

Colorectal Cancer: Post-operative Complications and Their Risk Factors

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Abstract. *Background.* Colorectal cancer is one of the most common cancers in the world, and surgery remains the only curative treatment. However, post-operative complications impact patients' outcomes and quality of life. Identifying risk factors for these complications is essential for improving surgical outcomes and patient safety. *Methods.* We conducted a retrospective study of 277 patients who underwent CRC surgery at the Hospital of Lithuanian University of Health Sciences Kauno Klinikos between January 1 and December 31, 2023. Data were collected on demographic, clinical, and surgical variables. Statistical analyses were performed using IBM SPSS software and included univariate and multivariate logistic regression to identify independent risk factors for postoperative complications. *Results.* The overall postoperative complication rate was 22.7%, with anastomotic leakage being the most common complication (8.2%). Logistic regression analysis identified older age as the only statistically significant independent risk factor for postoperative complications ($p = 0.016$). While urgent surgery and intra-operative complications showed strong associations with increased risk, these were not statistically significant in multivariate analysis. *Conclusion.* Our study highlights older age as a critical risk factor for postoperative complications in CRC surgery. Although the study is limited by its retrospective design and single-center sample, it provides valuable insights for improving patient outcomes.

Keywords: colorectal cancer, postoperative complications, anastomosis leakage.

Introduction

Colorectal cancer (CRC) is the third most common cancer worldwide, with some studies estimating that its burden will rise to 3.2 million new cases and 1.6 million deaths annually by 2040, predominantly in countries with a high or very high Human Development Index, such as Lithuania [1].

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Complete resection remains the only curative treatment, with procedures ranging from minimally invasive laparoscopic techniques to more extensive open resections. Even with recent advances in surgical technologies and neoadjuvant treatment regimens, there has been little improvement in the overall postoperative complication rate, which remains at around 30% [2].

The prevalence of these complications has shown discrepancies depending on demographic factors and surgical variables, including the complexity of the procedure and the experience of the surgeon, among other factors [2].

Postoperative complications may include infections, anastomotic leaks, hemorrhage etc. These complications have an obvious impact on immediate patient recovery; they also contribute to worsening life quality and prolong hospitalization time, creating financial burdens. Moreover, studies show that postoperative complications are associated with increased morbidity and risk of recurrence [3, 4].

Given the complex and multifaceted nature of postoperative complications, a thorough understanding of associated risk factors is essential. This knowledge not only aids in risk stratification but also informs pre-operative planning and postoperative care, ultimately aiming to enhance patient safety and improve surgical outcomes in the context of colorectal cancer treatment.

With this study we seek to advance our understanding of the risk factors for postoperative complications following CRC surgery. While previous research has explored these factors, the projected rise in CRC cases, evolving patient demographics, and advancements in treatment techniques highlights the need to update and advance our knowledge on this critical subject. Furthermore, to the best of our knowledge, no recent studies have investigated these risk factors based on findings from one of Lithuania's largest medical centres, the LSMU Kauno Klinikos.

Patients and Methods

We performed a retrospective review of medical records of patients who underwent surgical treatment of colorectal cancer from January 1, 2023, to December 31, 2023, at the Hospital of Lithuanian University of Health Sciences (LSMU) Kauno Klinikos. The study included patients older than 18 years with a colorectal cancer diagnosis (ICD codes C18, C19, and C20). Patients with metastases were excluded, as well as cases where procedures were performed for other reasons (e.g., colostomy closure, intussusception, or bowel obstruction). Finally, 277 patients were included in the analysis.

The pre-surgical variables were as follows: sex, age, body mass index (BMI), comorbidities, American Society of Anesthesiologists (ASA) score (I–IV), tumor localization (classified as colon [cecum to rectosigmoid colon] or rectum), and whether neoadjuvant treatment was administered. The surgical variables included whether the intervention was urgent, surgical approach (laparoscopic or open), operation type (resection with an anastomosis or obstructive type), operation time in minutes, whether the procedure was performed by a specialist proctologist, and whether any intraoperative complications were observed.

Postoperative complications with Clavien-Dindo Grade 1 or higher were included. Recorded in-hospital postoperative complications were: anastomotic leakage, hemorrhage, intra-abdominal abscess, wound infection, unverified intra-abdominal infection, and others. Data about the length of hospital stay, repeated hospitalization, and in-hospital death were also included in the study.

Statistical analyses were performed using IBM SPSS software. Univariate and multivariate binary logistic regression analysis was performed to identify independent variables for postoperative complications. Data were presented as an odds ratio (OR) with a 95% confidence interval. Variables with a p-value <0.3 in univariate analysis were included in the multivariable analysis. All p-values <0.05 were considered significant.

