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RISK FACTORS FOR THE OCCURRENCE OF POSTOPERATIVE COMPLICATIONS IN COLECTOMIZED PATIENTS FOR THE TREATMENT OF COLORECTAL CANCER: A CASE-CONTROL STUDY

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Abstract

Introduction: Colorectal neoplasia is the most common cancer of the gastrointestinal tract, and surgery is the gold standard for its treatment in cases of resectable, non-metastatic cancer. Many comorbidities and complications are associated with patients undergoing colectomy for cancer treatment. **Objective:** To understand the comorbidities and complications in patients who underwent colectomy for colorectal cancer treatment. **Materials and Methods:** This is a case-control study conducted through electronic medical records of patients undergoing surgery for colorectal cancer treatment at Hospital São José do Avaí (Itaperuna, Rio de Janeiro) over a period of 10 years (January 2010 to December 2020). Cases included colectomized patients who experienced postoperative complications, and controls were those without complications. Study data were stored in an Excel spreadsheet and processed using SPSS Statistics 26. Chi-square tests were performed for bivariate analysis, and variables with $p > 0.3$ proceeded to multivariate analysis. **Results:** The age range of the 203 colectomized patients analyzed was 53 to 74 years and was not statistically significant for complication occurrence ($p = 0.881$). Of all patients, 47.5% were men and 52.2% were women; gender was not statistically significant for complication occurrence ($p = 0.455$). The main surgical techniques used were rectosigmoidectomy (43.4%), right colectomy (25.0%), and left colectomy (21.9%). The most observed post-colectomy complications were anastomotic fistula (8.9%), abscess (6.9%), and complications related to protective colostomy and ileostomy (4.4%). Among the analyzed risk factors, previous surgery (OR = 2.6; CI = 1.2-5.4; $p = 0.000$),

radiotherapy (OR = 6.5; CI = 2.5-16.6; p = 0.000), and chemotherapy (OR = 6.059; CI = 2.5-14.6; p = 0.009) showed statistically significant differences for complication occurrence. **Conclusion:** Previous surgery, chemotherapy, and radiotherapy demonstrated influence on the occurrence of complications after colectomy in patients with colorectal cancer.

Keywords: Colectomy, Laparoscopy, Postoperative intra-abdominal complications

Introduction

The colon is affected by many diseases, such as Crohn's Disease, Upper Gastrointestinal Bleeding, Diverticular Disease, Megacolon, Intestinal Polyps, Colorectal Cancer, and various forms of colitis. Many of these diseases are amenable to surgery, and partial or total colectomies are a therapeutic option for treating these pathologies in certain situations[1].

The fundamental principle of laparoscopic colectomy is the same as conventional laparotomy; however, the accesses used to enter the abdominal cavity are different. Thus, the principles are[1]: (i) extensive resections of the tumor and potentially involved structures; and (ii) resections of vascular and lymphatic elements; and (iii) preventive measures to prevent the diffusion or implantation of tumor cells. However, patients may occasionally experience postoperative complications due to various factors. In the United States, approximately 320,000 colectomies are performed annually[2], and multicenter and single-center studies[3] have found complication rates of 26% and reoperation rates of 11.2%.

Many postoperative complications can occur due to colectomies, such as intra-abdominal abscess[4], anastomotic fistulas[5], hemorrhage[6], evisceration, anastomotic dehiscence[7], abdominal wall infection, hematoma formation, and complications related to protective colostomy and ileostomy. Numerous risk factors leading to complications include gender, age, smoking, diabetes, and the urgency of surgery, among others. Recently, Yamamoto et al[8]. reported overall morbidity, intra-abdominal septic complications, and

anastomotic fistula rates of 24%, 12%, and 8%, respectively, after ileocolonic resection for Crohn's Disease in seven referral centers in Japan, Brazil, and Italy.

Thus, there is a need for an observational study that contributes to identifying the incidence, prevalence, and impact of risk factors on the occurrence of postoperative complications. Based on this data, it will be possible to implement risk management measures, preventing them when factors are modifiable or mitigating them, and consequently improving the quality of life and survival rates of patients.

