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Recurrence Rates and Postoperative Complications Following Colorectal Cancer Surgery: A 5-Year Study at a Tertiary Care Hospital in Peshawar

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ABSTRACT

Colorectal Cancer (CRC) is a leading cause of cancer related morbidity and mortality in the world. In low- and middle-income countries like Pakistan, delayed diagnosis, lack of access to specialist care, and irregular post-operative surveillance make things worse for a successful outcome. **Objective:** To evaluate the five-year recurrence rates and postoperative complications among patients undergoing colorectal cancer surgery at a tertiary care center in Peshawar, KPK, Pakistan. **Methods:** This retrospective cohort study was carried out in the department of General Surgery, Hayatabad Medical Complex, Peshawar, from March 2020 to February 2025. Patients presenting with metastatic disease at the time of surgery, palliative or bypass procedures, patients with missing follow-up data and patients lost to follow-up within 12 month following surgery were excluded from the study. **Results:** In terms of tumor stage, 14.4% had stage I, 28.5% had stage II, 46.8% had stage III, and 10.3% had stage IV. The majority of the patients (61.5%) underwent open surgery, while 38.5% underwent laparoscopic surgery. Postoperative complications were recorded in 122(39.1%) patients. Anastomotic leakage occurred in 6.7%, while surgical site infections (SSI) were observed in 12.2% of cases. **Conclusions:** A 26.9% recurrence rate and a high burden of postoperative complications were observed among colorectal cancer patients. Advanced stage, open surgery, anastomotic leaks, and older age were significantly associated with increased recurrence risk.

INTRODUCTION

As the third most common cancer (9.7% of all diagnosed cancers) and the second leading cause of cancer-related deaths globally, Colorectal Cancer (CRC) remains one of the most prevalent and fatal tumors [1]. For CRC, especially localized or locally advanced tumor stages, surgery is the cornerstone of curative therapy [2]. Despite significant advancements in surgical technique, perioperative care, and adjuvant medication, postoperative complications and relapse remained a significant therapeutic problem [3]. Depending on the tumor stage, surgical margins, and whether lymph nodes are involved, the 5-year recurrence rate for colorectal cancer following surgical resection has been reported to range from 20-40% globally [4]. The liver and lungs are the most common sites for metastases, and recurrence might be local, regional, or distant [5]. Tumor biology, microsatellite instability, preoperative CEA levels, and the degree of lymphadenectomy are some of the several factors that influence recurrence [6]. In addition to contributing to poor patient outcomes, surgical complications such anastomotic leak, wound infection, and ileus may further raise the chance of recurrence and death [7]. Pakistan has an increasing trend of CRC with

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scarce local surgical outcome data, particularly from under developed regions including Khyber Pakhtunkhwa (KPK) [8]. Some reasons for the poor outcome in this group of patients include sociocultural determinants, and presentation at a late stage, lack of proper screening program, and access to oncology services. National studies have reported variable outcomes, with considerable heterogeneity in recurrence and complication rates, likely attributable to differences in postoperative protocols, patient adherence, and surgical expertise [9, 10].

International guidelines serve as standards for surgical quality and follow-up, but locally-derived data for assessment and improvement for CRC treatment in Pakistan are urgently needed. Few studies have systematically investigated the long-term prognosis of surgically treated colorectal cancer cases in Peshawar KPK. It is important to understand the pattern of relapse and the profile of postoperative adverse events for surgical planning, resource allotment and long-term monitoring. The aim of this study was to determine the recurrence rate of colorectal carcinoma, as well as the surgical morbidity and mortality among the patients operated for colorectal cancer during the last five years.

METHODS

This retrospective cohort study was carried out in the Department of General Surgery, Hayatabad Medical Complex, Peshawar, from March 2020 to February 2025. Patients who were at least 18 years old who underwent curative-intent surgery for histologically certified colorectal adenocarcinoma during the study period were enrolled. Patients presenting with metastatic disease at the time of surgery, palliative or bypass procedures, patients with missing follow-up data and patients lost to follow-up within 12 month following surgery were excluded from the study. Patients who had systemic or metachronous cancer were also excluded. The sample size was calculated using the standard formula for estimating proportions in cohort studies: Assuming a 95% confidence level (Z = 1.96), and an expected recurrence rate (P) of 25%, and a 5% margin of error (d = 0.05), the minimum required sample size was 288 patients [11]. To account for potential exclusions, incomplete records, and loss to follow-up, a slightly larger sample of 312 patient were included. All data were obtained retrospectively from medical records, operation notes, and follow-up clinic visits. Demographic and clinical information (age, sex, tumor location, TNM staging, histopathological grade and surgical related factors (type of resection, surgical approach and operation time, etc.) were collected. Postoperative morbidity was classified using the Clavien-Dindo classification system, where:

- Grade I–II were considered minor complications,
- Grade III–V were considered major complications.

