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NSQIP analysis of unplanned reoperation in patients undergoing low anterior resection or abdominoperineal resection for rectal cancer

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Abstract

Background: The rate of unplanned reoperation for rectal cancer can provide information about surgical quality. We sought to determine factors associated with unplanned reoperation following low anterior resection (LAR) and abdominoperineal resection (APR) for patients with rectal cancer and outcomes following these reoperations.

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was used to conduct this retrospective study. Patients who underwent elective LAR and APR for rectal cancer from 2012–2014 were identified. The primary outcomes were 30-day reoperation rates and postoperative complications.

Results: 454 LAR patients (5.9%) and 289 APR patients (8.1%) required reoperation within 30 days of their index operation. The most common reasons for reoperation were infection, bleeding, and bowel obstruction. Multivariate analysis revealed that male sex (OR: 1.5, $p=0.001$), poor functional status (OR: 2.2, $p=0.04$), operative time (OR: 1.001, $p=0.01$), low preoperative albumin (OR: 0.79, $p=0.04$), and lack of ostomy (OR, 0.66, $p=0.005$) were independent risk factors for reoperation after LAR. Smoking (OR: 1.7, $p=0.001$), COPD (OR: 1.8, $p=0.03$), poor functional status (OR: 2.1, $p=0.032$), operative time (OR: 1.003, $p<0.001$), low preoperative albumin (OR: 0.69, $p=0.007$), and open approach (OR: 1.5, $p=0.02$) were independent risk factors for reoperation after APR. Postoperative complication rates are high for those undergoing reoperation, often leading to non-home discharge ($p<0.001$) after reoperation.

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Conclusion: Reoperation following LAR and APR for rectal cancer is not uncommon. This study highlights the indications for reoperation, potentially modifiable preoperative risk factors for reoperation, and the morbidity associated with such operations.

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We identify risk factors for reoperation after LAR and APR and characterize the postoperative complications after reoperation. The importance of these findings are that they may guide surgical planning, technique and post-operative management.

Introduction

Variation in surgical outcomes has been a topic of wide discussion and research in the setting of the rising cost of healthcare. Traditionally, metrics such as morbidity and mortality have been used as proxies for surgical quality¹. Recent data has demonstrated the utility of unplanned reoperation rates as a quality metric for monitoring quality across hospitals, as they are discrete, easily-tracked events²⁻⁶. Moreover, reoperations have clear implications for increased patient morbidity and healthcare costs^{7,8}. For example, one year mortality after colorectal surgery has been shown to be independently predicted by reoperation⁹. Given its importance, several variables relating to unplanned reoperations were added to the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database in 2012, allowing for closer examination of these patients and their overall outcomes.

Prior studies have found that colorectal operations account for the greatest proportion of unplanned reoperations with associated increases in overall hospital cost and mortality rates³. In colorectal cancer patients, reoperation in the early postoperative period has been further associated with worse long-term oncological outcomes¹⁰. Prior work from Merkow et al. demonstrated that 5.7% of colorectal patients required reoperations¹. Despite the clear implications of reoperation on overall patient outcomes and cost, there are no studies focused on unplanned reoperations in patients with rectal cancer undergoing abdominoperineal resection (APR) or low anterior resection (LAR) and risk factors associated with reoperation.

The aim of this study was to determine the factors associated with unplanned reoperation following LAR and APR for patients with rectal cancer and to examine the outcomes following these reoperations using ACS NSQIP database. The goal is to provide recommendations for risk-stratification based on preoperative characteristics that may improve overall patient outcomes.

Methods

Data source and patient selection

The ACS NSQIP is a validated, risk-adjusted, national program which provides data on patient demographics, medical comorbidities, operative variables, and postoperative events, which can be used for quality improvement. Further details of ACS NSQIP are described elsewhere¹¹. Using the ACS NSQIP database, we identified 11,297 patients undergoing

LAR or APR from 2012 through 2014. We utilized 2012–2014 data as these were the first years that unplanned reoperation was included in the NSQIP database. Patients were identified using Current Procedural Terminology codes for APR and LAR, including 45110, 44146, 44155, 44156, 55157, 44158, 44145, 44207, 44208. This study was reviewed by Brigham and Women's Hospital IRB and found to be exempt.

