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Research Article

Nutritional Factors Associated with Complications After Loop Ileostomy Reversal in Patients with Inflammatory Bowel Disease

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Abstract

Background: Ileostomy formation is often performed in an acute setting with increased nutritional demands - presumed nutritional recovery has occurred at time of reversal. There is a paucity of data evaluating the effect of nutritional status on serious complications following loop ileostomy reversal in patients with inflammatory bowel disease (IBD). While ileostomy reversal is often considered a routine procedure relatively free of complications, we chose to evaluate our group of patients with IBD having this procedure and explored if measures of nutritional compromise at the time of reversal were associated with post-operative complications.

Methods: We retrospectively reviewed 359 patients with IBD who underwent ileostomy reversal. Demographics, clinical characteristics, and laboratory values were compared between patients stratified by serious 30-day post-operative complications.

Results: The overall median time to reversal was 13.1 weeks, (IQR 11-16), and this was comparable between those with and without serious complications. The overall serious complication rate was 22/359 (6.1%). Patients with serious complications had lower median albumin at time of reversal (3.3 vs 3.8; p = 0.049), higher incidence of anemia (68.4% vs 37.5%, p = 0.013) and greater interval decrease in BMI from time of ileostomy creation to closure (-2.1 vs -0.6; p = 0.03). Multivariate modeling demonstrated that for each integer increase in albumin, the odds of serious complication decreased by 59% (OR 0.41, 95% CI 0.20-0.83).

Conclusions: IBD patients are at unique increased risk for nutritional compromise. Patients with malnutrition may be at increased risk of serious complications following ileostomy reversal. Surgeons should consider routine assessment of nutritional status prior to surgery and some patients may benefit from delay for optimization prior to ileostomy reversal.

Keywords: Inflammatory Bowel Disease; Ileostomy Reversal; Malnutrition; Postoperative Complications; Colorectal Surgery

Abbreviations

IBD: Inflammatory Bowel Disease; BMI: Body Mass Index.

Introduction

The most commonly feared complication after creation of a distal bowel anastomosis is a leak; resultant negative sequelae may include reoperation, sepsis, and even death. Diversion with loop ileostomy may reduce morbidity associated with leak and associated reinterventions [1,2]. Following ileostomy formation, reversal is generally performed 8 to 12 weeks after to allow sufficient time for recovery from the acute pathology addressed in the primary surgery and resultant postoperative catabolic stress state, maturation of intra-abdominal adhesions, and resolution of inflammation and edema within the abdomen and ileostomy orifice [3]. Ileostomy reversal is considered a relatively simple procedure; however, it is not without risk. Postoperative morbidity rates up to 21% have been reported in recent literature [4,5].

Surgery in patients with inflammatory bowel disease (IBD) is a common indication for loop ileostomy construction. These pa-

tients are often nutritionally compromised because of hindered ability of inflamed intestinal mucosa to absorb nutrients [6,7]. Malnutrition has been associated with increased risk of postoperative complications [8]. Patients with IBD undergoing ileostomy reversal are especially vulnerable to malnutrition states as a consequence of the metabolic derangements associated with loop ileostomy output, the increased metabolic demands associated with acute disease flares, and the stress from the initial surgical procedure.

Ostomy creation is often performed in the setting of an acute illness process. Ideally, reversal occurs after resolution and recovery from the initial illness, however studies evaluating the influence of nutritional status on morbidity following ileostomy reversal are limited, and the authors are not aware of any analyses of nutritionally recovery following loop ileostomy reversal in patients with IBD [9,10]. The aim of this study was to characterize nutritional factors associated with increased risk of serious complications after loop ileostomy reversal in IBD patients.

Materials and Methods

A retrospective analysis was conducted to identify all patients who underwent loop ileostomy reversal from 1981 to 2016 by colorectal surgeons within a single surgical practice at an academic medical center. Clinical and demographic characteristics were recorded at time of ileostomy creation and reversal, and perioperative data was collected at reversal.

The decision to create a loop ileostomy and the technique of construction was determined by the surgeon at the time of the initial surgery. Our general approach towards closure entails a circum-stomal incision with laparotomy only when necessary. Stapled reversal is performed with bowel resection and a linear GIA stapler to create a side-to-side anastomosis (functional end-to-end). Hand-sewn reversal is performed either via resection with a sewn anastomosis or via suture closure of the antimesenteric bowel wall without resection.

