

Risk Factors for Severe Postoperative Complications After Laparoscopic Colorectal Cancer Surgery in Octogenarians: A Retrospective Cohort Study

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Purpose: To evaluate the incidence and risk factors of severe postoperative complications in patients aged ≥ 80 years undergoing laparoscopic colorectal cancer surgery.

Patients and Methods: Patients aged ≥ 80 years who underwent laparoscopic colorectal cancer surgery between February 2007 and September 2018. Severe complications were defined as Clavien–Dindo grade III or higher. Univariate and multivariate logistic regression analyses were performed to identify risk factors.

Results: Among 170 patients, 26 (15.3%) experienced severe postoperative complications. Gastrointestinal events were most common (8.0%), followed by respiratory (3.5%) and cardiovascular (2.9%) complications. Two patients (1.2%) died postoperatively. Multivariate analysis identified estimated blood loss >100 mL (OR = 4.53, 95% CI: 1.75–11.70, $P < 0.01$) and age ≥ 85 years (OR = 4.48, 95% CI: 1.27–15.79, $P = 0.02$) as independent risk factors. Hemoglobin <120 g/L (OR = 2.56, 95% CI: 0.99–6.60, $P = 0.05$) and ASA III (OR = 2.49, 95% CI: 0.98–6.35, $P = 0.06$) showed borderline significance.

Conclusion: Severe complications occurred in 15.3% of octogenarians undergoing laparoscopic colorectal cancer surgery. Age ≥ 85 years and intraoperative blood loss >100 mL were independent risk factors. Preoperative anemia and ASA III were borderline predictors. These factors may aid in perioperative risk stratification and surgical decision-making in elderly patients.

Keywords: colorectal cancer, laparoscopic surgery, octogenarians, postoperative complications, risk factors

Introduction

Colorectal cancer (CRC) remains one of the most prevalent and lethal malignancies worldwide.¹ With the global rise in life expectancy, the number of elderly patients diagnosed with CRC continues to increase, and individuals aged ≥ 80 years (octogenarians) now represent a growing surgical population.² Although advanced age is not an absolute contraindication to surgery, octogenarians often present with reduced physiological reserve, multiple comorbidities, and impaired postoperative recovery capacity, posing unique perioperative challenges.³

Laparoscopic surgery has become the standard approach for CRC resection, offering benefits such as reduced surgical trauma, faster recovery, and shorter hospital stay.⁴ Several studies have demonstrated its safety and feasibility in elderly patients.^{5,6} However, concerns remain regarding the risk of severe postoperative complications, particularly in very elderly individuals undergoing minimally invasive procedures.⁷ Severe complications, typically defined as Clavien–Dindo grade III or higher, may require reoperation, interventional procedures, or intensive medical support. In

octogenarians, such events are more frequent and often involve cardiopulmonary systems, including heart failure, pneumonia, and arrhythmias.⁸ These complications are associated with prolonged hospitalization, increased healthcare costs, and elevated perioperative mortality.⁹

Identifying risk factors for severe complications is essential for improving perioperative management and guiding individualized treatment strategies. Previous studies have suggested associations with age, American Society of Anesthesiologists (ASA) score, intraoperative blood loss, and preoperative nutritional status.^{10,11} However, most existing models are based on younger cohorts, and data specifically focusing on patients aged ≥ 80 years undergoing laparoscopic CRC surgery remain limited.¹² Patients aged ≥ 85 years are often considered a distinct subgroup within the elderly population due to markedly reduced physiological reserve and higher perioperative risk, and this threshold has been used in prior surgical risk-stratification studies.¹³ Despite the increasing number of octogenarians undergoing minimally invasive colorectal surgery, high-quality data describing severe postoperative complications and their risk factors in this population remain scarce.

We therefore hypothesized that specific clinical and intraoperative factors would be associated with an increased risk of severe postoperative complications in this population. This study aimed to evaluate the incidence and risk factors of severe postoperative complications in octogenarians undergoing laparoscopic colorectal cancer surgery. By identifying high-risk features, we sought to support evidence-based perioperative planning and improve surgical outcomes in this vulnerable population.

Materials and Methods

Study Design and Patient Selection

This retrospective cohort study included patients aged ≥ 80 years who underwent elective laparoscopic radical resection for pathologically confirmed colorectal adenocarcinoma at the Cancer Hospital, Chinese Academy of Medical Sciences between February 2007 and September 2018. The end date of 2018 was chosen because complete and validated 30-day postoperative follow-up data were available only up to that year in the institutional database. Inclusion criteria were: (1) age ≥ 80 years at the time of surgery; (2) histologically confirmed adenocarcinoma of the colon or rectum; (3) elective laparoscopic curative-intent resection; and (4) no history of inflammatory bowel disease, intestinal tuberculosis, or prior colorectal surgery. Patients who underwent open surgery or emergency procedures, or conversion from laparoscopy to open surgery were excluded, as the present dataset captured only procedures completed laparoscopically. During the same period, 143 additional patients aged ≥ 80 years underwent open colorectal surgery and were not included in the present analysis, as the study specifically focused on outcomes after laparoscopic procedures.