Variables and outcomes

Demographic, preoperative, operative, and postoperative variables were obtained for analysis. Patient demographic variables included age, race, gender, BMI, ASA class, and associated comorbidities. Metrics of patient's preoperative functional status, as defined by their ability to perform activities of daily living in the 30 days prior to surgery, were also collected. Use of chronic preoperative steroids within 30 days prior to the principle operative procedure or at the time of surgical consideration was also noted. Surgical procedures were categorized by type, approach (open versus laparoscopic), and wound class. All procedures were for rectal cancer and patients undergoing emergency operations were excluded. Laboratory variables obtained included creatinine, albumin, hematocrit, and platelets. Postoperative complications were analyzed and included superficial, deep and organ space infections, pulmonary complications such as pneumonia and pulmonary embolism, renal insufficiency, cardiac arrest or myocardial infarction, bleeding, deep vein thrombosis, sepsis, death and readmission. We also analyzed discharge destination, which refers to home versus non-home discharge.

The primary study outcome was unplanned reoperation within 30 days of the index procedure. "Unplanned reoperation" was defined by the NSQIP database as an "unplanned return to the operating room for a surgical procedure related to either the index or concurrent procedure performed ... [and] may occur at any hospital or surgical facility," including hospitals other than the facility where the index procedure was performed¹². Secondary outcomes included postoperative complications.

Statistical analyses

Bivariate exploratory analyses were carried out using Pearson Chi-square or Fisher's exact tests for categorical variables and independent *t* tests for continuous variables. Multivariate logistic regression analysis was then performed to determine independent risk factors for reoperation. All lab values were expressed as mean values with standard deviations. $P < 0.05$ was considered statistically significant for all tests run. All statistical analyses were calculated using SPSS software version 20.0 (SPSS Inc., Chicago, IL).

Results

A total of 11,297 patients were identified. 7,714 patients underwent LAR and 3,583 patients underwent APR. 454 LAR patients (5.9%) and 289 APR patients (8.1%) required reoperation within 30 days of their index operation.

Patient Characteristics and Risk Factors for Reoperation

In the LAR group, patients who needed a reoperation compared to patients who did not need a reoperation were older (62.4 versus 60.9, $p = 0.01$), more likely to have preoperative hypertension (53% versus 44.9%, $p = 0.001$), use steroids (4.4% versus 2.6%, $p = 0.03$), have worse functional status (3.08% versus 1.06%, $p < 0.001$), and have a higher ASA class (61.6% versus 51.4%, $p < 0.001$, Table 1). Patients who were female (29% versus 42%, $p < 0.001$) or white (68.7% versus 76.8%, $p = 0.001$) were less likely to have a reoperation. Patients who had longer index operation times had higher rates of reoperation (250 min versus 236 min, $p = 0.01$). Reoperation was more common in patients who did not have an ostomy at the time of the index surgery (46.9% versus 40.1%, $p = 0.005$). High preoperative creatinine, low albumin, and low platelets were also associated with increased risk of reoperation (Table 1).

For patients who underwent APR, reoperation was similarly more common in older patients (63.5 versus 61.6, $p = 0.02$). Reoperation was also higher in patients who had COPD (8.3% versus 4.4%, $p = 0.003$) or were active smokers (31.8% versus 20.3%). Patients with poor functional status (4.8% versus 2.1%, $p = 0.005$) and high ASA class (69.5% versus 63.2%, $p = 0.04$) were also at an increased risk of reoperation. Longer index operative time was again noted to be associated with reoperation (349 min versus 289 minutes, $p < 0.001$). Low albumin was found to be associated with reoperation (3.72 g/dL versus 3.8, $p = 0.003$); however, creatinine, hematocrit and platelet level were not associated with reoperation in the APR cohort.