Complications which were specifically analyzed included anastomotic leaks, Surgical Site Infection (SSI), wound dehiscence, postoperative ileus, intra-abdominal abscess and thromboembolic events. Tumor recurrence was defined as radiologically or histologically confirmed local, regional, or distant disease occurring after initial curative surgery. Diagnosis was confirmed either clinically or by imaging and/or biopsy. Imaging was conducted through contrast enhanced CT (Siemens SOMATOM Definition Flash) or MRI (GE Signa Explorer 1.5T). Biopsy was performed in certain patients to confirm recurrence histologically. Type of recurrences were noted in forms of presence/abscence, time to recurrence (months to month since surgery) and site of recurrence. The follow-up time for the individual patients was 57 months or until the first event (recurrence or death) was observed. Surveillance was according to institutional guidelines by protocol; it included regular clinical review and regular CEA testing. CEA levels were measured using the Roche Cobas e411 analyzer, via Electrochemiluminescence Immunoassay (ECLIA) method. Serial CEA monitoring was performed every 3 to 6 months as per institutional follow-up protocols. Data were entered and analyzed using SPSS version 25.0. Continuous variables were expressed as means ± standard deviation or medians with interquartile ranges, depending on distribution, while categorical variables were presented as frequencies and percentages. Comparison with categorical variables were analyzed with chi-square, and with continuous variables by independent t-test. Recurrence-free survival was analyzed using Kaplan-Meier survival curves, and predictors of recurrence were identified by Cox proportional hazards regression. Recurrence-Free Survival (RFS) was defined as the time from surgery to the first documented recurrence or death. Overall Survival (OS) was defined as the time from surgery to death from any cause. Patients without recurrence or death were censored at the last known follow-up date. $P \leq 0.05$ was considered to be statistically significant. Ethical approval was obtained from Institutional Review Board before data collection (reference # 1217). As this was a retrospective study, the requirement for individual informed consent was formally waived by the IRB.

RESULTS

The participants' average age was 57.6 years, while 41.7% of the subjects were female and 58.3% were male. The tumors were distributed as follows: rectal tumors (40.7%) and colon cancers (59.3%). In terms of tumor stage, 14.4% had stage I, 28.5% had stage II, 46.8% had stage III, and 10.3% had stage IV. The majority of the patients (61.5%) underwent open surgery, while 38.5% underwent

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laparoscopic surgery. A total of 122 (39.1%) patients experienced at least one postoperative complication following colorectal cancer surgery. The total number of complication events recorded was 141, indicating that some patients experienced more than one type of complication. This results in an event-based complication frequency of 45.2%. The breakdown of individual complications is shown in table-1

Table 1: Demographic, Tumor, Surgical, and Postoperative characteristics of the study population

Variables	Frequency (%)
Mean Age (Years)	57.6
Gender	
Male	182 (58.3)
Female	130 (41.7)
Tumor Location	
Colon	185 (59.3)
Rectum	127 (40.7)
Tumor Stage	
Stage I	45 (14.4)
Stage II	89 (28.5)
Stage III	146 (46.8)
Stage IV	32 (10.3)
Surgical Approach	
Open Surgery	192 (61.5)
Laparoscopic Surgery	120 (38.5)
Postoperative Complications	
Anastomotic Leak	21 (6.7)
Surgical Site Infection (SSI)	38 (12.2)
Postoperative Ileus	34 (10.9)
Wound Dehiscence	19 (6.1)
Intra-abdominal Abscess	17 (5.4)
DVT/PE	12 (3.8)
Recurrence	
Recurrence Rate	84 (26.9)
Mean Time to Recurrence (months)	18.4

The Kaplan-Meier curve demonstrated a 12-month Recurrence-Free Survival (RFS) of 91.2%, 24-month RFS of 78.5%, 36-month RFS of 65.3%, and a 60-month RFS of 51.8%. The Overall Survival (OS) rates at 12, 24, 36, and 60 months were 95.6%, 867%, 74.9%, and 62.4% respectively. The median overall survival was estimated at approximately 57 months. The overall mortality rate was 69(22.1%). The predominant cause of death was cancer recurrence, 50 (72.5%) patients. Mortality due to surgical complications was observed in 10 (14.5%) patients, while unrelated medical causes were responsible for 9 deaths (13%) table 2.

