ORIGINAL CONTRIBUTION

Effect of Diagnosis on Outcomes in the Setting of Enhanced Recovery Protocols

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BACKGROUND: Implementation of enhanced recovery protocols in colectomy reduces length of stay and morbidity, but it remains unknown whether benefits vary by clinical diagnosis.

OBJECTIVE: Outcomes after colectomy in the setting of enhanced recovery protocols were compared for 3 diagnoses: 1) neoplasm, 2) diverticulitis, and 3) IBD.

DESIGN: This was a retrospective registry-based cohort study.

SETTINGS: Novel enhanced recovery variables were released in the American College of Surgeons National Surgical Quality Improvement Program in 2014.

PATIENTS: Patients with enhanced recovery variable data undergoing elective colectomy (July 2014 to December 2015) for neoplasm, diverticulitis, or IBD were included.

MAIN OUTCOME MEASURES: The primary outcome of interest was prolonged length of stay. Additional outcomes included surgical site infection, death/serious morbidity, reoperation, readmission, and days to achieve per os pain control, tolerance of a diet, and return of bowel function.

RESULTS: We identified 4620 patients with neoplasm, 1730 patients with diverticulitis, and 593 patients with IBD. Patients undergoing colectomy for IBD were more likely to have prolonged length of stay (OR, 1.98; 95% CI, 1.46–2.69), death/serious morbidity (OR, 1.62; 95% CI, 1.13–2.32), and readmission (OR, 1.54; 95% CI, 1.15–2.08) compared with patients with neoplasm. Patients with IBD took longer than patients with neoplasm or diverticulitis to achieve per os pain control (mean, 4.2 days vs 3.4 and 3.5 days, $p < 0.001$) and tolerate a diet (mean, 4.1 days vs 3.7 and 3.5 days, $p < 0.001$). No statistically significant differences in outcomes between patients with neoplasm and diverticulitis were seen.

LIMITATIONS: There may be heterogeneity among implemented enhanced recovery protocols.

CONCLUSIONS: Patients undergoing colectomy for neoplasm and diverticulitis have improved outcomes in comparison with patients undergoing colectomy for IBD. Knowledge of expected outcomes for patients with different diagnoses may inform clinician and patient expectations. See **Video Abstract** at http://links.lww.com/DCR/A623.

KEY WORDS: Colorectal surgery; Enhanced recovery; Enhanced recovery after surgery; Inflammatory bowel disease.

Enhanced recovery protocols (ERPs) refer to perioperative care pathways designed to minimize the physiologic stress of surgery and accelerate post-

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operative recovery. Common pathway elements include comprehensive patient education, multimodal opioid-sparing analgesic techniques, and early postoperative mobilization and feeding. Enhanced recovery protocols permit standardization of perioperative care with evidence-based practices and can promote an interdisciplinary approach. Numerous randomized trials have demonstrated that ERP implementation is associated with decreased hospital length of stay and, in most studies, decreased complications.[1–3]

Recognizing the benefits of ERPs, the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) released novel ERP variables in July 2014. The enhanced recovery in NSQIP variables was optional, and included both process measures related to ERP adherence as well as recovery-specific outcomes.

Patients undergo colorectal surgery for a variety of diagnoses with discreet pathophysiology. The possibility that diagnosis may affect surgical outcomes after colorectal surgery has been previously recognized and explored. Overall, it appears that diagnosis does impact postoperative complications and mortality.[4] Studies have demonstrated a significant effect of diagnosis on outcomes including postoperative ventilator dependency, postoperative urinary retention, return to the operating room, surgical site infection type, and prolonged length of stay.[5–9]

Most ERP studies have been performed in specific patient populations or have looked at the benefit to all patients undergoing colorectal surgery. The effect of diagnosis on outcomes after colorectal surgery in the setting of ERPs remains largely unknown. The objective of this cohort study was to explore the effect of diagnosis on outcomes after colorectal surgery in the setting of ERPs.

