.[40, 46] TGR5 and FXR modulate intestinal health, with work in mouse models reporting that TGR5 and FXR protect against IBD development.[47] With this effect in mind, we previously tested the role of TGR5 in the effects of VSG on mice with DSS-induced colitis. While sham-operated TGR5 knockout mice exhibited the expected exacerbation of IBD relative to wild-type, VSG increased the severity of DSS-induced colitis.[48] Thus, it is possible that post-operative enhancements in bile acid signaling promote improved IBD outcomes in patients with pre-existing IBD and/or is a compensatory response to protect against increased risk in IBD-naive patients. Further work is needed to understand the role of bile acid signaling in the effects of bariatric surgery in patients with pre-existing IBD and to understand the potential role of FXR.

There were several limitations to this review. As we only searched the Pubmed/MEDLINE database, this study may have been influenced by selection bias. Further, inconsistent reporting by included studies limited our ability to identify outcomes and complications based on the specific type of bariatric operation. Studies also varied in level of detail reported on IBD history, such as whether patients were in remission, had active disease, or what medications they were taking. Specific UC or CD outcomes and complications based on the type of bariatric operation would prove useful as well. Additionally, long-term studies of bariatric surgery outcomes in patients with IBD are not available in the literature. Discrepancies between studies and gaps in knowledge necessitate further research on the relationship between IBD in patients evaluated for or who have undergone bariatric surgery.

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Conflicts of Interest

None declared.

Data Availability

Data sharing is not applicable to this article, as no new data were generated or analyzed for this review paper. All original data are available from referenced work.

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