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Unplanned reoperation following colorectal surgery: indications and operations

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Abstract

Aim—Prior studies have demonstrated a reoperation rate ranging from 5.8% to 7.6% following colorectal surgery. However, the indications for reoperation have not been extensively evaluated. We aimed to describe the indications for reoperation and associated procedures following colorectal resection.

Methods—This is a retrospective cohort study of all patients undergoing colorectal resection at a single institution from 2003–2013. For patients who returned to the operating room, the primary indication was categorized into mutually exclusive categories and all procedures performed within 30 days of the initial operation were indexed. Univariate and multivariate analyses were performed.

Results—We identified 2,793 patients who underwent colorectal operations, of which 407 (14.6%) were emergent. A total of 178 (6.7%) patients returned to the operating room. On multivariate analysis, emergent operation, malnutrition, corticosteroid use, and operative duration were independently associated with reoperation; independent functional status was protective. The most common indications for reoperation were anastomotic leak and bowel obstruction. The most common procedures performed were ostomy creation, bowel resection, and adhesiolysis.

Conclusions—Reoperation after colorectal surgery is a relatively common occurrence for which we have identified the risk factors, most common indications, and specific procedures performed. This knowledge will help identify areas for improvement.

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Keywords

colorectal; surgery; reoperation; ACS NSQIP

Introduction

Resections of the colon and rectum are among the general surgery procedures with the highest rates of morbidity and mortality [1]. Patients who undergo these procedures are at an increased risk of requiring reoperation, and those who do return to the operating room have even higher rates of morbidity and mortality [2].

Rate of reoperation within 30 days is a well-recognized quality measure that is one of the seven currently in use in the Centers for Medicare and Medicaid Services' (CMS) Physician Quality Reporting System (PQRS) [3]. In 2019 the PQRS will become part of the Merit-Based Incentive Payment System (MIPS) which will adjust physician payment based on quality, resource use, clinical practice-improvement activities, and meaningful use of electronic health records [4].

Prior studies have shown a rate of reoperation ranging from 5.8% to 7.6% following colorectal surgery, however, the indications for returning to the operating room and procedures performed within 30 days have not been extensively evaluated [2, 5]. Given that reoperation impacts both patient outcomes and physician reimbursement, knowledge of why and for what patients return to the operating room can help identify areas where improvement would be most beneficial. In this study, our aim was to describe the indications for reoperation and associated procedures following both elective and emergent colorectal resection.

Materials and Methods

Dataset

All adult patients undergoing colorectal resection between January 1, 2003 and December 31, 2013 at the University of Virginia Health System were identified using the University of Virginia American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database. This dataset excludes trauma patients**.** From the inception of the ACS NSQIP at the University of Virginia, all colorectal cases have been abstracted. Therefore, this dataset captured every patient who underwent segmental colectomy, total colectomy, proctocolectomy, proctectomy, and abdominoperineal resection for the given time period and collected information on patient demographics, preoperative risk factors, operative variables, and postoperative events including unplanned returns to the operating room for a surgical procedure within 30 days of the index operation [6]. The University of Virginia Institutional Review Board for Health Sciences Research approved the protocol for this study.

Predictor Variables

Preoperative variables included patient age, gender, body mass index, functional status, smoking status, corticosteroid use, malignancy status, history of chemotherapy, history of radiation, and comorbidities of diabetes or malnutrition (weight loss of >10% body weight served as a proxy). Operative variables included procedure type, operative duration, and emergency status. These were assessed for all patients included in this study.

Associated Outcomes

The ACS NSQIP defines “unplanned reoperation” as any return to the operating room for a surgical procedure under general, spinal, or epidural anesthesia within 30 days of the index operative procedure, for any reason excluding follow-up procedures based on pathology results [6]. The University of Virginia database also captures select bedside surgical procedures performed under conscious sedation which are not included in the ACS NSQIP. In addition to the patients identified by the ACS NSQIP, we also elected to include percutaneous tracheostomy and percutaneous endoscopic gastrostomy tube placement in the reoperation group for this study.