Preoperative Evaluation and Surgical Procedure

All patients underwent comprehensive preoperative assessment, including chest–abdominal–pelvic computed tomography (CT), electrocardiography, echocardiography, and pulmonary function testing. Patients with significant cardiopulmonary comorbidities were further evaluated by anesthesiology and intensive care specialists to assess perioperative risk.

Surgical procedures were categorized according to standard anatomical definitions. Right-sided resections included right hemicolectomy and extended right hemicolectomy; left-sided resections included left hemicolectomy and sigmoid colectomy. Rectal procedures included high anterior resection, low anterior resection, and abdominoperineal resection. All procedures were performed under general anesthesia with endotracheal intubation. Pneumoperitoneum was established via a supraumbilical trocar, maintaining intra-abdominal pressure at 13–15 mmHg. A medial-to-lateral approach was used for all resections. The extent of lymphadenectomy and mesocolic or mesorectal excision followed oncologic principles, including complete mesocolic excision (CME) or total mesorectal excision (TME), depending on tumor location. Anastomoses were performed using stapled or hand-sewn techniques, and protective stomas were created at the discretion of the operating surgeon.

Definition of Outcomes and Variables

The primary outcome was the occurrence of severe postoperative complications, defined as Clavien–Dindo grade III or higher events within 30 days after surgery. Postoperative complications were identified based on inpatient medical records and 30-day follow-up data, and classified according to the Clavien–Dindo grading system.¹⁴

Collected variables included demographic and clinical characteristics (age, sex, body mass index (BMI), ASA classification, comorbidities, preoperative albumin and hemoglobin levels), tumor-related factors (location, size, and pathological TNM stage), and perioperative parameters (operative time, estimated blood loss, prior abdominal surgery, and presence of preoperative partial bowel obstruction).

Statistical Analysis

Statistical analyses were performed using SPSS version 29.0 (IBM Corp., Armonk, NY). Categorical variables were expressed as counts and percentages, and compared using the chi-square test or Fisher's exact test, as appropriate. Variables with potential clinical relevance and statistical association in univariate analysis were selected for multivariate logistic regression to identify independent risk factors for severe postoperative complications. A two-sided *P* value < 0.05 was considered statistically significant.

Results

Patient Characteristics

A total of 170 patients aged 80 years or older who underwent laparoscopic radical resection for colorectal cancer were included, comprising 101 males (59.4%) and 69 females (40.6%), with a median age of 82 years (range, 80–94 years). The most common tumor location was the rectum (*n*=85, 50.0%), followed by the sigmoid colon (*n*=42, 24.7%), ascending colon (*n*=39, 22.9%), and descending colon (*n*=4, 2.4%). Among the 85 patients with rectal cancer, 48 underwent resection with primary anastomosis (including 2 with a diverting stoma), while 37 required permanent colostomy (19 Hartmann procedures and 18 abdominoperineal resections). All patients were included in the analysis. Pathological TNM staging showed that stage I–II disease accounted for 106 cases (62.4%) and stage III for 64 cases (37.6%). Preoperative comorbidities were present in 122 patients (71.8%), with hypertension being the most common (*n*=83, 48.8%), followed by diabetes mellitus (*n*=28, 16.5%), coronary artery disease (*n*=25, 14.7%), cardiac arrhythmia (*n*=25, 14.7%), chronic obstructive pulmonary disease (*n*=23, 13.5%), and cerebrovascular disease (*n*=4, 2.4%). Details are presented in [Table 1](#).

Incidence of Severe Postoperative Complications

Within 30 days postoperatively, 26 patients (15.3%) experienced severe complications classified as Clavien–Dindo grade III or higher. Some patients developed multiple complications, and the total number of complication events exceeded 26. Gastrointestinal complications were the most common (*n*=13, 7.6%), including anastomotic leak (*n*=7, 4.1%), gastroparesis (*n*=3, 1.8%), ileus (*n*=2, 1.2%), and anastomotic bleeding (*n*=1, 0.6%). Respiratory complications occurred in 6 patients (3.5%), including pneumonia (*n*=5, 2.9%) and respiratory failure (*n*=1, 0.6%). Cardiovascular complications were observed in 5 patients (2.9%), including heart failure (*n*=2, 1.2%), shock (*n*=1, 0.6%), myocardial infarction (*n*=1, 0.6%), and atrial fibrillation (*n*=1, 0.6%). Additionally, wound complications, urinary complications, and incisional hernia each occurred in 2 patients (1.2%). Two patients (1.2%) died postoperatively due to pulmonary infection and sudden cardiac death. Details are presented in [Table 2](#).

