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Outcomes for ulcerative colitis with delayed emergency colectomy are worse when controlling for preoperative risk factors

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Abstract

BACKGROUND: Increasing evidence supports immediate colectomy in acute fulminant ulcerative colitis compared to ongoing medical management. Prior studies have been limited to inpatient-only administrative datasets or single institution experiences.

OBJECTIVE: The purpose of this study was to compare outcomes of early versus delayed emergency colectomy in patients admitted with ulcerative colitis flares while controlling for known preoperative risks and acuity.

DESIGN: Cohort study of patients undergoing emergent total abdominal colectomies for ulcerative colitis compared by timing of surgery.

SETTING: American College of Surgeons National Surgical Quality Improvement Program (NSQIP), 2005–2015.

PATIENTS: Those undergoing total abdominal colectomy with an operative indication of ulcerative colitis admitted on a non-elective basis.

MAIN OUTCOME MEASURE: 30-day NSQIP-reported mortality and postoperative complications. Early operation within 2 days of admission.

RESULTS: We identified 572 total abdominal colectomies after propensity score matching. Median time to surgery was 1 hospital day in the early group versus 6 hospital days in the delayed

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group ($p < 0.001$). Early operation was associated with a lower mortality rate (4.9% versus 20.3% in matched groups, $p < 0.001$) and lower complication rate (64.5% versus 72.0%, $p = 0.052$). Multivariable logistic regression with propensity weighting of mortality on preoperative risk factors demonstrated early surgery to be associated with an 82% decrease in the odds of death compared to delayed surgery ($p < 0.001$). Regression of morbidity on preoperative risk factors demonstrated early surgery to be associated with a 35% decrease in the odds of a complication with delayed surgery ($p = 0.034$).

LIMITATIONS: Quality improvement data used for clinical research question.

CONCLUSIONS: Patients undergoing immediate surgical intervention for acute ulcerative colitis have decreased postoperative complications and mortality rates. Rapid and early transitioning from medical to surgical management may benefit those expected to require surgery on the same admission. See **Video Abstract** at <http://links.lww.com/DCR/Axxx>.

Keywords

Colectomy; Emergency surgery; Refractory; Ulcerative colitis

INTRODUCTION

Ulcerative colitis (UC) is characterized by relapse and remission. Up to 25% of patients with ulcerative colitis will suffer an acute flare severe enough to require hospitalization.^{1,2} Despite advancements in medical therapy, 20–40% of UC patients who are hospitalized at least once for medical management eventually undergo definitive colectomy.^{2–4} While it is preferred to perform a colectomy for UC in the elective setting,^{5,6} a substantial number of patients will need a colectomy emergently for acute UC flare refractory to medical therapy.^{7,8}

The optimal timing of colectomy in refractory UC remains controversial. Prior studies have shown that delaying colectomy even two days after admission for UC in patients who are refractory to medical treatment is associated with increased postoperative complications, hospital costs, and lengths of stay.^{9–13} However, these conclusions have limited generalizability due to the nature of single institutional case series or the potential residual confounding of large billing-derived datasets. Current guidelines recommend early consideration of colectomy for acute severe UC,¹⁴ but the exact criteria for and timing of such surgery is unclear. Not only is the inpatient trajectory of each acute severe UC patient difficult to predict, but clinical factors such as immediate preoperative acuity, chronic steroid or immunosuppressant use, and sepsis also influence postoperative outcomes in patients undergoing non-elective surgery. Previous large dataset analyses have not controlled for these factors limiting their conclusions regarding optimal timing for early intervention.¹³

The purpose of our study was to compare outcomes of early versus delayed emergency colectomy in patients admitted with an acute ulcerative colitis flare while controlling for clinically important preoperative risk factors and markers of patient acuity. Based on prior findings, we hypothesized that we would observe an independent association between immediate colectomy and decreased postoperative complications and mortality rates.

MATERIALS AND METHODS

Data Source and Case Identification with Primary Exposure Variable

We identified all adult patients undergoing a total abdominal colectomy for ulcerative colitis in the American College of Surgeon's National Surgical Quality Improvement Program (NSQIP) Participant Use Data File from January 1, 2005 to December 31, 2015. UC patients were identified using International Classification of Diseases, 9th Revision (ICD-9) diagnosis codes listed as the operative indication (ICD-9 code: 55.6). A total abdominal colectomy was identified by Current Procedural Terminology codes (Open: 44150, 44151, 44155, 44156, 44157, 44158; Laparoscopic: 44210, 44211, 44212). We excluded ileal pouch procedures due to their unlikely use in the emergent setting. The NSQIP abstracting guidelines maintain an extensive definition an "emergent" case (see Supplemental Digital Content - Appendix), and cases coded as non-emergent were excluded.