METHODS

Data Source and Study Cohort

Our data source was ACS NSQIP Procedure Targeted Colectomy cases from July 2014 to December 2015. The details of ACS NSQIP have been previously described, but, in brief, clinical data including risk factors and 30-day postoperative outcomes are collected according to robust, standardized definitions by trained, audited abstractors at each hospital.[10] Thirty-day postoperative outcomes (including inpatient, outpatient, and at outside facilities) are determined from the medical record and via direct communication with patients.

The ACS NSQIP Procedure Targeted Colectomy program includes colectomy cases as captured by Current Procedural Terminology code[11] and collects additional clinical data relevant to colectomy, including the diagnosis leading to surgery. Enhanced Recovery in NSQIP variables include 13 process measures on ERP adherence as well as recovery-specific outcomes described below (Supplemental Table 1, http://links.lww.com/DCR/A624). These variables were also assigned by trained data abstractors according to standardized, robust definitions, but were not subject to audit.

Cases were eligible for inclusion if complete Enhanced Recovery in NSQIP process measure data had been entered and if the diagnosis (reason for surgery) was in 1 of 3 categories: neoplasm, diverticulitis, or IBD. Emergency cases were excluded. Emergency cases were designated as such by the attending surgeon in the operative record.

Covariates

Variables collected for ACS NSQIP Procedure Targeted Colectomy cases include patient and procedure factors. Patient variables include demographics and comorbidities. Independent functional status was defined as the ability to perform activities of daily living without assistance from another individual. Partially or totally dependent functional status was defined as requiring assistance from another individual for completion of some or all activities of daily living. Normal or underweight was defined as a BMI of less than 25 kg/m^2, overweight as 25 to less than 30 kg/m^2, and obesity as greater than or equal to 30 kg/m^2. Procedure variables include the associated diagnosis, Current Procedural Terminology code, and a number of risk-adjustment variables specific to colectomy. Enhanced Recovery in NSQIP process measure variables capturing ERP adherence were summed to create an "Adherence Score" at the patient level, which included 3 categories: low adherence (0–5 elements), intermediate adherence (6–9 elements), and high adherence (>10 elements).

Outcomes

The primary outcome of interest was prolonged length of stay. Secondary outcomes of interest included death/serious morbidity, any surgical site infection, readmission, and unplanned reoperation. Death/serious morbidity is a composite measure defined by the ACS NSQIP that includes mortality, cardiac arrest or myocardial infarction, deep venous thrombosis, pulmonary embolism, sepsis or septic shock, deep wound infection, organ space infection, dehiscence, reintubation, pneumonia, renal failure or insufficiency, urinary tract infection, or reoperation.[11] Death/serious morbidity, a derivative of National Quality Forum endorsed composite measure 0706 (death or serious morbidity), was chosen to broadly capture postoperative morbidity. Because mortality is so rare in the primarily elective surgical population targeted by enhanced recovery, this composite outcome measure was selected to capture a wider spectrum of postoperative occurrences. Prolonged length of stay was defined as >75th percentile for length of stay in uncomplicated cases, which was determined to be 6 days in our cohort. Defining prolonged length of stay based on the length of stay distribution in uncomplicated

cases is standard in the ACS NSQIP and is 1 mechanism of accounting for the effect of complications on length of stay before risk adjustment.[12] The prolonged length of stay definition was then applied to all cases in the cohort, whether complicated or uncomplicated.

Outcomes of interest for exploratory, unadjusted analysis included 3 recovery-specific outcomes collected via enhanced recovery in NSQIP variables: the date (postoperative day) that pain control was achieved without the use of intravenous medication, postoperative day that the patient tolerated a diet, and postoperative day of return of bowel function (Supplemental Table 1, http://links.lww.com/DCR/A624). Tolerating a diet was defined as oral intake including at least 1 meal of solids and liquid intake of at least 800 mL without nausea, emesis, abdominal pain, or the need for intravenous fluids. Return of bowel function was defined as passage of flatus or a bowel movement.