Methods

This was an observational study, a retrospective cohort type, conducted at a single center (Hospital São José do Avaí, Itaperuna, Rio de Janeiro, Brazil). Patients undergoing colectomy for the treatment of benign and malignant colonic diseases from January 1, 2010, to December 31, 2020, at Hospital São José do Avaí, were included in the study.

Inclusion criteria: Patients undergoing colectomy by laparoscopy or laparotomy (abdominal rectosigmoidectomy, sigmoidectomy, left and right hemicolectomies, total colectomy, subtotal colectomy, anterior rectal resection) for the treatment of benign and malignant diseases. Patients undergoing mechanical anastomosis in elective or emergency surgery. Patients undergoing primary anastomosis.

Exclusion criteria: Patients undergoing surgical techniques other than those mentioned above and operated by low-experience surgeons. Patients undergoing manual anastomosis. Patients with terminal colostomy and ileostomy.

Surgeons with fewer than 50 cases of laparoscopic colectomy were excluded from the study due to insufficient experience[9], as well as those performing less than 2 laparoscopic colectomies weekly.

Patients were followed up postoperatively at 3, 7, 15, 30, 90, and 180 days in the medical office. If any significant changes were noted, the patient was admitted to Hospital São José do Avaí. Data will be collected through the analysis of electronic medical records containing information regarding hospitalizations, examinations, and consultations.

The postoperative complications evaluated will include: intra-abdominal abscess, anastomotic fistulas, hemorrhage, evisceration, anastomotic dehiscence, abdominal wall infection, hematoma formation, and complications related to protective colostomy and ileostomy.

Risks: There was a risk of breach of confidentiality and leakage of patient information, despite taking all necessary precautions to prevent such incidents. Patient names were replaced with numbers to reduce the risk of information leakage. Only the responsible researcher had access to the names.

Ethical aspects: Patients were contacted via telephone. They were informed about the study, given the opportunity to ask questions, and asked to complete the Informed Consent Form (ICF) for the use of patient data. If the patient had already passed away, the signature of the responsible family member will be requested. In the case of patients or family members who are not literate, the consent will be obtained through the imprint of the right thumb.

Statistical Analysis: After data collection, the information was organized in spreadsheets using the Microsoft Excel program, followed by a descriptive statistical analysis of absolute and relative frequencies represented through tables and graphs. Patients without postoperative complications were compared to those who experienced postoperative complications. Univariate analyses were conducted for risk factors related to complications. Factors with $p < 0.3$ were subjected to multivariate analysis, along with those identified as important in the literature, with the calculation of Odds Ratios (OR) for the selected

characteristics. For the multivariate analysis, odds ratios for the occurrence of postoperative complications with $p < 0.05$ and a 95% confidence interval (CI) were considered statistically significant. The chi-square test was employed for univariate analysis, and the Mann-Whitney test for multivariate analysis. Data were processed using SPSS software version 1.0.0.1406.

Results

The age range of the 203 colectomy patients analyzed was 53 to 74 years and was not statistically significant for the occurrence of complications ($p = 0.881$). In the studied population, 47.5% were men, and 52.5% were women; gender was not statistically significant for the occurrence of complications ($p = 0.455$) (TABLE 1). Regarding the risk factors, the three most observed were previous surgery, smoking, and Diabetes Mellitus, while the three least observed were ASA ¾, pulmonary disease, and urgent surgery (TABLE 1).

Table 1. Characteristics of the study population

Preoperative data	
Variable	Data
Age, years (median)	53,9-74,6
Gender	
Masculine	47,48% (97)
Feminine	52,22% (106)
Risk Factors	
Smoking	14,8% (30)
Chemotherapy	12,3% (25)

Radiotherapy	10,8% (22)
Previous Surgery	24,1% (49)
Diabetes Mellitus	12,8% (26)
Pulmonary Disease	4,4% (9)
ASA 3/4	3,5% (7)
CPOD	4,9% (10)
Coronary Disease	7,4% (15)
Renal Disease	6,4% (13)
Urgency Surgery	4,4% (9)
Alcoholism	9,9% (20)

The main surgical techniques used were rectosigmoidectomy (43.4%), right colectomy (25.0%) and left colectomy (21.9%). The most common post-colectomy complications were anastomotic leak (8.9%), abscess (6.9%) and complications related to colostomy and protective ileostomy (4.4%) (TABLE 2).