Neither the indication for reoperation nor a comprehensive list of all procedures performed is included in the ACS NSQIP. For each patient who underwent reoperation, the electronic medical record was accessed and operative notes, progress notes, and discharge summaries were reviewed by surgeons. The primary indication for the first return to the operating room was determined and sorted into one of 16 mutually exclusive categories. All procedures performed within 30 days of the index colorectal operation were sorted into 20 non-mutually-exclusive groups and indexed as multiple-response categorical variables. For each patient, only one instance of each type of reoperative procedure was documented such that a patient who underwent bowel resections on multiple occasions would only be counted in that category once. Patients who required more than one return to the operating room were also recorded.

Statistical Analysis

Predictor variables for patients who returned to the operating room versus those who did not were compared. Standard statistical analysis was performed using chi-square and fisher’s exact test where appropriate for categorical variables. Student’s T-test and Kruskal-Wallis test were used where appropriate for continuous variables. Multivariate logistic regression was performed using *a priori* selected patient variables. Statistical analysis was conducted using SAS software, version 9.3 (SAS Institute, Cary, NC). Statistical significance was set at p-values less than 0.05.

Results

Over the 11-year study period 2,793 patients underwent colorectal resection at the University of Virginia Health System, of which 407 (14.6%) were emergent. Colorectal surgeons performed 2,277 (81.5%) of the index operations. The most common presenting diagnoses for patients undergoing elective colorectal resection were malignant neoplasm (n=1077), inflammatory bowel disease (n=369), diverticular disease (n=240), benign

neoplasm (n=213), and obstruction (n=50) whereas the most common presenting diagnoses for patients undergoing emergent colorectal resection were diverticular disease (n=72), perforation (n=71), inflammatory bowel disease (n=51), malignant neoplasm (n=50), and vascular insufficiency (n=32). The most common initial operation performed in this cohort was a segmental colectomy (46.6%). A total of 178 (6.7%) patients returned to the operating room at least once and 16 (0.6%) required multiple returns to the operating room**.** Patient demographics, comorbidities, and operative factors are summarized in Table 1. Patients requiring reoperation were more likely to use corticosteroids, have recent weight loss >10% of body weight, current malignancy, and recent chemotherapy and were less likely to have an independent functional status. Emergent surgery was associated with increased rates of reoperation ((12.3% vs 5.3%, p=0.002) compared with elective surgery. Mortality for those who underwent reoperation was 7.9% compared to 2.9% for those who did not require reoperation (p=0.0012).

The results of our multivariable logistic regression are listed in Table 2. Independent functional status was protective against reoperation and also had the largest effect size. Emergent operation, recent weight loss, corticosteroid use, and operative duration (in order of decreasing effect size) were all independently predictive of the need for reoperation.

The morbidity profiles differed between patients who underwent elective and emergent index resections. Among elective patients, the most common indications for reoperation were anastomotic leak, obstruction, dehiscence, and bleeding. In contrast, the most common indications for reoperation following emergent colorectal resection were for a second look or delayed closure which was not part of the initial plan for the index operation, bleeding, dehiscence, and supportive surgery such as gastrostomy, jejunostomy, or tracheostomy. Tables 3 and 4 show the comprehensive lists of indications for reoperation following elective and emergent index operations, respectively.

The frequencies of reoperative procedures performed are displayed in Table 5. The vast majority of patients (83.7%) required an exploratory laparotomy. One third required washout, one fifth required additional bowel resection, and 15.7% required lysis of adhesions. Of the 90 patients who did not receive an ostomy at their index procedure, 51 (57%) underwent ostomy creation upon reoperation. Twelve percent underwent supportive procedures including gastrostomy, jejunostomy, and tracheostomy. Sixteen patients needed to return to the operating room more than once, which was 9% of patients requiring at least one reoperation and 0.6% of all patients in the cohort.