Statistical Analysis

Differences in patient and procedure characteristics among the 3 diagnoses were compared for statistical significance by using χ^2 or ANOVA, where appropriate. Unadjusted differences in outcomes by diagnosis were determined by using χ^2 tests for dichotomous outcomes (prolonged length of stay, surgical site infection, death/serious morbidity, reoperation, and readmission) or using Kruskal-Wallis (nonparametric ANOVA) tests for continuous outcomes (length of stay, date of per os (PO) pain control, date tolerating diet, date of return of bowel function). Adjusted differences in outcomes by diagnosis were determined by using multivariable logistic regression with forward selection (entry $p < 0.05$, predictors for each outcome listed in Supplemental Table 2, http://links.lww.com/DCR/A625) and robust standard errors to account for outcomes clustered in hospitals, while controlling for case and procedure mix and ERP adherence.

Additional Analyses

Additional analyses were performed to explore for potential sources of bias, including patient selection and case mix, which might impact the study results and the generalizability of those findings.

First, the distribution of case mix by clinical diagnosis in our study cohort (patients receiving care in the setting of enhanced recovery) was determined, as was the distribution of case mix by clinical diagnosis in the ACS NSQIP Procedure Targeted Colectomy data set for the same time period (July 2014 to December 2015).

Second, because creation of an ileostomy might contribute to longer hospital stay and increased readmission events, and patients with IBD underwent a higher proportion of total abdominal colectomy with ileostomy procedures than patients with neoplasm or diverticulitis, adjusted analyses were performed excluding patients who underwent total abdominal colectomy with ileostomy according to the methods described previously.

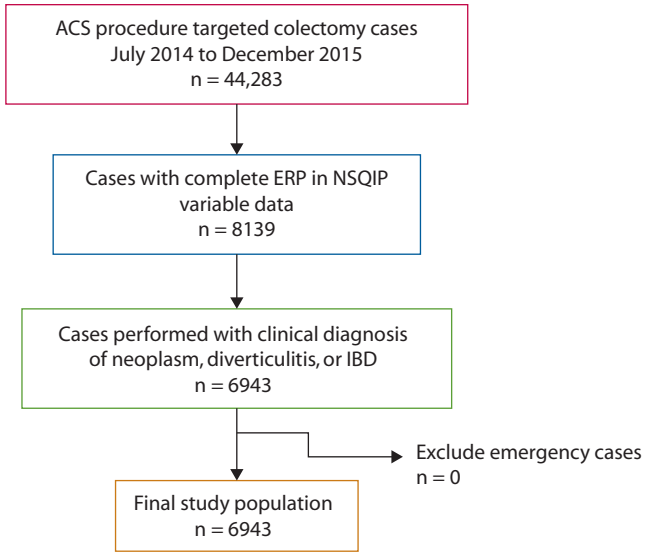

Figure 1. Flow chart of case selection. ACS = American College of Surgeons; NSQIP = National Surgical Quality Improvement Program; ERP = enhanced recovery protocol.

All analyses were performed in SAS (Cary, NC) Version 9.4.

This retrospective database analysis was determined to be nonhuman subject research and, therefore, exempt from institutional review board oversight by the Chesapeake Institutional Review Board (Pro00020273).

RESULTS

Overall, 6943 cases for the diagnoses of interest were identified with complete Enhanced Recovery in NSQIP data (Fig. 1). Of these, neoplasm accounted for 4620 (66.5%) cases, diverticulitis accounted for 1730 (24.9%) cases, and IBD accounted for 593 (8.5%) cases (Table 1). The distribution of clinical diagnoses in the overall ACS NSQIP Procedure Targeted Colectomy data set was also determined and found to be similar (Supplemental Table 3, http://links.lww.com/DCR/A626). In the study population, a higher percentage of patients undergoing surgery for neoplasm had an ASA class of III to V (57.3% vs 39.0% for diverticulitis and 40.8% for IBD, $p < 0.001$). Patients undergoing surgery for diverticulitis underwent a high percentage of partial colectomies with coloproctostomy (49.8% vs 28.3% for neoplasm and 4.1% for IBD, $p < 0.001$) and a low percentage of open procedures in comparison with the other diagnoses (15.8% vs 25.6% for neoplasm and 33.6% for IBD, $p < 0.001$). A high percentage of patients with IBD underwent total abdominal colectomy with ileostomy (25.1% vs 2.6% for neoplasm and 0.9% for diverticulitis, $p < 0.001$), and a lower percentage of patients with IBD completed a mechanical