Table 2. Type of Surgery and Complications in the study population

Operative Data	
Variable	Data
Type of Surgery	
Rectosigmoidectomy	43,3% (88)
Sigmoidectomy	1% (2)
Right colectomy	25% (51)
Transversectomy	1% (2)

Left colectomy	21,2% (43)
Total colectomy	2,5% (5)
Subtotal colectomy	0,5% (1)
Left colectomy plus rectosigmoidectomy	2,5% (5)
Anterior rectal resection	2,0% (4)
Not identified	1% (2)
Complication	
Anastomotic fistulas	8,9% (18)
Abscess	6,9% (14)
Bleeding	1% (2)
Evisceration	1% (2)
Dehiscence	2,5% (5)
Abdominal wall infection	1,5% (3)
Bruise	0,5% (1)
Complications related to colostomy and protective ileostomy	4,4% (9)

In the univariate analysis, previous surgery (OR = 2.62; CI = 1.25-5.49; p = 0.009), radiotherapy (OR = 6.55; CI = 2.58-16.63; p = 0.000) and chemotherapy (OR = 6.05; CI = 2.50-14.68; p = 0.000) showed a statistically significant difference in the occurrence of complications (TABLE 3).

Table 3. Univariate Analysis for risk factors associated to complications post-colectomy

	No complication		Complicated		
Variable	n = 163	0,80	n= 40	0,20	*p*
Age, years, IQR	64	53-74	64	53-74	0,881
Gender					0,455
Masculine	80	39,4%	17	8,4%	
Feminine	83	40,8%	23	11,3%	
Smoking					0,588
No	140	68,9%	33	16,3%	
Yes	23	11,3%	7	3,4%	
Chemotherapy					0
No	151	74,3%	27	13,3%	
Yes	12	5,9%	13	6,4%	
Radiotherapy					0
No	153	75,3%	28	13,8%	
Yes	10	4,9%	12	5,9%	
Previous Surgery					0,009
No	130	64%	21	11,8%	
Yes	33	16,2%	16	7,9%	
Diabetes Mellitus					0,129
No	145	71,4%	32	15,8%	
Yes	18	8,8%	8	3,9%	
Pulmonary Disease					0,056

No	158	77,8%	36	17,7%	
Yes	5	3,9%	4	2,0%	
ASA 3 e 4					0,117
No	159	78,3%	37	18,2%	
Yes	4	1,9%	3	1,5%	
CPOD					0,981
No	155	76,3%	38	18,7%	
Yes	8	3,9%	2	1,0%	
Coronary Disease					0,976
No	151	74,3%	37	18,2%	
Yes	12	5,9%	3	1,5%	
Renal Disease					0,686
No	152	74,8%	38	18,7%	
Yes	11	5,4%	2	1,0%	
Urgency Surgery					0,293
No	157	77,3%	37	18,2%	
Yes	6	2,9%	3	1,5%	
Alcoholism					0,070
No	150	73,8%	33	16,3%	
Yes	13	6,4%	7	3,4%	

Of the risk factors included in the multivariate analysis, Chemotherapy (OR = 6,05; CI = 2,5-14,68; p = 0.000), Radiotherapy (OR = 6,55; CI = 2,58-16,63; p = 0.000) and Previous

Surgery (OR = 2,62; CI = 1.25-5.49; p = 0.009) showed statistical significance for occurrence of complications post-colectomy (TABLE 4).