Table 1. Sociodemographic characteristics and procedure statistics and postoperative complications of patients who underwent CRC surgery in LSMU Kaunas Clinics at 2023

Gender n (%):		
Female		145 (52.3)
Male		132 (47.7)
Total		277
Age, years		67.57±11.756
BMI, kg/m²		27.15±5.28
Comorbidities n (%):		
Yes		189 (68.2)
No		88 (31.8)
ASA class n (%):		
1		0 (0)
2		48 (17.3)
3		202 (73)
4		27 (9.7)
5		0 (0)
Tumor location n (%):		
Colon		181 (65.3)
Rectum		96 (34.7)
Neoadjuvant treatment n (%):		
Prescribed		58 (20.9)
Colon		8 (13.8)
Rectum		50 (86.2)
Not prescribed		219 (79.1)
Urgency of the operation n (%):		
Urgent		37 (13.4)
Scheduled		240 (86.6)
Type of surgery performed n (%):		
Open surgery		198 (71.5)
Laparoscopic surgery		79 (28.5)
Conversion from laparoscopy to laparotomy n (%):		
Yes		15 (19)
No		64 (81)
Total		79 (100)
Type of surgery n (%):		
Resection with anastomosis		182 (65.7)
Obstructive type		95 (34.3)
Operation time, minutes		198.17±62.862
Postoperative complications n (%):		
Present		63 (22.7)
Absent		214 (77.3)
Complications n (%):	Intraoperative complications:	
	Present	7 (2.5)
	Absent	270 (97.5)
	Joint leakage:	
	Present	15 (8.2)
	After colon surgery	6 (40)
After rectal surgery	9 (60)	
Absent	167 (91.8)	
Total	182 (100)	

	Bleeding: Present Absent	10 (3.6) 267 (96.4)
	Intra-abdominal abscess: Present Absent	10 (3.6) 267 (96.4)
	Intestinal obstruction: Present Absent	7 (2.5) 270 (97.5)
	Wound infection: Present Absent	8 (2.9) 269 (97.1)
	Unverified intra-abdominal infection: Present Absent	10 (3.6) 267 (96.4)
	Damage to anatomical structures: Present Absent	2 (0.7) 275 (99.3)
	Other: Present Absent	1 (0.35) 276 (99.65)
Number of bed days, days		10.55±6.241
Re-hospitalization within 30 days n (%):		
	Yes	14 (5.1)
	No	259 (94.9)
	Total	273
Died in hospital n (%):		
	Yes	5 (1.8)
	No	272 (98.2)
T		
0 (complete response achieved after neoadjuvant therapy)		
	is	2 (0.7)
	1	23 (8.3)
	2	43 (15.5)
	3	168 (60.7)
	4	28 (10.1)
Other (complete response achieved after treatment; tumor spread)		13 (4.7)
N		
0 (complete response achieved after neoadjuvant therapy)		
	0	165 (59.6)
	1	72 (26.0)
	2	27 (9.7)
Other (complete response achieved after treatment; tumor spread)		13 (4.7)

Table 2. Univariate binary logistic regression analysis to assess the chance of developing postoperative complications

Variable	Univariate binary logistic regression analysis			Multivariate binary logistic regression analysis		
	OR	95% CI	p value	OR	95% CI	p value
Male Gender	1.278	0.728–2.243	0.393			
Age, years	0.970	0.947–0.993	0.011	0.971	0.948–0.994	0.016
BMI, kg/m ²	1.003	0.948–1.061	0.917			
Comorbidities	0.759	0.421–1.368	0.359			
Diabetes	1.307	0.595–2.871	0.505			
Pulmonary diseases	1.759	0.578–5.349	0.320			
Psychiatric illnesses	1.964	0.633–6.087	0.242			
ASA class	1.242	0.717–2.151	0.440			
Colon tumor	1.079	0.596–1.955	0.802			
Neoadjuvant treatment	0.859	0.423–1.745	0.675			
Emergency surgery	2.058	0.979–4.329	0.057	1.723	0.774–3.835	0.183
Open surgery	1.226	0.647–2.322	0.533			
Intraoperative complications	2.625	0.215–2.625	0.215			
Operation time, minutes	1.002	0.998–1.007	0.308			
Operating surgeon – Coloproctologist	0.481	0.192–1.206	0.119	0.616	0.229–1.658	0.338

Results

Sociodemographic Characteristics. Table 1 shows the sociodemographic characteristics of 277 patients. The study population included 145 (52.3%) female and 132 (47.7%) male patients, with a mean age of 67.57 ± 11.76 years. The BMI averaged 27.15 ± 5.2 , and 68.2% of patients had comorbidities. Tumor localization was predominantly in the colon (181 patients, 65.3%), while 96 (34.7%) had rectal cancer.

Procedure Statistics. As shown in Table 1, 37 (13.4%) patients underwent emergency surgery. Of the total procedures, 198 (71.5%) were open surgeries, while 79 (28.5%) were laparoscopic treatments. Among the laparoscopic cases, 15 were converted to laparotomy. Operation types varied, with 182 (65.7%) being resections with anastomosis and 95 (34.3%) being obstructive-type operations. Intraoperative complications were reported in 7 cases.