Table 1. Patient and procedure characteristics by diagnosis

Characteristics	*Neoplasm n = 4620*	*Diverticulitis n = 1730*	*IBD n = 593*	*p value*
Age, median (IQR)	66 (57–75)	59 (50–67)	40 (29–55)	<0.001
Sex, n (%)				<0.001
Men	2410 (52.2)	780 (45.1)	280 (47.2)	
Women	2210 (47.8)	950 (54.9)	313 (52.8)	
Race, n (%)				<0.001
White	3082 (66.7)	1456 (84.2)	471 (79.4)	
Black	460 (10.0)	111 (6.4)	44 (7.4)	
Other/unknown	1078 (23.3)	163 (9.4)	78 (13.2)	
Hispanic, n (%)				<0.001
No	3581 (77.5)	1496 (86.5)	528 (89.0)	
Yes	189 (4.1)	104 (6.0)	15 (2.5)	
Unknown	850 (18.4)	130 (7.5)	50 (8.4)	
ASA class, n (%)				<0.001
I–II	1973 (42.7)	1056 (61.0)	351 (59.2)	
III–V	2647 (57.3)	674 (39.0)	242 (40.8)	
Functional status, n (%)				<0.001
Independent	4518 (97.8)	1709 (98.8)	591 (99.7)	
Partially or totally dependent	102 (2.2)	21 (1.2)	2 (0.3)	
BMI, n (%)				<0.001
Normal or underweight	1331 (28.8)	399 (23.1)	312 (52.6)	
Overweight	1626 (35.2)	615 (35.6)	160 (27.0)	
Obese	1663 (36.0)	716 (41.4)	121 (20.4)	
ERP adherence, n (%)				0.161
Low (0–5 elements)	875 (18.9)	366 (21.2)	101 (17.0)	
Intermediate (6–9 elements)	2157 (46.7)	793 (45.8)	278 (46.9)	
High (>10 elements)	1588 (34.4)	571 (33.0)	214 (36.1)	
Procedure, n (%)				<0.001
Partial colectomy, ileocolostomy or NOS anastomosis	3195 (69.2)	853 (49.3)	420 (70.8)	
No stoma indicated	3043	770	388	
Stoma NOS	20	5	7	
Colostomy	132	78	25	
Partial colectomy, coloproctostomy	1306 (28.3)	861 (49.8)	24 (4.1)	
No stoma indicated	1147	824	22	
Colostomy	159	37	2	
TAC with ileostomy	119 (2.6)	16 (0.9)	149 (25.1)	
Surgical approach, n (%)				<0.001
Open	1183 (25.6)	273 (15.8)	199 (33.6)	
Laparoscopic/robotic/hybrid	1617 (35.0)	603 (34.9)	173 (29.2)	
Laparoscopic hand-assisted	1467 (31.8)	698 (40.4)	184 (31.0)	
Laparoscopic with unplanned conversion to open	353 (7.6)	156 (9.0)	37 (6.2)	
Mechanical bowel prep, n (%)				<0.001
Yes	2903 (62.8)	1245 (72.0)	299 (50.4)	
No	1297 (28.1)	332 (19.2)	250 (42.2)	
Unknown	420 (9.1)	153 (8.8)	44 (7.4)	
Antibiotic bowel prep, n (%)				<0.001
Yes	1851 (40.1)	810 (46.8)	271 (45.7)	
No	2382 (51.6)	807 (46.7)	290 (48.9)	
Unknown	387 (8.4)	113 (6.5)	32 (5.4)	

IQR = interquartile range; ERP = enhanced recovery protocol; NOS = not otherwise specified; prep = preparation; TAC = total abdominal colectomy.

bowel preparation in comparison with the other diagnoses (50.4% completed a mechanical bowel preparation vs 62.8% for neoplasm and 72.0% for diverticulitis, $p < 0.001$). There was no statistically significant difference in ERP adherence among the 3 diagnoses.