Table 4. Multivariate Analysis for risk factor associated to complications post-colectomy

Risk Factors	OR	(IC 95%)	*p*
Chemotherapy	6,05	(2,50-14,68)	0,000
Radiotherapy	6,55	(2,58-16,63)	0,000
Previous Surgery	2,62	(1,25-5,49)	0,009
Diabetes Mellitus	2,01	(0,80-5,03)	0,130
Pulmonary Disease	3,51	(0,89-13,73)	0,570
ASA 3 e 4	3,22	(0,69-15,02)	0,118
Urgency Surgery	2,12	(0,50-8,87)	0,294
Alcoholism	2,44	(0,90-6,60)	0,710

Discussion

Our demographic findings corroborate other research that found that individuals in low-volume institutions tend to be older and may exhibit a higher prevalence of comorbidities compared to participants in international trials. In several multicenter trials, the proportion of patients classified as ASA III and IV has ranged from 18% to 40%[3]. Contrarily, in our dataset, such patients accounted for 3,4% of the total. While other studies found a median age of 68 years[3], 40.7 years[4], 64,5 years[5], 52 years[6], 70,8 years[7], 33 years[8] and 67 years[9], ours found a median of 64. Gender was not found to be a risk factor for complications post-colectomy (p-valor = 0,455), as were not found in other studies[4, 7, 8].

Through our multivariate analysis, we found that the independent risk factors for the occurrence of post-colectomy complications are: chemotherapy, radiotherapy and previous

surgery. This finding is in line with the results of a meta-analysis published in 2022 that evaluated the risk for anastomotic leakage[11], however, it is possible to find studies that claim the opposite[5].

Huang *et al.* did a systematic review of observational studies that explored the risk factors associated with postoperative intra abdominal septic complications following surgery for Crohn's disease. It included 15 studies and also found history of previous surgery (OR 1.50, 95% CI 1.15–1.97) as risk factors for postoperative complications.[12]

In a retrospective analysis, Oliphant et al. found that patients who underwent chemotherapy had significantly poorer short-term stoma function scores than those who underwent surgery alone[13]. Common gastrointestinal side effects of chemotherapy, such as mucosal ulceration, diarrhea, and constipation, are typically observed in the initial weeks of treatment[14]. These findings in accordance with our research strengthen its results.

In meta-analysis suggested that nRT may increase the risk of AL, wound infection, and pelvic abscess compared to upfront surgery among patients with rectal cancer[15]. One potential explanation could be that the exacerbation of local tissue fibrosis, edema, and inflammatory reactions in the pelvic radiation area alters the typical anatomical plane, posing challenges in achieving standard Total Mesorectal Excision surgery and complete resection.

Our results indicated an elevated rate of intra-abdominal surgical complications in association with prior abdominal surgery. Previous surgical procedures could increase the presence of adhesions, thereby complicating the surgical process. While these may not alter the preoperative strategy, understanding a patient's history of previous surgery can be valuable in assessing the risk of complications, especially in cases where there are other risk factors.

Although other studies have found smoking to be a risk factor for complications, this was not our result. The same can be said in relation to diabetes mellitus, lung disease, emergency surgery and alcoholism[11].

Conclusions

In conclusion, this study focusing on the risk factors for complications related to colectomy found that radiotherapy, chemotherapy and previous surgery are independent variables that affect the outcome of the surgery.

The current study faced various limitations. Initially, the collected data might be susceptible to recall bias due to the retrospective design, involvement of multiple health workers.

Author Contributions

Study design: Vinicius Evangelista Dias e Homero Terra Padilha Filho;

Data collection and analysis: Homero Terra Padilha Filho e Paola Pimenta Vieira

Manuscript writing: Homero Terra Padilha Filho e Paola Pimenta Vieira

Manuscript revision and final version: Vinicius Evangelista Dias e Homero Terra Padilha Filho

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Compliance with Ethical Standards

The study was submitted to the Ethics Committee of the Universidade Iguaçu - Campus V/ Itaperuna - UNIG (protocol no. CAAE 54004121.8.0000.5288).

Conflict of Interest The authors declare that they have no conflicts of interest.

Research Involving Human Participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study. The manuscript does not contain any data that could identify the participants.

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