Association of Hematological Changes and Recurrence Status among Colorectal Cancer Patients in a Tertiary Referral Hospital

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Abstract

Background:
Colorectal cancer (CRC) remains one of the leading causes of cancer-related morbidity and mortality worldwide. Systemic inflammation is known to influence tumor progression and recurrence. Hematological parameters derived from routine complete blood count (CBC), such as hemoglobin level, leukocyte count, platelet count, and inflammatory indices including neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), may reflect tumor–host interactions and have potential prognostic value. This study aimed to evaluate the association between hematological changes and recurrence status among colorectal cancer patients treated in a tertiary referral hospital.
Methods:
This observational analytical study used a cross-sectional design based on secondary data from medical records of colorectal cancer patients treated between January 2020 and December 2024 in a tertiary referral hospital in Indonesia. Patients aged ≥18 years with histopathologically confirmed colorectal cancer and available preoperative CBC results were included. Hematological parameters analyzed included hemoglobin, leukocyte count, platelet count, neutrophil count, lymphocyte count, NLR, and PLR. Hematological abnormalities were categorized as presence or absence of hematological changes. Disease-free survival status was classified into recurrence and no recurrence. Statistical analysis was performed using the Fisher exact test with a significance level of $p < 0.05$.
Results:
A total of 32 patients were included with a mean age of 56.4 ± 11.2 years; 62.5% were male. The mean hemoglobin level was 12.7 ± 2.2 g/dL, leukocyte count 8.3 ± 2.1 $\times 10^3/\mu L$, platelet count 320.6 ± 128.4 $\times 10^3/\mu L$, NLR 3.1 ± 1.6, and PLR 189.4 ± 92.7. During follow-up, 18 patients (56.3%) remained disease-free and 14 patients (43.7%) developed recurrence. Hematological changes were observed in 19 patients (59.4%) and were significantly associated with recurrence status ($p = 0.028$).
Conclusion:
Hematological changes derived from routine CBC parameters were significantly associated with recurrence status in colorectal cancer patients. These parameters may serve as accessible indicators for identifying patients at risk of recurrence, although further studies with larger cohorts are needed to confirm their prognostic value.
Keywords: colorectal cancer; complete blood count; hematological parameters; recurrence

1. Introduction

Colorectal cancer (CRC) is one of the most prevalent malignancies globally and ranks fourth in incidence rate among the leading causes of cancer-related morbidity and mortality. According to global cancer statistics, more than 1.8 million new cases and approximately 881,000 deaths occur annually due to CRC (Sung et al., 2021). This condition stemmed from an abnormal cellular proliferation within the colon and rectum which may metastasize to distant organs if remain undetected and treated. Early detection in colorectal malignancies correlates with better prognostic values. Throughout the diagnostic process, complete blood count (CBC) has been established as a valuable parameter to provide critical information around physical condition of the patient and to stratify the recurrence risks (Siegel et al., 2023).

Recurrence status as an important indicator for evaluating treatment effectiveness in colorectal cancer. Recurrence status represents the period during which a patient remains free from disease recurrence after undergoing curative therapy. Several factors influence DFS, including tumor stage, biological characteristics, and host-related factors such as systemic inflammation (Mannucci et al., 2025).

Complete blood count (CBC) is a routine laboratory examination frequently performed in cancer patients. Increasing evidence suggests that hematological parameters derived from CBC, including hemoglobin level, leukocyte count, platelet count, and inflammatory ratios such as neutrophil-to-lymphocyte ratio (NLR), may reflect systemic inflammatory responses and tumor-host interactions. These parameters have been associated with tumor aggressiveness, treatment response, and survival outcomes in various malignancies, including colorectal cancer (Alsalman et al., 2022).

Anemia, leukocytosis, and thrombocytosis are commonly observed in colorectal cancer patients and may reflect chronic inflammation, tumor-induced hematopoietic changes, and immune dysregulation. These hematological alterations may contribute to tumor progression, angiogenesis, and metastasis (Virdee et al., 2020). Therefore, evaluating CBC parameters may provide valuable prognostic information and help identify patients at higher risk of recurrence.

2. Methods

2.1 Study Design

This study is an observational analytical study with cross-sectional approach which aims to evaluate the association between complete blood count parameters and disease-free survival in patients with colorectal cancer. Secondary data were extracted from the medical records of patients treated at a tertiary referral hospital in Indonesia between January 2020 and December 2024. Ethical approval for the study was obtained from the institutional ethical committee of health research.