Unadjusted analyses demonstrated statistically significant differences for all outcomes among the diagnoses. In general, patients with IBD had the longest length of stay (mean 6.0 days vs 5.7 days for neoplasm and 5.0 days for diverticulitis, $p < 0.001$) and the highest rates of adverse outcomes including prolonged length of stay (29.0% vs 24.4% for neoplasm and 19.0% for diverticulitis, $p < 0.001$), surgical site infection (10.0% vs 7.1% for neoplasm and 6.7% for diverticulitis, $p < 0.05$), death/serious

Table 2. Length of stay, morbidity, and readmission by diagnosis

Variables	Neoplasm n = 4620	Diverticulitis n = 1730	IBD n = 593	p value
LOS				
Median (IQR)	4 (3–6)	4 (3–6)	5 (3–7)	<0.001
Mean (SD)	5.69 (5.05)	4.99 (4.35)	5.97 (4.50)	
Prolonged LOS, n (%)	1126 (24.4)	328 (19.0)	172 (29.0)	<0.001
SSI, n (%)	326 (7.1)	116 (6.7)	59 (10.0)	0.024
DSM, n (%)	543 (11.8)	149 (8.6)	89 (15.0)	<0.001
Reoperation, n (%)	149 (3.2)	48 (2.8)	33 (5.6)	0.004
Readmission, n (%)	424 (9.2)	121 (7.0)	77 (13.0)	<0.001

Unadjusted outcomes compared with χ^2 tests or Kruskal-Wallis test (LOS).
LOS = length of stay; IQR = interquartile range; SSI = surgical site infection; DSM = death/serious morbidity.

morbidity (15.0% vs 11.8% for neoplasm and 8.6% for diverticulitis, $p < 0.001$), reoperation (5.6% vs 3.2% for neoplasm and 2.8% for diverticulitis, $p < 0.01$), and readmission (13.0% vs 9.2% for neoplasm and 7.0% for diverticulitis, $p < 0.001$), whereas patients with diverticulitis had the shortest length of stay and lowest complication rates (Table 2). Patients with IBD took longer than patients with neoplasm or diverticulitis to achieve PO pain control (mean 4.2 days vs 3.4 and 3.5 days, $p < 0.001$) and to tolerate a diet (mean 4.1 days vs 3.7 and 3.5 days, $p < 0.001$) (Table 3). There was no statistically significant difference in the postoperative day of return of bowel function.

Adjusted analyses showed no statistically significant differences between diverticulitis and neoplasm in odds of prolonged length of stay, surgical site infection, death/serious morbidity, reoperation, or readmission (Table 4). Patients with IBD were more likely than patients with neoplasm to experience prolonged length of stay (OR, 1.98; 95% CI, 1.46–2.69), death/serious morbidity (OR, 1.62; 95% CI, 1.13–2.32), and readmission (OR, 1.54; 95% CI, 1.15–2.08). There were no statistically significant differences between IBD and neoplasm in surgical site infection or reoperation.

Subset-adjusted analyses in which patients undergoing total abdominal colectomy with ileostomy were excluded showed no statistically significant differences in outcomes between diverticulitis and neoplasm (Supplemental Table 4, http://links.lww.com/DCR/A627). As in the adjusted analyses above, patients with IBD were more likely than patients with neoplasm to experience prolonged length of stay (OR, 2.20; 95% CI, 1.65–2.94) and readmission (OR, 1.54; 95% CI, 1.13–2.10). There was no statistically significant difference in death/serious morbidity or surgical site infection between patients with IBD and neoplasm, but patients with IBD were more likely to undergo reoperation (OR, 1.94; 95% CI, 1.15–3.29).