Discussion

Reoperation following surgery is associated with increased morbidity, mortality, and cost to the healthcare system. Previous studies have found reoperation rates after colorectal resections to be higher than other general surgery procedures [1, 2, 7]. As patient outcomes and physician reimbursement are significantly impacted by reoperation rates, knowledge regarding indications for reoperation and reoperative procedures performed could provide valuable insight.

Our data reveal that 6.4% of patients at our institution require reoperation following colorectal resection, consistent with previously published reoperation rates [2, 5]. These other studies used large databases such as the ACS NSQIP and the Surveillance, Epidemiology, and End Results (SEER)-Medicare-linked database. These databases contain patient-level data but given the variables included in the databases, the authors were only able to categorize the indication into one of very broad categories such as “shock/hemorrhage”, “organ injury/laceration”, and “wound infection/separation”. In order to gain more granularity, the present study sought to take a more in depth look at the specific indications for reoperation and an exhaustive list of the associated procedures performed. Inpatient notes, including all operative reports, were reviewed to assess the preoperative and postoperative diagnoses, surgeon’s findings, and procedures performed to determine the reason for reoperation. As categorizing operative findings requires surgical clinical judgment, surgeons acted as our reviewers classify indications for reoperation into 16 categories and identified 19 types of procedures plus an “other” category.

We hypothesized that anastomotic leak would be the major indication for reoperation following both elective and emergent colorectal resections. Unexpectedly, only 22% of reoperations were performed for a leak. Interestingly, though return to the operating room for second look, bleeding, or dehiscence was more likely following emergent surgery, return for anastomotic leak was more common in the elective population (1.5% vs 0.7%). This may be due to an increased propensity for diversion or end ostomy during emergent colorectal resection. Using the ACS NSQIP data from 2005 to 2008, Ricciardi et al found that the reoperation rate for patients undergoing colorectal resection was 35.7% higher than the overall surgical population [2]. Aside from pancreatectomy and bariatric procedures, anastomotic leak is a rare complication of most other non-colorectal surgical procedures. With anastomotic leaks censored from our data, our overall reoperation rate is 5.0% which is similar to the 5.6% reoperation rate Ricciardi found in the overall surgical population. This suggests that although the rate of reoperation for anastomotic leak is lower than what we had anticipated, it is the major contributor to excess reoperations in patients undergoing colorectal resection. It is important to note that our leak rate is not the 1.4% seen in Tables 3 and 4, as this number only represents the patients who required reoperation. Patients with leaks managed with image-guided percutaneous drain placement were not captured in this study. Furthermore, our Department of Radiology has readily available, skilled proceduralists which may contribute to a lower reoperative rate than seen at other institutions.

There were several risk factors for reoperation noted in our cohort. Emergent status and operative duration >3 hours are both markers of a more difficult case, and not surprisingly, led to increased risk of reoperation. These difficult cases at high risk for complications and reoperation may require different, more cautious management during the index procedure with increased consideration of fecal diversion or negative pressure wound therapy. While the urgency of the procedure and operative duration are not necessarily within our control, we did identify malnutrition and corticosteroid use as potentially modifiable risk factors. Similarly, independent functional status was found to be protective. Previous studies have shown the importance of preoperative nutrition and functional status on outcomes in abdominal surgery [8, 9]. Mayo et al showed that a “prehabilitation” regimen can enhance

outcomes following colorectal surgery [10]. Our study supports these findings and offers some insight into why these patients have worse outcomes.

Our study has several limitations. First, these analyses are limited by the retrospective study design. The ACS NSQIP includes only specific variables so other patient or operative factors not accounted for by NSQIP may have contributed to need for reoperation. This study was performed at a single institution which may limit its generalizability. We examined every colorectal resection performed regardless of the surgeon's specialty. Though the majority of cases were performed by colorectal surgeons, a significant amount were performed by general surgeons in other specialties while on call or as part of a more extensive operation. Lastly, this study examined 11 years of operations and we were not able to control for the effects of secular trends including changes in popular practice such as the use of diverting loop ileostomy, or the overall improvement in care with time.