Patients were classified as having an "early" surgical intervention if the procedure day was 2 days or less following admission. We based this definition on prior studies and our own exploratory analysis demonstrating a similar trend of increasing complication after 2 to 3 days of admission in NSQIP data.⁹⁻¹³ All other surgical interventions were classified as "late." We defined these terms based on the perspective of the consulting surgeon rather than the patient's clinical time course, which is not readily obtainable from NSQIP data. Therefore, in the analysis below we performed sensitivity analysis of findings using all admissions versus admissions excluding acute inpatient transfers. Ultimately, we reported results with all admissions given statistically identical primary outcomes associations with covariates, the perspective described here, and the larger sample size affording additional subanalyses.

NSQIP Clinically-Abstracted Variables

Patient demographics included sex and age categorized into quartile. NSQIP also provides the most recent preoperative laboratory values and clinically abstracted, standardized comorbidities that have been previously described and can be found in the information accompanying the annual publication of the Participant Use File.^{15,16} Laboratory values were stratified by relative distributions within the study population assigning a value of "high" if greater than 2 standard deviations from the population mean, and a value of "low" if less than 2 standard deviations from the population mean. An exception to distributional stratification was made for three well-established and clinically highly relevant laboratory tests (hematocrit, white count, and albumin) using widely published sex- and age-adjusted thresholds.¹⁷ In-hospital mortality, post-operative complications, and post-operative length of stay (LOS) were also obtained from the NSQIP dataset using similarly standardized definitions.^{15,16}

Statistical Analysis

Due to the unique availability of preoperative lab values and clinically abstracted, standardized comorbidities available in NSQIP data, we first compared the early versus late emergent total abdominal colectomy for UC populations by the complete set of preoperative predictors as well as postoperative outcomes available in the Participant Use File. In this

initial exploratory analysis, we also tested for statistically significant trends in the year-to-year complication rate using simple logistic regression; the lack of any observed trend or statistical significance led us to not pursue temporal effects of the study time period from further analysis. We also evaluated stratifying the analysis by procedures with a bowel-bowel anastomosis and without but decided to exclude this variable due to its presumed role as a mediator rather than a confounder of complications and existing power limitations. Due to the high potential for covariate differences between the exposure groups, we performed propensity score matching with 1:1 replacement on the following covariates: sex, age quartile, ASA class tertile, operative approach, chronic (> 10 days) steroid (or other immunosuppressant) use, preoperative transfusion needs, acute renal failure, preoperative sepsis and SIRS, and weight loss greater than 10% in the last six months.

We selected these predictors through consensus-driven discussions between the authors to identify important factors when assessing degree of toxicity and operative readiness during hospitalization for acute ulcerative colitis. When considering different measures for certain aspects of physiology (e.g., assessing oxygen carrying capacity of blood with the last hematocrit laboratory value versus the abstractor's indication of the need for a preoperative blood transfusion), we selected the option that we believed was more durable and more demonstrably true of worse disease state. Balance plots were used to qualitatively compare pre- and post-matched populations (data not reported). Continuous variables were compared using Wilcoxon-Mann-Whitney tests of medians. Binary and categorical variables were compared using χ^2 tests of proportions. We then performed doubly robust logistic regression on the matched sample to examine independent risks of mortality and complications. Regression models were constructed using *a priori* surgeon and gastroenterologist consensus of predictors with well-established associations to outcomes of interest. We considered including any variables that remained unbalanced after propensity score matching at a p-value significance of less than 0.05 but ultimately left these values out of our final model due to the risk that the remaining differences were demonstrative of lead-time bias and were more descriptive of more time in hospital rather than rational predictors of post-operative outcomes. We also tested significant covariates (e.g., sepsis, preoperative transfusion) for interaction effects with the primary explanatory variable of operation timing. A p-value of less than 0.05 was considered statistically significant for interpretation of multivariable regressions. Missing data was excluded from regression analysis if less than 10% for any variable within the sample. All analyses were performed using Stata® 14.2 (StataCorp, College Station, TX). This study design was reviewed and approved by the Johns Hopkins Medicine Institutional Review Board.