Table 3. Recovery-specific outcomes by diagnosis

Variables	Neoplasm	Diverticulitis	IBD	p value
POD PO pain control	n = 4268	n = 1583	n = 552	
Median (IQR)	3 (2–4)	3 (2–4)	3 (2–5)	<0.001
Mean (SD)	3.40 (2.55)	3.52 (2.29)	4.20 (2.83)	
POD tolerating diet	n = 4393	n = 1651	n = 567	
Median (IQR)	3 (2–5)	3 (2–4)	3 (2–5)	<0.001
Mean (SD)	3.66 (2.96)	3.52 (2.35)	4.09 (3.09)	
POD return of bowel function	n = 4516	n = 1692	n = 584	
Median (IQR)	2 (1–3)	2 (2–3)	2 (1–4)	0.462
Mean (SD)	2.59 (1.79)	2.57 (1.52)	2.75 (2.07)	

Unadjusted outcomes compared with Kruskal-Wallis tests.
POD = postoperative day; PO = per os (by mouth); IQR = interquartile range.

Table 4. Odds of prolonged length of stay, morbidity, and readmission by diagnosis

Variables	Diverticulitis	IBD
(Ref = neoplasm)	OR (95% CI)	
Prolonged LOS	1.08 (0.94–1.24)	1.98 (1.46–2.69)[a]
SSI	1.01 (0.79–1.29)	1.33 (0.85–2.09)
DSM	0.89 (0.72–1.11)	1.62 (1.13–2.32)[a]
Reoperation	0.80 (0.57–1.11)	1.46 (0.80–2.69)
Readmission	0.83 (0.67–1.04)	1.54 (1.15–2.08)[a]

Odds of each outcome by diagnosis determined using multivariable logistic regression with forward selection and robust standard errors to account for patients clustered in hospitals while controlling for case and procedure mix and adherence with enhanced recovery protocols.
LOS = length of stay; SSI = surgical site infection; DSM = death/serious morbidity.
[a]Denotes statistical significance.

DISCUSSION

The proven benefits of ERP implementation in randomized controlled trials and multicenter studies have fueled enthusiasm for widespread implementation of ERPs within colorectal surgery, yet no studies to date have examined whether outcomes in the setting of ERPs vary by clinical diagnosis. Using novel ERP variables introduced in NSQIP, we found that outcomes in the setting of ERPs are similar for patients undergoing colorectal surgery for neoplasm or diverticulitis, whereas patients with IBD had higher odds of prolonged length of stay, death/serious morbidity, and readmission, and they took longer to achieve PO pain control and to tolerate a diet. One possible explanation for the increased risk of adverse outcomes in the IBD population relative to other colorectal clinical diagnoses is that patients with IBD are more likely to undergo extensive surgeries with an ileostomy like total abdominal colectomy. Our adjusted analyses controlled for procedure mix, and even in subset analysis excluding patients undergoing total abdominal colectomy with ileostomy, patients with IBD had higher odds of prolonged length of stay and readmission.

Prior studies have explored the relationship between diagnosis and postsurgical outcomes in the colorectal population under traditional perioperative care, with many studies showing that patients with IBD have higher rates of adverse outcomes and longer time to recovery.[5,7–9,13] Inflammatory bowel disease comprises Crohn's disease and ulcerative colitis, which are chronic, immune-mediated

inflammatory disorders of the GI tract with environmental, genetic, and microbial contributing factors. Patients with IBD may be at increased risk of postoperative complications and delayed recovery for several reasons. The inflammatory process underlying IBD in the GI tract is also associated with systemic inflammation and chronic pain.[14] In addition, common IBD treatments, including immune-modulating medications, are hypothesized to increase the risk of infection, although the literature in this area remains mixed.[15–18]

In the colorectal surgery population, IBD has been identified as an independent predictor of adverse outcomes including unplanned reoperation and postoperative ventilator dependency.[5,9] A recent study by Gross et al[19] showed that patients with IBD were at a higher risk of postoperative venous thromboembolism events than patients undergoing colorectal surgery for neoplasm, and a study by Abelson et al[20] reported that in the era of biologics, patients with ulcerative colitis were at increased risk of postoperative morbidity and nonroutine discharge compared with the prebiologic era. Our adjusted analysis in the setting of ERPs mirrored these results; patients with IBD in our cohort had higher odds of death/serious morbidity than with other diagnoses. Interestingly, in our subset analyses excluding patients who underwent total abdominal colectomy with ileostomy, IBD was no longer associated with increased odds of death/serious morbidity and was newly associated with reoperation. It is possible that, in the main analysis, the increased risk of death/serious morbidity in patients with IBD was in part driven by case mix (higher number of total abdominal colectomy with ileostomy procedures) even though case mix was controlled for in our model. Total abdominal colectomy with ileostomy is a relatively definitive operation, despite the associated morbidity. One possible explanation for the new association between IBD and reoperation in our subset analysis is the removal of a significant number of patients who had undergone a definitive surgical procedure. Further work is needed to delineate these findings. Prior studies have yielded mixed results regarding the association between IBD and infectious complications, with some studies suggesting that IBD is a risk factor for both surgical site infection and infectious complications like *Clostridium difficile*.[15–17] We did not see increased odds of surgical site infection in the IBD cohort population in our cohort.