Conclusions

In this study, we found a 5.3% reoperation rate following elective colorectal resection and a 12.3% reoperation rate following emergent colorectal resection. We have identified anastomotic leak and bowel obstruction as the most common indications for reoperation within 30 days following elective operations whereas second looks and bleeding are most common following emergent operations. Upon returning to the operating room, a large majority of patients undergo exploratory laparotomy and nearly 40% require ostomy revision or creation. With this information, surgeons may be able to recognize complications earlier in the postoperative period, identify portions of the index procedure in which improvement would be the most beneficial, and better inform patients of the expectations, outcomes, and possible complications of their operations.

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Table 1

Characteristics of patients stratified by reoperation status

Patient Demographics, Comorbidities, and Operative Data					
Variable	**No Reoperation**		**Reoperation**		**P-value**
	2615		**178**		
Age (years)	58.43	±0.32	57.64	±1.31	0.53
Sex: Female	1338	51.2%	83	46.6%	0.24
Body Mass Index	26.5	(22.7 – 30.9)	25.8	(22.1 – 30.6)	0.45
Diabetes Mellitus	371	14.2%	28	15.7%	0.57
Current Smoker	611	23.4%	50	28.1%	0.15
Corticosteroid Use	323	12.4%	36	20.2%	0.002
Recent Weight Loss > 10%	247	9.4%	27	15.2%	0.01
Malignancy	922	35.3%	43	24.2%	0.003
Independent Functional Status	2319	88.7%	132	74.2%	<0.0001
Chemotherapy	95	3.6%	1	0.6%	0.03
Radiotherapy	241	9.2%	9	5.1%	0.06
Operative Group					
Segmental Colectomy	1218	46.6%	96	53.9%	0.06
Abdominal Perineal Resection	179	6.8%	13	7.3%	0.82
Proctectomy	920	35.2%	42	23.6%	0.002
Proctocolectomy	139	5.3%	6	3.4%	0.26
Total Colectomy	159	6.1%	21	11.8%	0.003
Laparoscopic Approach	541	20.7%	27	11.8%	0.10
Operative Duration (hours)	2.80	(2.03 – 3.75)	3.02	(2.08 – 4.02)	0.17
Emergent Operation	357	13.7%	50	28.1%	<0.0001

Normally distributed continuous data (Age) is listed as Mean (±SEM), nonparametric data is listed as Median (IQR). Categorical data is listed as n / %.

Table 2

Risk-adjusted odds ratios for factors associated with reoperation

Multivariate Analysis for Reoperation			
Variable	**Wald Chi-Square**	**Odds Ratio (95% CI)**	**P-value**
Age (for each year > 65 years)	0.001	1.00 (0.99 – 1.01)	0.97
Sex: Female	0.73	0.87 (0.64 – 1.20)	0.39
Body Mass Index (for each point > 30)	0.0006	1.00 (0.98 – 1.02)	0.98
Diabetes Mellitus	0.40	1.15 (0.74 – 1.79)	0.53
Current Smoker	0.27	1.10 (0.76 – 1.59)	0.60
Corticosteroid Use	4.27	1.57 (1.02 – 2.40)	0.04
Recent Weight Loss > 10%	3.84	1.58 (1.00 – 2.50)	0.05
Malignancy	1.85	0.76 (0.51 – 1.13)	0.17
Independent Functional Status	11.84	0.50 (0.34 – 0.74)	0.0006
Chemotherapy	3.39	0.15 (0.02 – 1.13)	0.07
Radiotherapy	0.27	0.82 (0.38 – 1.75)	0.60
Laparoscopic Case	1.46	0.76 (0.48 – 1.19)	0.23
Operative Group	7.39	–	0.11
Segmental Colectomy	–	Reference	–
Abdominal Perineal Resection	0.73	1.06 (0.52 – 2.15)	0.39
Proctocolectomy	3.54	0.43 (0.18 – 1.03)	0.06
Proctectomy	0.66	0.72 (0.47 – 1.09)	0.42
Total Colectomy	2.73	1.23 (0.72 – 2.09)	0.10
Operative Duration (for each hour > 3.0 hours)	9.58	1.18 (1.06 – 1.31)	0.002
Emergent Operation	8.00	1.80 (1.20 – 2.69)	0.005