Postoperative Complications. Table 1 also summarizes the postoperative complications. The overall postoperative complication rate was 22.7% ($n = 63$). The most common complication was anastomotic leakage ($n = 15$), which was more frequent after rectal cancer surgery. Other common complications included hemorrhage, intra-abdominal abscess, and unverified intra-abdominal infection, each observed in 10 cases.

Patients were hospitalized for an average of 10.55 ± 6.24 days. Within 30 days post-discharge, 14 (5.1%) patients were rehospitalized, and 5 patients died during their hospital stay.

Univariable logistic analysis revealed that urgent operations and reported intraoperative complications had the highest odds ratios for developing postoperative complications (OR 2.058, CI 0.979–4.329, $p = 0.057$; OR 2.625, CI 0.215–2.625, $p = 0.215$, respectively). Procedures performed by coloproctologists showed reduced odds of complications (OR 0.481, CI 0.192–1.206, $p = 0.119$).

Variables included in the multivariable analysis were age, urgent operations, and procedures performed by coloproctologists. Age was the only statistically significant independent risk factor in both univariable and multivariable logistic regression analyses, with p-values of 0.011 and 0.016, respectively.

Discussion

This study examined the risk factors associated with postoperative complications following curative CRC surgery, based on data collected over the course of one year at a single center.

The overall postoperative complication rate of 22.7% highlights the high-risk nature of colorectal surgery. However, this rate is lower than the complication rates reported in other studies [2, 3]. In this study, anastomotic leakage was the most common complication, recorded in 8.2% of cases, with 6 cases following rectal cancer surgery and 9 following colon cancer surgery.

Similar occurrence rates have been reported in previous research [5]. A recent meta-analysis involving 154 981 patients found that anastomotic leakage has significant negative impacts on disease-free survival, overall survival, local recurrence, and overall recurrence [5, 6]. Therefore, AL remain one of the most severe and feared postoperative complications and pre- and intra-operative decisions about whether to perform an anastomosis or a stoma remains difficult.

Our analysis identified age as the only statistically significant risk factor for postoperative complications following CRC surgery in both univariable and multivariable logistic regression models. Managing CRC in older adults demands careful consideration of the effects of aging on comorbidities, functional and cognitive status, and socioeconomic factors. Recent recommendations emphasize the use of geriatric assessment tools such as the G8 and comprehensive geriatric assessment (CGA) to optimize care. Multidisciplinary collaboration between oncology and geriatric specialists is also critical to delivering personalized treatment plans [7]. However, older adults remain underrepresented or excluded from clinical trials, underscoring the urgent need to include this population in future CRC studies to enhance evidence-based management in this rapidly evolving field.

While urgent surgeries and intraoperative complications were not statistically significant predictors in the multivariable analysis, their strong correlations with complication rates suggest clinical relevance. This finding aligns with previous studies. previous studies [8]. Notably, though not statistically significant, surgeries performed by coloproctologists showed reduced odds of complications (OR 0.481). However, the variability in results (95% CI 0.192–1.206) likely reflects the small sample size.

This study provides valuable insights into risk factors associated with postoperative complications in CRC surgery by examining a broad range of potential predictors. However, several limitations should be considered when interpreting these findings. First, the retrospective design of the study may introduce biases inherent in the use of previously collected data, including potential inaccuracies or inconsistencies in medical records. Second, the sample size, drawn from a single institution, limits the generalizability of the results and reduces statistical power to detect associations, especially for less common risk factors or subtle effects.

Larger, multi-center studies with prospective designs and long-term follow-up are needed to validate these findings and explore risk factors for complications after CRC surgery with greater precision. Future research should focus on enhancing preoperative assessment methods to better predict surgical outcomes, particularly for high-risk populations such as elderly patients and those undergoing urgent or complex surgeries.

Recent observations suggest that the number of CRC cases will continue to rise globally [1], with surgery remaining the only curative treatment. Our findings demonstrate that older age is a key independent risk factor for postoperative complications. Given the growing number of elderly patients undergoing CRC surgery, future studies should investigate additional variables contributing to complications in this population.

Targeted preoperative strategies, such as optimizing comorbid conditions and incorporating geriatric assessments, may improve outcomes in these high-risk patients.

Conclusion

Colorectal cancer is an ever-growing in the modern world, surgery remains the only curative treatment for this condition. This study investigated the risk factors for post-operative complications following colorectal cancer (CRC) surgery, analyzing data from a single institution over a one-year period. The overall complication rate of 22.7%, among the observed complications, anastomotic leakage was the most common. Univariable and multivariable analysis suggest age as an only statistically significant risk factor for post operative complications. These findings provide valuable insights into risk factors for colorectal cancer surgical complications and underscore the need for targeted pre-operative and intra-operative strategies, particularly for older and high-risk patients.

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