2.2 Study Participants

The study population consisted of all patients diagnosed with colorectal cancer during the study period. Patients were recruited using a consecutive sampling technique, in which all eligible subjects who met the inclusion criteria were included until the required sample size was achieved. The minimum sample size was calculated based on previously reported proportions of hematological abnormalities among colorectal cancer patients, resulting in a minimum required sample of 29 participants. Ultimately, a total of 32 patients were included in the final analysis. Included participants in the final analysis were above 18 years old with colorectal cancer which were confirmed through histopathological examination with complete blood count results prior to the surgical treatment. Patients with prior adjuvant therapy such as chemotherapy or radiotherapy and/or inflammatory bowel disease, coagulation disorders, concurrent malignancies, incomplete clinical or laboratory records were excluded from the analysis.

2.3 Data Collection and Analysis

The primary variables analysed in this study included complete blood count examinations and disease-free survival status. Complete blood count components evaluated include hemoglobin levels, leukocyte count, platelet count, neutrophil count, lymphocyte count, neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR). Hematological abnormalities were categorized based on predefined operational criteria and classified into two groups: patients with hematological abnormalities and patients without hematological abnormalities. Disease-free survival (DFS) was defined as the absence of clinical, radiological, or histopathological evidence of tumor recurrence following curative treatment during the follow-up period. DFS status was categorized into two groups: recurrence and no recurrence.

Data extraction was performed using standardized data collection forms. Demographic characteristics, laboratory results, and follow-up information were recorded from the medical records and subsequently analyzed. Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 22. Continuous variables were presented as mean ± standard deviation, while categorical variables were summarized as frequencies and percentages. The association between hematological abnormalities and disease-free survival was analyzed using the Fisher exact test due to the relatively small sample size. A p-value < 0.05 was considered statistically significant.

3. Results

3.1 Study Population Characteristics

A total of 32 patients diagnosed with colorectal cancer were included in this study. The mean age of the patients was 56.4 ± 11.2 years with range of 32–78 years. Male patients constituted the majority of the study population (62.5%), while females accounted for 37.5%. Most patients were married (75.0%), and 40.6% had a family history of disease.

Table 1. Characteristics of the Population

Variable	Category	n	%
Age (Mean ± SD)		56.4 ± 11.2	
Age range		32–78	
Sex	Male	20	62.5
	Female	12	37.5
Marital status	Married	24	75.0
	Unmarried	8	25.0
Family history	Yes	13	40.6
	No	19	59.4

3.2 Hematological Parameters

The hematological profile of the patients demonstrated variations in several complete blood count parameters. The mean leukocyte count was 8.3 ± 2.1 $\times 10^3/\mu L$ (range: 4.6–13.2 $\times 10^3/\mu L$). The mean neutrophil count was 5.4 ± 1.9 $\times 10^3/\mu L$, while the mean lymphocyte count was 2.0 ± 0.6 $\times 10^3/\mu L$.

The average platelet count was 320.6 ± 128.4 ×10³/µL. Inflammatory indices showed a mean neutrophil-to-lymphocyte ratio (NLR) of 3.1 ± 1.6 and a mean platelet-to-lymphocyte ratio (PLR) of 189.4 ± 92.7. The mean hemoglobin level among patients was 12.7 ± 2.2 g/dL.

Table 2. Complete blood count parameters among colorectal cancer patients

Parameter	Mean ± SD	Range
Leukocytes (×10³/µL)	8.3 ± 2.1	4.6–13.2
Neutrophils (×10³/µL)	5.4 ± 1.9	2.3–10.1
Lymphocytes (×10³/µL)	2.0 ± 0.6	0.9–3.5
Platelets (×10³/µL)	320.6 ± 128.4	150–720
NLR	3.1 ± 1.6	1.1–7.8
PLR	189.4 ± 92.7	75–480
Hemoglobin (g/dL)	12.7 ± 2.2	8.4–16.8

Among the 32 patients enrolled in our cohort, 18 patients (56.3%) remained disease-free till the end point of the data collection while 14 patients (43.7%) developed recurrence. Further analysis to associate the haematological abnormalities and disease-free status of the patients enrolled in this study. Fisher Exact test was conducted to identify the asssociation between hematological changes and recurrence status among the patients.