Due to the suspicion that IBD patients may still be nutritionally compromised at the time of reversal, we attempted to evaluate nutritional status by we measuring albumin, hemoglobin and BMI at ileostomy creation, reversal and the interval change between these time points, as has been previously described [10]. Perioperative complications included events which occurred at time of ileostomy reversal surgery to 30 days postoperatively. Serious complications included Clavien-Dindo ≥ 3 [11]. Bowel obstruction was defined as having clinical evidence (obstipation, abdominal pain, emesis and/or distention) with dilated small bowel on radiologic imaging. Ileal anastomotic leak was diagnosed as clinical or radiologic evidence of a leak, fistula or collection. Anemia was defined as a hemoglobin of <11 mg/dl.

Patients who experienced a serious complication were compared to those who did not. Univariate statistical analyses were performed using Fisher's exact test and chi-square for categorical variables and Student's t-test and Wilcoxon Signed-Rank test for continuous variables. All factors that increased risk of serious complications were included as covariates in the final multivariate logistic regression. Data was analyzed using SAS 9.4 (SAS Institute, North Carolina). Statistical significance was set at $p < 0.05$ for all analyses.

Results

Of 428 patients, we identified 359 (83.9%) who underwent loop ileostomy reversal between 1981 and 2015. There were 208 (57.9%) males and the median age was 36.8 (IQR 27.7-50.3) years old. At the time of ileostomy formation, the majority of patients (n = 296; 82.5%) had a diagnosis of UC, while 63 (17.5%) were diagnosed with CD. In patients with UC, restorative proctocolectomy was the most common indication in UC (86.5%). Among patients with CD, the most common indication for ileostomy formation was diversion in the setting of complex CD (77.8%), and when data were available, 51.9% (14/27) were on immunomodulating medications or steroids at time of ileostomy reversal. Overall, median time to ileostomy reversal was 13.6 months (IQR 11.7-20.6). The majority of cases were performed using a stapled anastomosis (309; 86.1%).

The overall serious complication rate in this series was 6.1% (22/359). A comparison of demographic and clinical data between patients with and without serious complications is presented in table 1. Age, type of IBD diagnosis, ASA, time to reversal, intraoperative estimated blood loss and operative time were comparable between patients with vs without serious complications. ($p > 0.05$). Median hospital length of stay (LOS) was significantly longer for patients with serious complications (9.5 v 5 days; $p < 0.0001$). Of the 22 patients with serious complications, 5/22 (22.7%) had anastomotic leak , 1/22 (4.5%) died and 8/22 (36.4%) required reoperation. Amongst patients that had anastomotic leak, 2 required reoperation. The remainder of patients who underwent reoperation within 30 days had small bowel obstruction requiring lysis of adhesions (n = 6). A complete description of observed complications is presented in table 2.

	No Serious Complications (n = 337)	Serious Complications (n = 22)	P value
Male, n(%)	196 (58.2)	12 (54.6)	0.824
Age at Reversal, Median (IQR)	36.5 (27.7-49.8)	41.5 (32.1-57.8)	0.1023
ASA Score, n(%)			
1	6 (1.78)	0 (0)	0.766
2	276 (81.9)	19 (86.4)	
3	55 (16.3)	3 (13.6)	
IBD Diagnosis, n(%)			
Crohn's Disease	59 (17.5)	4 (18.2)	0.936
Ulcerative Colitis	278 (82.5)	18 (81.8)	
Interval Time to Reversal, Median (IQR)	13.6 (11.7-20.6)	13.5 (11-19)	0.764
Operative Time, Median (IQR)	57 (43-76)	60 (39-87)	0.959
Estimated Blood Loss, Median (IQR)	10 (5-30)	7.5 (5-20)	0.549
Anastomosis Technique, n (%)			
Handsewn	46 (13.7)	4 (18.2)	0.527
Stapled	291 (86.4)	18 (81.8)	
Length of Stay, Median (IQR)	5 (4-7)	9.5 (5-19)	<0.0001

Table 1: Comparison of demographics and clinical data between patients with and without serious complications.

Complication, n (%)
SBO/Ileus 54 (15)
Wound Infection 10 (2.8)
UTI 7 (1.9)
Leak 8 (2.2)
Reoperation 10 (2.8)
Death 1 (0.28)

Table 2: Description of complication rates.