Multivariate analysis was conducted, which revealed that male sex (OR: 1.7, 95%CI: 1.35–2.23, $p = 0.001$), poor functional status (OR: 2.2, 95%CI: 1.03–4.50, $p = 0.04$), operative time (OR: 1.002, 95%CI: 1.001–1.008, $p = 0.001$), low preoperative albumin (OR: 0.80, 95%CI: 0.63–0.99, $p = 0.05$), and lack of ostomy during the index procedure (OR: 0.66, 95%CI: 0.52–0.89, $p = 0.001$) were independent risk factors for reoperation after LAR (Table 2). Smoking (OR: 1.7, 95%CI: 1.2–2.4, $p = 0.001$), COPD (OR: 1.8, 95%CI: 1.1–3.1, $p = 0.03$), poor functional status (OR: 2.1, 95%CI: 1.1–4.3, $p = 0.032$), operative time (OR: 1.003, 95%CI: 1.002–1.004, $p < 0.001$), low preoperative albumin (OR: 0.69, 95%CI: 0.53–0.90, $p = 0.007$), and open approach (OR: 1.5, 95%CI: 1.1–2.1, $p = 0.02$) were independent risk factors for reoperation after APR.

Indications for Reoperation

The mean time to reoperation was 10.6 days and 13.1 days for LAR and APR, respectively. After LAR, the most common cause for reoperation was postoperative infection (20.3%, Table 4). Wound disruption (9.7%), bleeding complications (7.5%) and obstruction (6.6%) were other causes for reoperation in the immediate postoperative period. Genitourinary complications, ostomy complications, ischemic colitis, and perforation were also found to be associated with reoperation in this cohort. Similarly, after APR, the most common cause for reoperation was postoperative infection (17.3%), followed by wound disruption (15.6%), obstruction (9.7%), and bleeding complication (8.7%).

Postoperative Complications

In the LAR cohort, the risk of all complications was higher in the reoperation cohort, except for cerebrovascular accident where there was no statistical difference between the reoperation and the no reoperation cohort (Table 3). For patients undergoing APR, reoperation was associated with higher rates of superficial, deep and organ space infections, dehiscence, pneumonia, failure to wean from ventilator, bleeding, DVT, sepsis, septic shock, death, and readmission. Notably, patients who underwent reoperation for either LAR or APR were significantly more likely to have a non-home discharge ($p < 0.001$) (Table 3).

Discussion

This is the first study in the literature to analyze factors associated with reoperation and outcomes after reoperation in patients undergoing LAR/APR for rectal cancer.

Understanding predictive factors for reoperations can help risk stratify patients and focus efforts to improve overall outcomes. Early identification of patients who are at high risk for reoperation can additionally help operative planning and patient counseling. In this study, we showed that 8.1% of APR patients and 5.9% of LAR patients required reoperation within 30 days of the index operation for management of infection, bleeding and bowel obstruction. Operative time, poor nutritional status and poor functional status were major risk factors for reoperation.

Prior studies on reoperation rates after all colorectal surgery have reported rates ranging from 1.8% to 14%^{1,3-5}; there are no studies looking specifically at rectal cancer surgery which is technically more difficult and carries a higher complication rate¹³. The timing of complications after APR or LAR for rectal surgery is also not well defined in the literature. One study in patients undergoing laparoscopic or open colectomy analyzed the rate of anastomotic leak in colorectal surgery and timing to detection of this complication. This study concluded that the mean time after index operation for anastomotic leak was 9.8 days¹⁴. In our study, the mean time to reoperation was 10.6 days and 13.1 days for LAR and APR, respectively. This data may allow providers to predict timing of morbid complications in the postoperative period.