Table 2: Oncologic outcomes and survival metrics (n = 312)

Variables	Frequency (%)
Recurrence-Free Survival (RFS)	
12-month RFS	285 (91.2)
24-month RFS	245 (78.5)
36-month RFS	204 (65.3)
60-month RFS	162 (51.8)
Overall Survival (OS)	
12-month OS	298 (95.6)
24-month OS	270 (86.7)
36-month OS	234 (74.9)
48-month OS	195 (62.4)
Median Overall Survival	47 months
Overall Mortality	69 (22.1)
Cause of Mortality	
Cancer recurrence	50 (72.5)
Surgical complications	10 (14.5)
Other causes	9 (13.0)

Tumor recurrence was identified in 84 patients, yielding an overall recurrence rate of 26.9%. The mean time to recurrence was 18.4 months (range: 4 to 49 months). Among those with recurrence, Stage III patients had the highest frequency (44 cases), followed by Stage II (18 cases), Stage IV (17 cases), and Stage I (5 cases), as illustrated in the figure below figure 1.

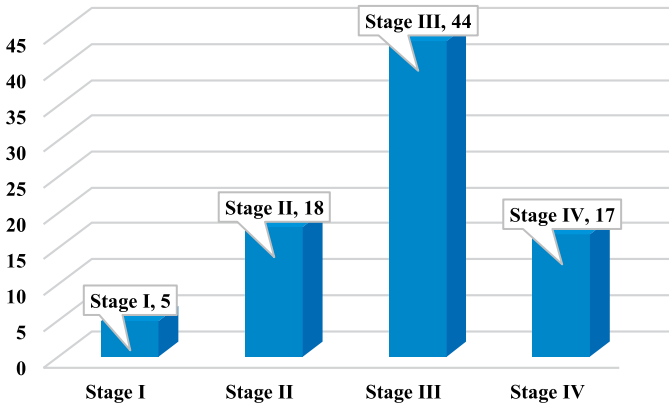

Figure 1: Recurrence Stage Frequency by TNM

Statistical analysis showed a significant association between higher tumor stage and recurrence ($p < 0.001$), and patients with recurrence were notably older than those without ($p = 0.012$). No significant links were found between recurrence and gender or tumor location. Open surgery was associated with higher complication rates ($p = 0.022$). A weak but significant positive correlation was observed between age and time to recurrence ($p = 0.035$), and recurrence-free survival varied significantly across tumor stages ($p < 0.001$) table 3.

Table 3: Association between Clinical Variables and Tumor Recurrence

Variables	Test Used	Test Statistic	p-Value
Age (recurrence vs no recurrence)	t-test	t = 2.52	0.012
Gender vs. Recurrence	Chi-square	$\chi^2 = 1.24$	0.26
Tumor Stage vs. Recurrence	Chi-square	$\chi^2 = 24.8$	<0.001
Tumor Location vs. Recurrence	Chi-square	$\chi^2 = 2.06$	0.15

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Surgical Approach vs. Complication	Chi-square	$\chi^2 = 5.23$	0.022
Anastomotic Leak vs. Recurrence	Chi-square	$\chi^2 = 2.23$	0.14
Age and Time to Recurrence	Pearson Correlation	r = 0.21	0.035
Tumor Stage and RFS	Log-rank test	$\chi^2 = 29.6$	<0.001

Cox regression analysis identified tumor stage, surgical approach, anastomotic leak, and age as independent predictors of recurrence. Advanced-stage disease (Stage III–IV), open surgery, and anastomotic leaks were significantly associated with higher recurrence risk. Additionally, increasing age modestly raised the recurrence risk table 4.