A comparison of nutritional data is presented in table 3. Patients with serious complications had lower median albumin (3.3 vs 3.8; p = 0.049) at ileostomy reversal, and higher incidence of anemia (68.4% vs 37.5%, p = 0.013). Additionally, patients with serious complications had a higher magnitude reduction in BMI between the time of ileostomy creation to closure (-2.1 vs -0.6; p = 0.03). On univariate analysis, only anemia and albumin at reversal were associated with serious complications (Table 4). Multivariate modeling demonstrated that for each integer increase in albumin, odds of serious complication decreased by 59% reduction in serious complication (OR 0.41, 95% CI 0.20-0.83). Having anemia at time of reversal increased odds of serious complication by 234% (OR 3.34, 95% CI 1.1-10.7).

	No Serious Complications (n = 337)	Serious Complications (n = 22)	P value
Albumin at Creation	3 (2.7-3.6)	3.3 (3-3.5)	0.471
Albumin at Reversal, Median (IQR)	3.8 (3.3-4.3)	3.3 (2.8-4.1)	0.0491
Interval Change in Albumin, Median (IQR)	0.7 (0-1.1)	0.1 (-0.4-0.5)	0.050
Anemic at Ileostomy, Median (IQR)	105 (46.3)	8 (50)	0.801
Anemic at Reversal, Median (IQR)	85 (35)	13 (68.4)	0.006
BMI at Ileostomy, Median (IQR)	23.5 (20.5-27.2)	25.9 (23.3-29.9)	0.239
BMI at Reversal, Median (IQR)	23.2 (20.4-26.4)	23.8 (21.3-26.5)	0.762
Interval Change in BMI, Median (IQR)	-0.6 (-2.1-0.2)	-2.1 (-3.4- -0.9)	0.033

Table 3: Comparison of nutritional factors between patients with and without serious complications.

	Univariate Analysis OR (95% CI)	Multivariate Analysis
Gender Female Male	 Ref 0.863 (0.36-2.05)	-
Age at Reversal	1.028 (1.0-1.06)	-
ASA Score 1 2 3	 Ref 1.40 (0.401-4.88) 0.810 (0.232-2.83)	-
IBD Diagnosis, Ulcerative Colitis Crohn's Disease	 Ref 1.05 (0.34-3.21)	-
Interval Time to Reversal	1.0 (0.976-1.03)	-
Operative Time	0.995 (0.97-1.02)	-
Estimated Blood Loss	0.986 (0.95-1.03)	-
Anastomosis Technique Handsewn Stapled	 Ref 0.711 (0.23-2.2)	-
Albumin at Creation	1.2 (0.55-2.29)	-
Albumin at Reversal	0.492 (2.66-0.91)	0.41 (0.20-0.83)
Interval Change in Albumin	0.52 (0.27-1.02)	-
Anemic at Ileostomy	1.16 (0.42-3.2)	-
Anemic at Reversal	4.03 (1.48-10.98)	3.34 (1.07-10.7)
BMI at Ileostomy	1.02 (0.94-1.12)	-
BMI at Reversal	0.991 (0.89-1.10)	-
Interval Change in BMI	0.828 (0.66-1.04)	-

Table 4: Univariate and Multivariate Analysis of Serious Complications.

Discussion

Loop ileostomy is often constructed in patients with IBD to divert the fecal stream away from areas of severe acute disease, protect distal anastomoses and mitigate septic complications following surgical treatment of disease. Ileostomy reversal is often considered a routine procedure; however, it associated with some morbidity and mortality. The overall serious complication rate following ileostomy reversal in this series of IBD patients was 6.1%, which is consistent with previous reports [3,5,12]. Previous studies have assessed potential risk factors for complications after ileostomy reversal, yet there remains a lack of consensus as to which clinical factors are associated with complications. To date, very few studies have examined the role of nutritional status, and none that we are aware of have exclusively examined IBD patients. Our study demonstrates that IBD patients with suboptimal nutritional status had increased risk of serious postoperative complications. This may have important implications for timing of stoma closure in this population and suggests a role for nutritional optimization prior to reversal.

Patients with IBD are at unique increased risk for malnutrition at time of loop ileostomy reversal. At baseline, patients with IBD have high rates of malnutrition (up to 70%) [13]. Loop ileostomy may intensify this condition as a result of malabsorption in the setting of rapid small intestinal transit. Finally, following major surgical intervention at time of ileostomy formation, postoperative stress leads to increased energy expenditure and protein catabolism [14]. Impaired nutritional status in the setting of the postoperative hypermetabolic state decreases the ability of the body to compensate and hinders recovery. Inflammation and malnutrition is associated with increased risk of postoperative complications [15-17].