Prior studies have suggested that demographic factors have little impact on postoperative outcomes and frequency of postoperative procedures after colorectal surgery⁵. Other studies have concluded that patient characteristics such as age, comorbidities, and acuity of surgery were associated with postoperative outcomes, and are more predictive than other metrics including annual colorectal surgical volume¹⁵. We identified several patient characteristics that predicted a higher risk for reoperation. Poor functional status and low preoperative albumin were found to have a significant association with reoperation after both APR and LAR. Low preoperative albumin can provide information about a patient's overall nutritional status prior to surgery and can be predictive of wound healing potential. This is supported by a study which analyzed prognostic nutritional index, a measure calculated based on the serum albumin concentration and peripheral blood lymphocyte count, and its ability to predict postoperative outcomes in colorectal cancer¹⁶. They found that a low preoperative nutritional index was associated with an increase in overall postoperative complications as well as poor survival. Moreover, overall functional status may serve as a proxy for a

patient's overall fitness and ability to recover post-surgically. These findings suggest that a patient's nutritional and functional optimization prior to elective rectal cancer surgery may improve outcomes and reduce the rates of reoperation.

Our study also demonstrated that longer operative time was linked to reoperation in both APR and LAR. Longer operative time may be a marker for case difficulty, which could explain its association with an increased number of reoperations. A series of smaller studies have defined an association between longer operative duration and infection risk^{17–19}. While there is no consensus on the exact etiology of this association, some have proposed that longer operations increase anesthesia dose, increase the risk of hypothermia and electrolyte derangements, and prolong overall physiologic stress, which can have implications for wound healing and recovery²⁰. As the majority of reoperations in this series were secondary to infection, minimizing operative time may be one way to reduce need for reoperation and improve overall outcomes²¹. Improvement in technical skills is one way to reduce complications intraoperatively and risk of postoperative complications. Appropriate and meticulous pre-operative planning may also assist in more efficient intraoperative care. Longer operative time might also just be a marker for a more difficult surgery.

Patients with a history of smoking or COPD were found to have a high risk for reoperation after APR. This association has been highlighted in prior studies, including one study that analyzed over 40,000 Plastic Surgery patients and found that smokers had a higher risk for wound complications or dehiscence as well as surgical wound infections²².

For patients undergoing LAR, the presence of an ostomy is protective of reoperation in this series. As the most common cause for reoperation after LAR is postoperative infection (20.3%) with organ space infection accounting for the majority of these infections (45.37%), it is logical that patients who are diverted during their index procedure may be less likely to develop anastomotic leaks or deep pelvic infections, requiring further procedure. A prior study by Michaels et al. looking at elective colorectal resection found that anastomotic leak was associated with 22% of reoperations; they also concluded that return to OR for anastomotic leak was more common in the elective surgery population after colorectal surgery (1.5 vs. 0.7%). Interestingly, this study found that 57% of patients who did not receive an ostomy at their index procedure underwent ostomy creation at the time of reoperation.²¹ The implication of this finding is that cases at high risk for complications secondary to difficulty dissection may benefit from closer consideration of fecal diversion at the index procedure.

Postoperative complications are particularly prevalent in patients who underwent reoperation after LAR or APR. Prior studies have found that technical problems such as inadequate hemostasis, wound dehiscence and anastomotic leaks led to most reoperations^{21,23,24}. In our study, the rate of superficial, deep wound, and organ space infection were found to be the most common reasons for reoperation after both LAR and APR. This is consistent with prior work including one study from Khoury et al. which found that indications for reoperation were most commonly anastomotic leak/abscess, followed by massive bleeding, bowel obstruction, and wound complications¹⁰. While it is difficult to surmise whether these unplanned returns to the operating room were preventable, attention to minimizing risk of

infection through measures such as enforcement of sterile techniques and preoperative antibiotics is critical. While our data demonstrate a clear association between infection and reoperation, further studies will be necessary to determine the etiology and extent of these wound infections in order to determine whether future cases can be prevented. Furthermore, the NSQIP data is limited in that it does not include other procedures such as percutaneous abscess drainage by Interventional Radiology; therefore, it does not capture all potential procedures that may be indicated and subsequently add to overall post-surgical morbidity.