RESULTS

We identified 508 total abdominal colectomies that after propensity score matching yielded an effective sample size of 573 through 1:1 replacement. 50.1% of the total population underwent colectomy within 2 days of admission. Median time to colectomy was 1 hospital day in the early group versus 6 (IQR: 4 – 9) hospital days in the delayed group ($p < 0.001$). Overall, 30-day mortality was 6.1% in the unmatched groups and 10.1% after matching. There were no differences in propensity-matched variables in the early versus late surgery groups by sex, age category, surgical approach, operative acuity by ASA class, steroid (or

other immunosuppressant) use, weight loss, acute transfusion needs, preoperative sepsis rate, or preoperative renal failure (Table 1). After matching, those in the early colectomy group still had a worse functional status (functional independence: 81.6% versus 87.0%, $p = 0.014$), higher rates of hypertension requiring medication (39.4% versus 22.4%, $p < 0.001$), lower rates of preoperative dyspnea (11.1% versus 19.6%, $p < 0.001$), lower rates of COPD (8.4% versus 14.7%, $p = 0.018$), and lower rates of ventilator dependence (9.8% versus 15.7%, $p = 0.032$). Preoperative laboratory values were not statistically different except for a greater prevalence of low serum albumin in the delayed group (94.7% versus 88.6%, $p = 0.011$), low hematocrit in the delayed group (94.0% versus 87.2%, $p = 0.006$), high platelets in the delayed group (7.3% versus 3.5%, $p = 0.048$), and high prothrombin time in the delayed group (6.8% versus 2.6%, $p = 0.030$) (Table 2).

When comparing early versus late groups, an early colectomy was associated with a lower mortality rate (4.9% versus 20.3%, $p < 0.001$) and lower complication rate (64.5% versus 72.0%, $p = 0.052$). Reduced complication occurrences that contributed to a lower overall complication rate in the early group included wound infections, postoperative sepsis, prolonged postoperative mechanical ventilation, unplanned reintubation, postoperative renal failure, postoperative cardiac arrest, and postoperative bleeding (Table 3). There was no difference in postoperative lengths of stay or operative duration.

Multivariable logistic regression with propensity weighting of mortality on preoperative risk factors demonstrated early colectomy to be associated with an 82% decrease in the odds of death compared to delayed colectomy ($p < 0.001$) (Table 4). Regression of morbidity on preoperative risk factors demonstrated early colectomy to be associated with a 35% decrease in the odds of a complication with delayed colectomy ($p = 0.034$) (Table 5).

DISCUSSION

We examined UC patients who underwent emergent total abdominal colectomy comparing those who were operated on within 48 hours of admission versus those operated on in a delayed fashion. When controlling for other factors, those operated on within 48 hours reduced their odds of a complication by 35% and their odds of death by 82%. The outcomes benefit seen in the early group was maintained even when factoring potential differences in acuity presentation by factors such as sepsis, chronic steroid use, and chronic malnutrition.

The optimal timing threshold of urgent colectomy for refractory UC remains unknown, and prior studies have been constrained by the lack of generalizability in institutional series and potential confounding in administrative billing data. The purpose of this study was to use the increasing availability of emergent colectomy data in the clinically abstracted NSQIP Participant Use file to further explore the relationship between immediate and delayed operation interventions for refractory UC requiring urgent surgery.

The benefits of early surgery when urgent total abdominal colectomy is required for acute UC is well-known, but recent studies continue to narrow the interval of how early is early enough. “Early” has historically been defined as colectomy following a short 7 to 10 day-course of pharmacologic rescue therapy,^{4,18} but recent evidence suggests that much shorter

time intervals between acute presentation and colectomy may provide substantial reductions in the risk of morbidity.^{6,9,10,13} Evidence is mounting that for those acute UC patients who will require colectomy even an overnight delay may be associated with clinically significant worse surgical outcomes.

Our findings provide additional support for early surgical intervention in those patients with acute UC who will ultimately require total abdominal colectomy on the same admission. An important limitation of prior studies has been that ascertaining the effect of the ubiquitous features of acute UC patient presentation (e.g., hemodynamic stability, steroid use) on surgical timing. Importantly, our conclusions are sustained even when factoring in the preoperative clinical condition of the patient. Although some laboratory values remained unbalanced in the analytic sample, we believe the variable selection methodology described in the Methods addressed any clinical effect of these differences by choosing similar variables that were successfully matched upon.