While it is believed that malnutrition is associated with increased risk of complications in postoperative patients, there is no defined gold standard for measurement of nutritional status [8]. In this series, we utilized BMI, albumin and hemoglobin. Albumin is the most used indicator of nutritional status in the literature and hypoalbuminemia has been utilized as a measure of inflammation and increased postoperative complications [16]. We identified only two other series that evaluated the relationship between albumin at time of ileostomy reversal and postoperative complication [9,10]. In one series of 150 ileostomy and ileostomy reversals, Kim., *et al*. demonstrated that severe hypoalbuminemia (albumin < 2.8 mg/dL) and interval decrease of 1.3 mg/dL from ileostomy formation to reversal were associated with increased complication risk, especially the risk of surgical site infections [10]. Similarly, a 2009 study of 325 loop ileostomy reversals demonstrated increased mortality with albumin < 3.4 mg/dL [9]. We found that IBD patients with serious complications following loop ileostomy reversal had lower mean albumin compared to patients without serious complications (3.3 mg/dL vs 3.8), and higher albumin equated to a 57% reduction in serious complications. Indeed, an interval net decrease in albumin was only observed in patients with serious complications. The failure to demonstrate a significance in the observed interval decrease may be the result of incomplete data as it has not been standard of care to measure albumin in all preoperative patients. However, the trends supported by this study and those cited suggest that some patients have worsening malnutrition during the period between formation and reversal, and ileostomy reversal in patients with hypoalbuminemia increases risk of complications.

BMI has been established as a measure of malnutrition both in the literature and in validated nutritional screening tools [16,18-20]. The role of BMI as a risk factor for postoperative complications following loop ileostomy reversal is mixed; previous studies have either demonstrated no association or higher BMI (BMI of ≥30) to be associated with post-operative complications [21-23]. A thicker abdominal wall and increased comorbid conditions in obese patients may result in increased intraoperative technical challenges and risks of medical postoperative morbidity. In our series, patients with serious complications had greater median interval decrease in BMI from ileostomy creation to reversal (-2.1 vs -0.6). Similar results were observed by Kim., *et al*. Decreases in BMI during the interval between formation and reversal may reflect worst nutritional status and increased risk of morbidity.

Anemia has been found to be a risk factor for anastomotic leak in colorectal literature, and specifically for ileostomy reversal [9,24,25]. Similarly, we found that patients with anemia had increased risk of serious complications. As many as two-thirds of patients with IBD are anemic; this is the result of both ongoing blood loss from inflamed intestinal mucosa and deficiencies in iron, folate and B12 [26,27]. Chronic inflammation and hemolysis likely further contribute to anemia commonly observed in IBD patients [28]. While we did not specifically measure these nutrients in our patients, their anemia likely reflects a micronutrient deficiency that could conceivably be corrected with pre-closure supplementation.

Appropriate identification of anemia etiology with subsequent supplementation has been demonstrated to be effective in management of anemia in patients with IBD [29].

The optimal interval between primary surgery and closure remains controversial. Early reversal has been associated with increased morbidity because of bowel wall edema and increased intraperitoneal adhesions. Our study demonstrated no difference in closure time between patients with and without serious complications, suggesting that this was not an issue in our population. Although we found no data to link poor nutrition to SBO/ileus, poor nutritional status was associated with serious complications in this study. Nutritional optimization may play an important role in reducing serious complications after ileostomy reversal in patients with IBD, which may include delaying stoma reversal until measurable parameters have returned to normal.

This study has several limitations. The retrospective nature raises the potential for observation bias as well as a limited ability to identify causal associations between potential risk factors and post-operative outcomes. Furthermore, the small numbers of major complications may have limited our ability to assess risk factors. Most of the patients in this study underwent ileostomy reversal following IPAA for UC. It is our current standard to perform IPAA as a 2 or 3 stage-approach. However, our practice previously differed– as such, to have sufficient patients for analysis, the study encompassed almost the entire experience of loop ileostomy reversals performed by a single surgical practice at a single academic medical center over a long time period. Although the field of colorectal surgery has seen great changes over this period, the technology and surgical techniques involved in loop ileostomy reversal has remained fairly consistent, as have the complication rates assessed [3-5].

Conclusion

Although loop ileostomy reversal is a common procedure in patients undergoing operative treatment of IBD, postoperative morbidity is still observed. Patients with malnutrition, as defined by hypoalbuminemia, anemia and interval decrease in BMI, may be at increased risk of serious complications following ileostomy reversal. IBD patients are at unique increased risk for nutritional compromise, and may benefit from optimization preoperatively. Surgeons should consider routine assessment of nutritional status prior to surgery.

Conflict of Interest

The authors have no financial conflict of interests to report.

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