The implications for reoperation are sizeable. Prior data has concluded that compared to non-reoperated patients, those who underwent reoperation in the early postoperative period had worse long-term oncologic outcomes¹⁰. Notably, in our series, in both patients who underwent LAR or APR, death was also more common in the patients who underwent reoperation. Finally, patients who underwent reoperation were more likely to be discharged to a non-home discharge destination. Prior studies analyzing predictors of unplanned readmission after colorectal surgery have found that discharge to any destination other than home after index hospital admission was associated with unplanned readmission²⁵. Readmissions have implications for overall health care costs; the cost to Medicare has been estimated to be \$17.4 billion annually²⁶. This has prompted hospital penalties for preventable readmissions with 30-days. More concerning, unplanned hospital readmissions have also been associated with greater 1 year mortality in patients after colectomy²⁷.

Our study identifies risk factors associated with unplanned reoperation after surgery for rectal cancer. To improve outcomes, patients with risk factors for reoperation should undergo more extensive assessment preoperatively. Based on their preoperative characteristics, patients may benefit from increased nutritional optimization or a more rigorous preoperative fitness protocol prior to operative intervention. As many of these procedures for management of rectal adenocarcinoma are performed electively, using preoperative time to optimize patients would be valuable. Pre-habilitation programs are an example of one such approach that may help patients optimize their fitness in preparation for surgery. Additionally, intraoperative and postoperative resources could be individualized for patients deemed high-risk based on their preoperative characteristics. Some of these resources include use of wound protection devices intraoperatively, more rigorous antiseptic protocols, and strict adherence to anticoagulation guidelines for patients at high risk for re-bleeding. Furthermore, early preoperative risk stratification may help determine which patients may benefit from novel postoperative fast track recovery protocols such as Enhanced Recovery After Surgery.

This study is not without limitations. First, the study only highlights data provided in NSQIP, which only follows patients up to 30 days after the index procedure. We chose to evaluate data from the first several years after the inclusion of reoperation in the NSQIP database. Furthermore, smaller secondary procedures, which may not have required operative intervention, are not captured. Additionally, the specific etiology for reoperation cannot be determined from the NSQIP database; however, regardless of the nature of their subsequent operative procedures, the trends in overall patient outcomes, mortality and discharge planning remain true. Next, the ACS NSQIP database is biased towards including larger hospitals, potentially making the data less generalizable to all hospitals. We are unable

to comment on whether the reoperations were performed by the surgeon who performed the index operation, and thus there may be variability in the threshold for re-operative surgery. We were unable to include data on patients' neoadjuvant treatment, including radiation or chemotherapy, which may have impacts on their wound healing potential. Finally, we did not control for several factors that impact wound healing after APR such as omental flaps and gracilis flaps.

Conclusions

Strategies to reduce the incidence of reoperations are necessary to improve overall patient outcomes. In our study, we identified a series of patient characteristics which can be optimized prior to elective surgery for rectal cancer. We also have highlighted risk factors which may be targeted in quality improvement projects to reduce the incidence of reoperations.

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Table 1a.**Patient Characteristics for APR**