Table 4: Multivariate Cox Proportional Hazards Regression for Predictors of Recurrence

Predictor	Hazard Ratio (HR)	95% Confidence Interval (CI)	p-Value
Stage III–IV (vs I–II)	2.78	1.92 – 4.01	<0.001
Anastomotic Leak	1.89	1.15 – 3.10	0.012
Open Surgery (vs Laparoscopy)	1.52	1.01 – 2.30	0.045
Age (per year increase)	1.03	1.01 – 1.06	0.008

DISCUSSION

These average age of patients was 57.6 years, which is comparable to the average age of Western communities; yet, Oh B, found that the great majority of CRC cases in Western populations occur in people over 65 years of age [12]. With a significant percentage of Pakistani CRC patients under 60 years in over study, Bhurgri and Samiullah, had previously reported this trend of younger age of onset in populations of South Asian heritage [13]. Genetic predisposition, eating habits, and the region's underutilization of screening colonoscopies are some of the factors that could be responsible for this situation. Older age was significantly associated with recurrence (p = 0.012), and a weak but statistically significant positive correlation was noted between age and time to recurrence (r = 0.21, p = 0.035), implying that while recurrence risk increases with age, it may occur slightly later in older individuals. In terms of gender, 58.3% of research participants were men, which is consistent with statistics published by Al Rashid F *et al.*, who similarly discovered a male prevalence among CRC patients in Lahore [14]. Higher exposure to possible risk factors, such as smoking, eating red meat, and engaging in sedentary behavior, may contribute to the rise in prevalence among men. In this study, colon cancer was more common (63.4%) than rectal cancer (36.6%), which is also consistent with a global incidence analysis. However, when compared to the study of Hemminki *et al.*, which exhibited higher incidence of rectal cancer, this might be explained by changes in distribution, most likely as a result of different environmental exposures or referral patterns [15]. Despite this variation, tumor location was not significantly associated with recurrence in the cohort (p = 0.15), suggesting that anatomical site alone may not independently predict oncologic outcomes. This staging data showed that the majority of patients received a diagnosis at Stage III (46.8%), followed by Stage II (28.5%). This end-stage illness resembles those reported by Ahmad R *et al.*, and points to systemic issues with delayed detection, low public awareness, and the absence of structured screening programs in Pakistan [16]. It was found that anastomotic leakage rates of 6.7%, SSIs of 12.2%, and postoperative ileus of 10.9% in this sample. These rates are similar to the 5–8% reported by Abbasi H *et al.*, who examined complications after colorectal surgery in Rawalpindi [17]. The series' recurrence rate of 26.9% was in line with rates reported in long-term follow-up studies 20–35% [18]. Anastomotic leak emerged as a significant independent risk factor (p = 0.012). These findings highlight the importance of surgical approach and perioperative care in influencing long-term oncologic outcomes. Stage III patients had the highest recurrence rate (52.3% of all recurrences), supporting the literature's earlier reports on the predictive significance of tumor stage Detering *et al* [19]. Just a small percentage of recurrences occur more than two years after surgery, and the mean time to recurrence in these series (18.4 months) is comparable to the data of Doah K *et al.*, demonstrating the importance of careful follow-up shortly after surgery [20]. Tumor stage was strongly associated with recurrence in the analysis (p < 0.001), indicating its prognostic value. Patients with Stage III–IV disease had significantly higher recurrence rates than those with early-stage disease. This Kaplan-Meier analysis in this series demonstrated a gradual decrease in recurrence-free survival, with a considerable decrease in the first 30 months. These findings are consistent with those of Uehara *et al.*, who highlighted the requirement to front load surveillance protocols in the first two to three years to detect early recurrences potentially still salvageable [21]. The study strength lies in its relatively large sample size and long follow-up that enabled meaningful assessment of patterns of recurrence and complications after the procedure. Furthermore, the adoption of the standard data collection procedure, along with the survival analysis, helped to ensure the soundness of the findings. However the study is not without limitations. First, it is a single-center retrospective study, which may susceptible to various biases such as selection bias and incomplete documentation. Additionally, detailed adjuvant treatment, molecular tumor features, and socioeconomic data were not available, which further restricted the depth of multivariate analyses. Prospective, multi-center studies with comprehensive molecular profiling and follow-up data are needed in the future to develop region-specific evidence-based approaches to management.

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CONCLUSIONS

This study found that a significant proportion of colorectal cancer cases were diagnosed at an advanced stage, with an overall recurrence rate of 26.9% and a 60-month recurrence-free survival of 51.8%. Postoperative complications were observed in 39.1% of patients, with surgical site infections and postoperative ileus being the most common. Advanced tumor stage, anastomotic leak, open surgical approach, and increasing age were independently associated with higher recurrence risk.

Authors Contribution

Conceptualization: TAR, FOS
Methodology: HJA, HI
Formal analysis: HAJ, HI
Writing, review and editing: TAR, FOS

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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