The limitations of this study are two-fold: analytical and clinical. First, data quality is limited by the NSQIP data being prospectively collected for quality improvement rather than specifically for clinical decision-making. It may be susceptible to between-institution reporting differences as well as heterogeneity in data capture abilities of the individual clinical reviewers. For example, more than 25% of those without sepsis or systemic inflammatory response syndrome still had leukocytosis. We carefully tested our models with and without such variables to ensure no material impact on our conclusions. Similarly, although the NSQIP administrators maintain in-depth definitions of variables, the current definition of “emergent” can be interpreted differently by different abstractors and there is the added complexity of interpreting how a surgeon may book a case and his or her intended urgency.¹⁹ Finally, differentiating rescue medication regimens is not currently available in NSQIP data. If occurring, the lack of complete or accurate data capture should be equally likely across all records and therefore would favor the null hypothesis.

Importantly, while the use of propensity score matching may help account for covariate outliers, the methodology is equally as susceptible as conventional regression methods for residual confounding due to unobserved differences in these populations.²⁰ In addition, propensity score matching enriches analytical samples so that between-group imbalances are minimized but also limit the generalizability of overall point estimates. For example, the mortality rates reported here, while statistically comparable between early and late groups, cannot be directly compared to other studies. Due to the ethical and practical difficulties of performing a randomized controlled trial of timing of emergent colectomy in this patient population, data from a high-quality outcomes dataset such as NSQIP likely represents the best compromise between data quality and feasibility. NSQIP data continues to grow, and we anticipate the opportunity to revisit the data in the future to ask additional questions with its increasing potential sample size (e.g., day-by-day delay in complication rates).

The second consideration of limitations of this study is its findings’ limited usefulness for the ulcerative colitis stakeholders outside of a surgical context. This study is not able to inform the critical transition point when the multidisciplinary care team acknowledges the failure of medical therapy for acute UC and begins to favor surgical intervention. NSQIP

data provides time from admission to surgery, but we are not able to report on the sequence of key events (e.g., admission for medical therapy, surgical consultation, etc.) that occurs between these two points. An important question that cannot be answered by our study design is how the surgeon and multidisciplinary team make an evidence-based decision to abort further medical interventions in favor of surgery. Such a management question is critical for improving care of UC but will likely need large multi-institutional datasets of acutely presenting UC patients prior to further investigation. What we can suggest is that once it is clear to the team that medical rescue is not possible, any further delay in colectomy may confer substantially worse post-operative outcomes. Such a recommendation is increasingly common at critical surgical decision-making junctures that rely on observational studies and meta-analyses for current professional society guidelines. For example, guidelines for surgical intervention for *Clostridium difficile* colitis are based on a similarly designed study that noted worse outcomes with further delay if surgery was inevitable.^{21–23}

CONCLUSION

UC patients undergoing emergent total abdominal colectomy had substantially lower mortality and lower rates of complication when comparing those operated on immediately versus those operated on more than 48 hours after admission. Even short delays in surgical intervention once failing medical therapy may be contributing to substantially worse post-operative outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Demographic and baseline characteristics for propensity score-matched patients undergoing emergent total abdominal colectomy at NSQIP institutions by timing of surgery.

Table 1.

Characteristic (%)	Total N=573	Early Colectomy N=287 (50.1)	Delayed Colectomy	p
Age (years)				0.563
< 50	43.1	42.9	43.4	
50–65	31.9	30.0	33.9	
65–85	22.3	24.0	20.6	
>85	2.6	3.1	2.1	
Gender				0.967
Male	50.3	50.2	50.4	
Female	49.7	49.8	49.7	
ASA				0.651
1 or 2	19.6	21.0	18.2	
3	39.2	37.8	40.6	
4 or 5	41.3	41.3	41.3	
Functional Status				0.014
Independent	84.3	81.6	87.0	
Partial dep	8.3	7.8	8.8	
Total dep	7.4	10.6	4.2	
Operative Approach				0.411
Open	85.9	84.7	87.1	
Laparoscopic	14.1	15.3	12.9	
Comorbidities				
Chronic steroids*	46.3	47.4	45.1	0.584
Weight loss	16.2	16.4	16.1	0.924
Sepsis	65.6	66.9	64.3	0.518
Angina	0.6	0.9	0.0	0.445