	No reoperation (3294)	Reoperation (289)	p-value
Demographics			
Age, y	63.56 ± 12.72	61.66 ± 13.62	0.02
Female	1,337 (40.59%)	101 (34.95%)	0.06
BMI (kg/m ²)	27.65 ± 6.35	28.10 ± 7.03	0.26
Race			
White	2554 (77.53%)	212 (73.36%)	0.001
Black	274 (8.32%)	44 (15.22%)	
Asian	109 (3.31%)	8 (2.77%)	
Other	357 (10.84%)	25 (8.65%)	
Comorbidities			
Diabetes	526 (15.97%)	52 (17.99%)	0.37
HTN	1,622 (49.24%)	137 (47.40%)	0.55
COPD	146 (4.43%)	24 (8.30%)	0.003
Smoker	669 (20.31%)	92 (31.83%)	<0.001
Functional Status	72 (2.19%)	14 (4.84%)	0.005
Steroid Use	113 (3.43%)	10 (3.46%)	0.98
Weight Loss	245 (7.44%)	23 (7.96%)	0.75
Procedure Characteristics			
Laparoscopic	1136 (34.49%)	75 (25.95%)	0.003
Wound Class 3/4	490 (14.88%)	52 (17.99%)	0.16
ASA Class 3/4	2,083 (63.24%)	201 (69.55%)	0.04
Operative time, min	289.65 ± 125.88	349.13 ± 167.40	<0.001
Ostomy	3,404 (46.9%)	182 (40.1%)	0.005
Preoperative Labs			
Creatinine (mg/dL)	0.92 ± 0.48	0.97 ± 0.92	0.34
Albumin (g/dL)	3.84 ± 0.52	3.72 ± 0.56	0.003
HCT (%)	37.90 ± 4.67	37.46 ± 5.14	0.14
Platelet (×10 ³)	245.40 ± 85.53	250.58 ± 88.99	0.33

Table 1b.**Patient Characteristics for LAR**

	No reoperation (7260)	Reoperation (454)	p-value
Demographics			
Age, y	60.97 ± 12.76	62.49 ± 13.04	0.01
Female	3,105 (42.77%)	133 (29.30%)	<0.001
BMI (kg/m ²)	28.29 ± 6.34	28.37 ± 6.13	0.77
Race			
White	5,575 (76.79%)	312 (68.72%)	0.001
Black	462 (6.36%)	45 (9.91%)	
Asian	328 (4.52%)	18 (3.96%)	
Other	895 (12.33%)	79 (17.40%)	
Comorbidities			
Diabetes	1097 (15.11%)	73 (16.08%)	0.58
HTN	3264 (44.96%)	241 (53.08%)	0.001
COPD	254 (3.50%)	20 (4.41%)	0.31
Smoker	1146 (15.79%)	83 (18.28%)	0.16
Functional Status	77 (1.06%)	14 (3.08%)	<0.001
Steroid Use	192 (2.64%)	20 (4.41%)	0.03
Weight Loss	287 (3.95%)	23 (5.07%)	0.24
Procedure Characteristics			
Laparoscopic	3824 (52.67%)	225 (49.56%)	0.2
Wound Class 3/4	573 (7.89%)	53 (11.67%)	0.004
ASA Class 3/4	3734 (51.43%)	280 (61.67%)	<0.001
Operative time, min	236.11 ± 112.16	250.38 ± 119.72	0.01
Preoperative Labs			
Creatinine (mg/dL)	0.90 ± 0.34	0.97 ± 0.46	0.002
Albumin (g/dL)	3.97 ± 0.51	3.89 ± 0.54	0.005
HCT (%)	39.02 ± 4.77	39.08 ± 5.34	0.81
Platelet (×10 ³)	243.64 ± 78.18	235.40 ± 74.63	0.03

Table 2.

Multivariate Analysis

Independent Risk Factors for Reoperation following APR			
	OR	95% CI	p value
Smoking	1.7	1.2–2.4	0.001
Functional Status	2.1	1.1–4.3	0.032
	No reoperation (3294)	Reoperation (289)	p-value
COPD	1.8	1.1–3.1	0.03
Operative Time	1.003	1.002–1.004	<0.001
Albumin	0.69	0.53–0.90	0.007
Open Surgery	1.5	1.1–2.1	0.02
Independent Risk Factors for Reoperation following APR			
	OR	95% CI	p value
Male Sex	1.7	1.35–2.23	0.001
Functional Status	2.2	1.03–4.50	0.04
Operative Time	1.002	1.001–1.008	0.001
Albumin	0.80	0.63–0.99	0.05
Ostomy	0.66	0.52–0.89	0.001