Risk Factors for Severe Postoperative Complications

Univariate analysis identified age ≥85 years (odds ratio (OR) = 4.02, 95% confidence interval (CI): 1.32–12.27, *P* = 0.02), preoperative hemoglobin <120 g/L (OR = 3.36, 95% CI: 1.42–7.96, *P* = 0.01), ASA class III (*P* = 0.08), estimated blood loss >100 mL (OR = 4.80, 95% CI: 2.00–11.52, *P* < 0.001), operative time >180 minutes (*P* = 0.07), and rectal tumor location (*P* = 0.09) as potential risk factors for severe postoperative complications (*P* < 0.1). Variables with statistical and clinical relevance were included in the multivariate logistic regression model. Age ≥85 years (OR = 4.48, 95% CI:

Table 1 Characteristics of Enrolled Patients

Variables	n (%)
Sex	
Male	101 (59.4)
Female	69 (40.6)
Age, years	
80–85	154 (90.6)
≥85	16 (9.4)
BMI, kg/m ²	
<24	88 (51.8)
≥24	82 (48.2)
ASA category	
II	111 (65.3)
III	59 (34.7)
Comorbidity	122 (71.8)
Hypertension	83 (48.8)
Diabetes mellitus	28 (16.5)
Coronary artery disease	25 (14.7)
Cardiac arrhythmia	32 (18.8)
COPD	23 (13.5)
Cerebrovascular disease	4 (2.4)
Previous abdominal surgery	30 (17.6)
Preoperative partial bowel obstruction	28 (16.5)
Tumor location	
Colon	85 (50)
Rectum	85 (50)

Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease; ALB, albumin; HGB, hemoglobin.

Table 2 Details of Postoperative Complications of Enrolled Patients (Clavien–Dindo ≥ III)

Complication (Clavien–Dindo ≥ III)	n (%)
Total ^a	26 (15.3)
Cardiovascular complications	
Shock	1 (0.6)
Heart failure	2 (1.2)
Myocardial infarction	1 (0.6)
Atrial fibrillation	1 (0.6)
Respiratory complications	
Pneumonia	5 (2.9)
Respiratory failure	1 (0.6)
Gastrointestinal complications	
Anastomotic leak	7 (4.1)
Anastomotic bleeding	1 (0.6)
Ileus	2 (1.2)
Gastroparesis	3 (1.8)
Wound complications	2 (1.2)
Urinary complications	2 (1.2)
Hernia	2 (1.2)
Mortality	2 (1.2)

Note: ^aMore than 1 complication could have occurred per patient.

Table 3 Risk Factors Associated with Postoperative Complications (Clavien–Dindo $\geq$ III)

Variables	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	p value	OR (95% CI)	p value
Sex (Male vs Female)	1.65 (0.68–4.05)	0.27		
Age (≥ 85 vs 80–85 years)	4.02 (1.32–12.27)	0.02	4.48 (1.27–15.79)	0.02
BMI (≥ 24 vs < 24 kg/m ²)	0.91 (0.39–2.09)	0.82		
ASA (III vs II)	0.47 (0.20–1.09)	0.08	2.49 (0.98–6.35)	0.06
Comorbidity	1.37 (0.52–3.66)	0.53		
Prior abdominal surgery	0.83 (0.26–2.60)	0.74		
Preoperative partial bowel obstruction	1.66 (0.60–4.61)	0.33		
Tumor location (Rectum vs Colon)	2.11 (0.88–5.05)	0.09		
Tumor size (≥ 5 vs < 5 cm)	1.38 (0.59–3.23)	0.46		
Stage (III vs I–II)	0.45 (0.17–1.18)	0.10		
Operative time (> 180 vs ≤ 180 min)	2.28 (0.94–5.52)	0.07		
Estimated blood loss (> 100 vs ≤ 100 mL)	4.80 (2.00–11.52)	< 0.001	4.53 (1.75–11.70)	< 0.01
ALB (< 35 vs ≥ 35 g/L)	1.36 (0.42–4.42)	0.61		
HGB (≥ 120 vs < 120 g/L)	3.36 (1.42–7.96)	0.01	2.56 (0.99–6.60)	0.05

Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists; ALB, albumin; HGB, hemoglobin; CI, confidence interval; OR, odds ratio.

1.27–15.79, $P = 0.02$) and estimated blood loss > 100 mL (OR = 4.53, 95% CI: 1.75–11.70, $P < 0.01$) were identified as independent risk factors. Preoperative hemoglobin < 120 g/L (OR = 2.56, 95% CI: 0.99–6.60, $P = 0.05$) and ASA class III (OR = 2.49, 95% CI: 0.98–6.35, $P = 0.06$) showed borderline significance. Details are presented in [Table 3](#).