Characteristic (%)	Total N=573	Early Colectomy N=287 (50.1)	Delayed Colectomy	p
Prior myocardial infarction	1.8	1.9	1.6	0.903
Peripheral vascular disease	2.4	2.8	1.6	0.624
Congestive heart failure	2.1	2.4	1.8	0.564
Hypertension	30.9	39.4	22.4	<0.001
Dyspnea				<0.001
With exertion	10.5	4.5	16.4	
Rest	4.9	6.6	3.2	
Active pneumonia	1.8	2.8	0.0	0.183
COPD	11.5	8.4	14.7	0.018
Smoker	15.0	14.9	15.0	0.986
Vent-dependent	12.7	9.8	15.7	0.032
Diabetes				0.056
Insulin- dependent	4.7	5.6	3.9	
Insulin-independent	8.6	5.9	11.2	
Acute renal failure	5.9	5.9	5.9	0.992
On dialysis	2.4	3.1	1.8	0.282
Ascites	7.0	6.3	7.7	0.505
Bleeding Disorder	12.2	14.3	10.1	0.130
Preoperative transfusion	11.2	11.2	11.2	0.988
Impaired sensorium	10.1	8.4	12.9	0.349
Coma	1.8	0.9	3.2	0.277
Prior TIA	1.8	2.8	0.0	0.183
Stroke with deficit	5.9	5.6	6.5	0.823
Prior stroke without deficit	1.8	2.8	0.0	0.183
Heavy alcohol use	1.2	1.9	0.0	0.279
BMI (Median, IQR)	24.7 (21.2–29.3)	24.2 (20.7–28.3)	25.2 (21.7–29.9)	0.435

Abbreviations: COPD – chronic obstructive pulmonary disease; TIA – transient ischemic attack; BMI – body mass index

NSQIP comorbidities not displayed: preoperative wound infection, pregnancy, disseminated cancer.

* “Chronic steroid use” as defined by NSQIP reporting includes the extended use of steroids or any other immunosuppressant.

Table 2.

Preoperative laboratory values for propensity score-matched patients undergoing emergent total abdominal colectomy at NSQIP institutions by timing of surgery.

Laboratory Test* (%)	Total N=573	Early Colectomy N=287 (50.1)	Delayed Colectomy N=286 (49.9)	p
Sodium				
High	2.3	2.8	1.8	0.411
Low	3.7	2.4	4.9	0.118
Blood urea nitrogen				
High	5.8	7.1	4.6	0.202
Creatinine				
High	7.0	5.3	8.7	0.106
Albumin				
Low	91.7	88.6	94.7	0.011
Bilirubin, Total				
High	5.4	2.3	8.5	0.002
Aspartate aminotransferase				
High	4.0	2.4	5.6	0.068
Alkaline Phosphatase				
High	2.8	4.2	1.5	0.054
White blood cell count				
High	57.8	55.6	60.0	0.299
Low	6.4	6.3	6.5	0.959
Hematocrit				
High	0.4	0.0	0.7	0.157
Low	90.6	87.2	94.0	0.006
Platelet count				
High	5.4	3.5	7.3	0.048
Partial thromboplastin time				
High	3.9	3.5	4.2	0.738
Prothrombin time				
High	4.7	2.6	6.8	0.030

Abbreviations: BUN – blood urea nitrogen; AST – aspartate aminotransferase

* Reported as relative distributions in the study population. “High” defined as greater than 2 standard deviations of the mean except for hematocrit (men: 52%, women: 47%), white blood cell count (10,800 cells per microliter), and albumin (over 60 years old: 4.6 grams per deciliter, under 60 years old: 5.2 grams per deciliter). “Low” defined as less than 2 standard deviations of the mean except for hematocrit (men: 42%, women: 37%), white blood cell count (4,800 cells per microliter), and albumin (over 60 years old: 3.5 grams per deciliter, under 60 years old: 3.2 grams per deciliter). Results not shown for abnormal laboratory values with zero cases in study population including: low BUN, low creatinine, high albumin, low bilirubin, low aspartate aminotransferase, low alkaline phosphatase, low platelets, low partial thromboplastin time, and low prothrombin time.

Table 3.