Table 3a.**Postoperative Complications following APR**

Surgical Complications			
Superficial infection	297 (9.02%)	44 (15.22%)	0.001
Deep wound infection	121 (3.67%)	65 (22.49%)	<0.001
Organ space infection	138 (4.19%)	46 (15.92%)	<0.001
Bleeding	657 (19.94%)	102 (35.29%)	<0.001
Dehiscence	80 (2.43%)	50 (17.30%)	<0.001
Medical Complications			
PNA	78 (2.37%)	19 (6.57%)	<0.001
Pulmonary embolism	21 (0.64%)	7 (2.42%)	0.006
Failure to wean from vent	37 (1.12%)	19 (6.57%)	<0.001
Renal insufficiency	24 (0.73%)	5 (1.73%)	0.08
Renal failure	12 (0.36%)	5 (1.73%)	0.009
UTI	178 (5.40%)	17 (5.88%)	0.73
CVA	5 (0.15%)	1 (0.35%)	0.4
Cardiac arrest	17 (0.52%)	0 (0%)	0.39
MI	25 (0.76%)	4 (1.38%)	0.29
DVT	28 (0.85%)	9 (3.11%)	0.002
Sepsis	129 (3.92%)	43 (14.88%)	<0.001
Septic shock	24 (0.73%)	13 (4.50%)	<0.001
Death	28 (0.85%)	7 (2.42%)	0.02
Readmission	401 (12.17%)	114 (39.44%)	<0.001
Discharge destination	410 (12.45%)	70 (24.22%)	<0.001

Table 3b.

Postoperative Complications following LAR

	No reoperation (7260)	Reoperation (454)	p-value
Surgical Complications	350 (4.82%)	46 (10.13%)	<0.001
Superficial infection			
Deep wound infection	51 (0.70%)	29 (6.39%)	<0.001
Organ space infection	288 (3.97%)	206 (45.37%)	<0.001
Bleeding	585 (8.06%)	92 (20.26%)	<0.001
Dehiscence	33 (0.45%)	38 (8.37%)	<0.001
Medical Complications			
PNA	85 (1.17%)	48 (10.57%)	<0.001
Pulmonary embolism	35 (0.48%)	15 (3.30%)	<0.001
Failure to wean from vent	30 (0.41%)	51 (11.23%)	<0.001
Renal insufficiency	98 (1.35%)	23 (5.07%)	<0.001
Renal failure	37 (0.51%)	17 (3.74%)	<0.001
UTI	225 (3.10%)	33 (7.27%)	<0.001
CVA	10 (0.14%)	1 (0.22%)	0.65
Cardiac arrest	21 (0.29%)	11 (2.42%)	<0.001
MI	29 (0.40%)	15 (3.30%)	<0.001
DVT	56 (0.77%)	21 (4.63%)	<0.001
Sepsis	155 (2.13%)	104 (22.91%)	<0.001
Septic shock	34 (0.47%)	60 (13.22%)	<0.001
Death	38 (0.52%)	17 (3.74%)	<0.001
Readmission	819 (11.28%)	183 (40.31%)	<0.001
Discharge destination	388 (5.34%)	85 (18.72%)	<0.001

Table 4.**Indications for Reoperation**

Reoperation Causes in APR (289 cases)	Mean Days to Reoperation
Postop infection (50) - 17.3%	13.1 ± 8.4
Wound disruption (45) - 15.6%	
Obstruction (28) - 9.68%	
Bleeding Complication (25) - 8.65%	
Ostomy Complication (17) - 5.89%	
GU Complication (12) - 4.15%	
Reoperation Causes in LAR (454 cases)	Mean Days to Reoperation
Postop infection (92) - 20.3%	10.62 ± 7.49
Wound disruption (44) - 9.7%	
Bleeding Complication (34) - 7.5%	
Obstruction (30) - 6.6%	
GU Complication (21) - 4.6%	
Ostomy Complication (20) - 4.4%	
Ischemic Colitis (11) - 2.4%	
Perforation (8) - 1.8%	