Similar to postoperative adverse events, studies have also explored recovery-specific outcomes for patients with IBD, including pain control, return of bowel function, and ileus. Chronic pain is a well-described phenomenon in patients with IBD,[14] and studies have estimated that between 3% and 13% of patients with IBD are chronic opioid users.[21,22] Opioid use has been associated with postoperative ileus and prolonged length of stay after surgery. Although we have no information on opioid use in our study cohort, we saw that patients with IBD took longer to achieve PO pain control. A recent study by Dai et al[13] in the setting of ERPs found that patients with IBD experienced higher rates of postoperative ileus than patients undergoing colorectal surgery for neoplasm. Ileus is a known complication of colorectal surgery, and often drives hospital length of stay.[6] Interestingly, although patients with IBD in our cohort took longer to tolerate a diet, they did not take longer than other patients to have return of bowel function. We found that, in the setting of ERPs, achieving pain control and tolerating a diet drove the length of stay to a greater degree than did delayed return of bowel function.

Enhanced recovery protocols are powerful in part because they can facilitate the standardized application of evidence-based medicine. As a patient population at unique risk for adverse outcomes in the postoperative period, patients with IBD may benefit from more targeted optimization in the preoperative period, and ERPs may represent a mechanism for implementation. Recent literature has explored preoperative nutrition conditioning and pharmacologic optimization among other strategies.[23] A recent systematic review found that malnutrition was a risk factor for postoperative complications in patients with IBD.[24] Nutritional screening for at-risk patients and the use of enteral or parenteral supplementation were found to decrease morbidity.[24] Incorporation of disease-specific optimization elements in an ERP may represent the next generation of enhanced recovery and could be of particular benefit in the IBD population.

One possible limitation of our study is the heterogeneity among ERPs implemented at different sites, although this has the advantage of making our findings generalizable. It is also possible that Enhanced Recovery in NSQIP variables were entered at sites without ERPs, although this seems unlikely because the variables were optional and would require considerable effort to collect. It is also possible that there is selection bias within our cohort and that patients with IBD were less likely to be placed on ERPs or that the patients with IBD who were considered eligible for enhanced recovery had a less severe disease burden. We found that the distribution of clinical diagnoses in our study cohort was similar to that in the overall ACS NSQIP Procedure Targeted Colectomy data set, so it is unlikely that this type of selection bias would significantly impact our findings. Finally, we were unable to adjust for factors including socioeconomic status and hospital case volume because these variables are not collected in ACS NSQIP. We did not have data on the use of alvimopan in our study population. Of note, because our study cohort did not include control groups in which care was performed in the absence of ERPs, we are unable to evaluate the differential benefit of ERP implementation for various clinical diagnoses.

CONCLUSION

Colorectal ERP implementation is becoming widespread, and a key component of ERPs is preoperative patient education, which sets patient expectations and facilitates a team approach to recovery. This study provides a description of expected colorectal surgery outcomes in the setting of ERPs for different diagnoses. Patients with IBD have higher odds of adverse outcomes, including prolonged length of stay, death/serious morbidity, and readmission, and take longer to achieve PO pain control and to tolerate a diet. In particular, in the setting of ERPs, knowledge of expected outcomes for patients with different diagnoses may affect patient education and clinician and patient expectations in the postoperative period. These findings suggest that future ERPs may benefit from tailoring education and expectations differently for patients with IBD.

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