Postoperative outcomes of propensity score-matched patients comparing early to delayed surgery for acute severe ulcerative colitis

Outcome (%)	Total N=573	Early Colectomy N=287 (50.1)	Delayed Colectomy N=286 (49.9)	p
Mortality	10.1	4.9	20.3	<0.001
Postoperative Length of Stay (median, IQR)	10 (6–16)	10 (6–18)	10 (7–14)	0.384
Operative Duration, median (IQR)	158 (124–200)	152 (114–206)	161 (130–184)	0.337
Number of complications, median (IQR)	2 (2–4)	2 (1–4)	2 (2–4)	0.445
At least one complication [*]	68.2	64.5	72.0	0.052
Specific complication ^{**}				
Postoperative transfusion	40.0	32.1	39.9	0.052
Postoperative sepsis	33.5	31.7	35.3	0.360
Prolonged ventilation	27.6	25.1	30.1	0.182
Wound infection	22.2	22.0	22.4	0.902
Acute renal failure	8.2	6.3	10.1	0.092
Urinary tract infection	5.1	5.9	4.2	0.346
Deep vein thrombosis	4.2	6.3	2.1	0.013
Myocardial infarction	3.3	3.1	3.5	0.810
Pulmonary embolism	1.8	1.1	2.5	0.200
Renal insufficiency	1.1	2.1	0.0	0.014
Stroke	1.4	0.7	2.1	0.153

Abbreviations: IQR – interquartile range

^{*} At least one complication: postoperative transfusion, postoperative sepsis, prolonged ventilation > 48 hours, any wound infection, acute renal failure, urinary tract infection, deep vein thrombosis, myocardial infarction, pulmonary embolism, renal insufficiency, stroke.

^{**} Complications with less than 1% occurrence not reported individually including postoperative pneumonia, unplanned reintubation, and cardiac arrest.

Table 4.

Doubly robust multivariable logistic regression of propensity score-matched acute severe ulcerative colitis patients dying within 30 days following total abdominal colectomy (propensity matched and weighted sample; n = 573)

Variable	Unadj. OR (95% CI)	p	Adj. OR (95% CI)	p
Early colectomy	0.20 (0.10–0.39)	<0.001	0.18 (0.08–0.43)	<0.001
Female sex	0.48 (0.24–0.94)	0.032	0.64 (0.26–1.54)	0.314
Age quartile	4.51 (2.93–6.96)	<0.001	3.60 (2.18–5.95)	<0.001
ASA tertile	3.48 (1.99–6.10)	<0.001	2.73 (1.07–6.97)	0.036
Preoperative transfusion	0.33 (0.08–1.42)	0.136	0.52 (0.10–2.71)	0.441
Chronic steroid use	1.21 (0.64–2.26)	0.559	2.08 (0.81–5.32)	0.128
Preoperative weight loss	1.94 (0.99–3.81)	0.051	1.57 (0.58–4.27)	0.374
Preoperative sepsis	1.75 (0.88–3.50)	0.113	1.64 (0.52–5.20)	0.397

Excluded laparoscopic approach covariate due to zero cases performed laparoscopically that resulted in death.

Abbreviations: ASA - American Society of Anesthesiologist classification

Table 5.

Doubly robust multivariable logistic regression of propensity score-matched acute severe ulcerative colitis patients having at least one complication following total abdominal colectomy (propensity matched and weighted sample; n = 573)

Variable	Unadj. OR (95% CI)	<i>p</i>	Adj. OR (95% CI)	<i>p</i>
Early colectomy	0.70 (0.49–1.00)	0.052	0.65 (0.44–0.97)	0.034
Female sex	0.92 (0.65–1.31)	0.657	0.77 (0.52–1.17)	0.229
Age quartile	2.26 (1.77–2.89)	<0.001	1.52 (1.14–2.03)	0.004
ASA tertile	3.39 (2.59–4.43)	<0.001	2.24 (1.63–3.09)	<0.001
Laparoscopic approach	0.39 (0.24–0.63)	<0.001	1.11 (0.63–1.95)	0.727
Preoperative transfusion	1.21 (0.68–2.16)	0.508	1.49 (0.79–2.79)	0.218
Chronic steroid use	0.46 (0.32–0.66)	<0.001	0.72 (0.48–1.10)	0.125
Preoperative weight loss	0.82 (0.51–1.31)	0.400	1.08 (0.63–1.83)	0.790
Preoperative sepsis	3.57 (2.46–5.17)	<0.001	2.18 (1.40–3.38)	0.001

Abbreviations: ASA - American Society of Anesthesiologist classification