C-statistic = 0.69. Hosmer-Lemeshow Test = 0.68

Table 3

Indications for reoperation following elective colorectal resection

Indications for Reoperation Following Elective Colorectal Resection		
Primary Indication for Reoperation*	**n**	**% of Patients Undergoing Elective Index Resection (n=2,386)**
Any	128	5.36%
Anastomotic Leak	36	1.51%
Obstruction	20	0.84%
Dehiscence	12	0.50%
Bleeding	10	0.42%
Deep Surgical Site Infection	9	0.38%
Bowel Injury	9	0.38%
Unidentified SIRS§	6	0.25%
Second Look	5	0.21%
Flap Issue‡	3	0.13%
Fistula	2	0.08%
Ostomy Complication	2	0.08%
Rectal Stump Leak	2	0.08%
Superficial Surgical Site Infection	1	0.04%
Urologic Injury	1	0.04%

*Categories are mutually exclusive.

§Unidentified SIRS includes cases where there was no definitive diagnosis at exploration for preoperative SIRS.

†Supportive surgery includes cases with the need for surgical or percutaneous gastrostomy, jejunostomy, and tracheostomy.

‡Flap issue includes cases with bleeding, ischemia, and necrosis of tissue flaps.

Table 4

Indications for reoperation following emergent colorectal resection

Indications for Reoperation Following Emergent Colorectal Resection		
Primary Indication for Reoperation*	**n**	**% of Patients Undergoing Emergent Index Resection (n=407)**
Any	50	12.3%
Second Look	16	3.9%
Bleeding	7	1.7%
Dehiscence	7	1.7%
Supportive Surgery†	4	0.98%
Anastomotic Leak	3	0.74%
Obstruction	3	0.74%
Rectal Stump Leak	3	0.74%
Deep Surgical Site Infection	2	0.49%
Ostomy Complication	2	0.49%

*Categories are mutually exclusive. §Unidentified SIRS includes cases where there was no definitive diagnosis at exploration for preoperative SIRS.

†Supportive surgery includes cases with the need for surgical or percutaneous gastrostomy, jejunostomy, and tracheostomy. ‡Flap issue includes cases with bleeding, ischemia, and necrosis of tissue flaps.

Table 5

Frequency of procedures performed at reoperation

Unplanned Reoperative Procedures Performed Following Colorectal Resection		
Reoperative Procedure*	**Totals (n/%)**	
	178	
Exploratory Laparotomy	149	83.7%
Washout	59	33.2%
Ostomy Creation	51	28.7%
Bowel Resection	37	20.8%
Fascial Closure	33	18.5%
Lysis of Adhesions	28	15.7%
Incision and Drainage/Debridement	19	10.7%
Ostomy Revision	18	10.1%
Hemostasis	16	9.0%
Second Look/Delayed Closure§	13	7.3%
Supportive Bedside Procedure†	12	6.7%
Surgical Feeding or Decompression Tube	11	6.2%
Bowel Repair	9	5.1%
Endoscopy	8	4.5%
Negative Exploratory Laparotomy‡	7	3.9%
Temporary Abdominal Closure	4	2.3%
Negative Pressure Wound Therapy	3	1.7%
Ostomy Closure	2	1.1%
Genitourinary Procedure	1	0.6%
Other	17	9.6%

*Categories are not mutually exclusive.

§Second look/delayed closure includes reoperations which were not part of the plan prior to the beginning of the index colorectal procedure.

†Supportive bedside procedure includes percutaneous gastrostomy and tracheostomy.

‡Negative exploratory laparotomy includes reoperations where there was no definitive diagnosis at exploration for preoperative SIRS.