Discussion

In this retrospective cohort study of 170 octogenarians undergoing laparoscopic colorectal cancer (CRC) surgery, we found that 15.3% experienced severe postoperative complications (Clavien–Dindo grade $\geq$ III), with gastrointestinal, respiratory, and cardiovascular events being the most common. Multivariate analysis identified age ≥ 85 years and intraoperative blood loss > 100 mL as independent risk factors, while preoperative anemia and ASA class III showed borderline significance.

Our findings align with previous studies reporting increased postoperative morbidity in elderly CRC patients. Oh et al¹⁵ demonstrated that octogenarians undergoing colorectal surgery had higher complication rates compared to younger cohorts, although long-term survival remained acceptable. Similarly, Utsumi et al¹⁶ identified age and intraoperative blood loss as significant predictors of adverse outcomes in a matched cohort study of laparoscopic CRC surgeries in patients aged ≥ 80 years.

The 15.3% incidence of severe complications in our cohort is comparable to prior reports, which range from 10% to 25% in octogenarians undergoing laparoscopic CRC surgery.^{17–19} Notably, gastrointestinal complications were the most frequent in our study, consistent with findings from recent systematic reviews,²⁰ which highlight the increased susceptibility of elderly patients to anastomotic leaks and ileus due to impaired tissue perfusion and delayed recovery.

Age ≥ 85 years emerged as a strong independent predictor of severe complications, underscoring the importance of physiological reserve in surgical tolerance.²¹ While age alone should not preclude surgery, it remains a surrogate marker for frailty and diminished organ function. Preoperative anemia, reflected by hemoglobin < 120 g/L, also showed a trend toward increased risk, consistent with evidence linking anemia to impaired wound healing and increased infection risk.²² Although preoperative anemia is routinely evaluated and corrected when appropriate in our center, full optimization is not always feasible in elderly patients requiring timely colorectal cancer surgery. Consequently, low hemoglobin levels may still persist at the time of operation and contribute to increased postoperative risk.

Intraoperative blood loss > 100 mL was another independent risk factor, highlighting the importance of meticulous hemostasis in elderly patients. Excessive blood loss may exacerbate hemodynamic instability and compromise postoperative recovery, particularly in those with limited cardiopulmonary reserve.²³ In our cohort, excessive bleeding was

generally related to technical difficulty—such as adhesions, fragile mesenteric vessels, or challenging pelvic dissection—rather than tumor stage alone. ASA class III, though not statistically significant, demonstrated a borderline association with complications, suggesting that global functional status remains a relevant consideration in preoperative risk stratification. Rectal cancer also showed a trend toward a higher risk of severe postoperative complications compared with colonic cancer (OR 2.11), although this association did not reach statistical significance, likely due to the limited number of events and the inherent complexity of pelvic surgery in elderly patients.

Nevertheless, this study has several limitations. The retrospective, single-center design may limit the generalizability of the findings. Although the cohort is relatively large for octogenarians undergoing laparoscopic colorectal cancer surgery, the sample size may still be insufficient to detect modest associations. Frailty indices and comprehensive geriatric assessments were not included, which may better reflect physiological vulnerability than chronological age alone. Only two patients received a diverting stoma, and the very small number precluded meaningful statistical evaluation; moreover, stoma formation represents a preventive surgical strategy rather than a patient-related risk factor, and was therefore not incorporated into the multivariate analysis. In addition, right-sided, left-sided, and rectal resections were analyzed collectively. This approach reflects real-world clinical practice in very elderly patients, and the limited sample size and low number of severe complications did not allow reliable subgroup analyses.

Conclusion

In octogenarians undergoing laparoscopic colorectal cancer surgery, severe postoperative complications occurred in 15.3% of patients, with gastrointestinal, respiratory, and cardiovascular events being the most common. Age ≥ 85 years and intraoperative blood loss >100 mL were identified as independent risk factors, while preoperative anemia and ASA class III showed borderline significance.

Data Sharing Statement

The database is available if properly requested and can be directly addressed to the corresponding author's Email address.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Ethics Committee of the Cancer Hospital, Chinese Academy of Medical Sciences (approval number: NCC 2017-YZ-026). All patients provided written informed consent. This study was conducted in accordance with the Declaration of Helsinki.

Acknowledgments

We would like to thank the Department of Colorectal Surgery at the Cancer Hospital, Chinese Academy of Medical Sciences, for their support in data collection and clinical coordination.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This work was supported by the CAMS Innovation Fund for Medical Sciences (CIFMS), Grant No. 2025-I2M-C&T-B-061.

Disclosure

The authors report no conflicts of interest in this work.

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