Table 3. Association between hematological changes and recurrence status

	Recurrence (%)	**No Recurrence (%)**	**Total**	**p-value**
Hematological Changes	7 (36,8)	12 (63,2)	19	0,028
No Hematological Changes	11 (84,6)	2 (15,4)	13	
Total	**18**	**14**	**32**	

Discussion

In this study, hematological changes were significantly associated with recurrence status among colorectal cancer patients treated in a tertiary referral hospital. This finding supports the concept that routine hematological parameters may reflect the biological interplay between tumor burden, host inflammatory response, and oncologic outcome. In colorectal cancer, recurrence remains a major clinical problem even after apparently curative treatment, and contemporary reviews note that approximately 30–50% of patients may eventually develop recurrence after radical surgery. Because of this, inexpensive and widely available biomarkers derived from routine blood tests remain clinically attractive for risk stratification and

postoperative surveillance (Menyhart et al., 2024; Tsai et al., 2024).

The biological rationale for this association is plausible. Colorectal cancer is increasingly recognized as a systemic inflammatory disease in addition to a localized malignancy. Tumor-associated inflammation can alter peripheral blood cell populations through cytokine-driven myelopoiesis, immune dysregulation, and platelet activation, thereby affecting leukocyte count, neutrophil predominance, lymphocyte suppression, and platelet-related indices. Recent meta-analytic evidence in colorectal cancer has shown that composite inflammatory markers such as the systemic immune-inflammation index and systemic inflammation response index are associated with worse survival outcomes, including disease-free or recurrence-free endpoints. These observations strengthen the idea that hematological disturbances may serve as peripheral surrogates of a more aggressive tumor–host interaction (Menyhart et al., 2024; Tez, 2024).

Anemia is one of the most frequent hematological abnormalities in colorectal cancer and may arise from chronic occult bleeding, iron deficiency, and inflammation-mediated disruption of iron metabolism. Reviews on colorectal cancer–related anemia describe a central role for inflammatory signaling and hepcidin dysregulation, which reduce iron availability and impair erythropoiesis. Clinically, anemia in colorectal cancer has been associated with poorer functional status, greater treatment burden, and less favorable oncologic outcomes. Therefore, reduced hemoglobin may not only reflect tumor-related blood loss but also a sustained inflammatory state that accompanies more advanced or biologically active disease (Chardalias et al., 2023; Frascatani et al., 2024; Jocić et al., 2022).

Platelet-related abnormalities may also be relevant in interpreting our findings. Platelets are increasingly understood to contribute to cancer progression by facilitating angiogenesis, protecting circulating tumor cells, and supporting metastatic spread. A 2024 umbrella review found that pretreatment thrombocytosis was consistently associated with inferior survival across multiple cancers, with highly suggestive evidence specifically in colorectal cancer. Likewise, literature on inflammatory and nutritional markers in colorectal cancer continues to support the prognostic role of platelet- and neutrophil-based indices. Taken together, these data suggest that abnormal platelet and leukocyte profiles may reflect a protumor inflammatory milieu that is clinically meaningful even when measured using routine complete blood count parameters (Menyhart et al., 2024; Shu et al., 2024; Tez, 2024).

However, the direction of the association in our dataset should be interpreted with caution. In the present cross-tabulation, recurrence appeared numerically more frequent in patients categorized as having no hematological changes than in those with hematological changes, despite the overall Fisher exact test indicating a statistically significant association. This pattern differs from most published studies, which generally link higher inflammatory burden or abnormal blood indices with poorer prognosis. Several

explanations are possible. First, the sample size was small, making the analysis vulnerable to unstable proportions and sparse-data effects. Second, the exposure was dichotomized into “hematological changes” versus “no hematological changes,” which may have obscured the prognostic direction of individual components such as anemia, leukocytosis, thrombocytosis, NLR, or PLR. Third, a single preoperative blood test can be influenced by factors other than tumor biology, including dehydration, occult infection, bowel obstruction, nutritional status, and peri-diagnostic stress. Finally, contemporary biomarker literature repeatedly highlights heterogeneity in cut-off values and timing of blood sampling as important limitations when interpreting inflammatory hematological markers in colorectal cancer (Chardalias et al., 2023; Menyhart et al., 2024; Tez, 2024).

These considerations indicate that our findings should be viewed as hypothesis-generating rather than definitive. Nevertheless, they remain clinically relevant because complete blood count is inexpensive, routinely available, and feasible in low-resource settings. Future studies should use larger prospective cohorts, stage-stratified analyses, and multivariable models that include tumor stage, histopathological risk factors, treatment modality, and separate evaluation of hemoglobin, leukocyte count, platelet count, NLR, and PLR rather than a composite binary classification. Serial rather than single-time-point hematological measurements may also provide a more accurate reflection of recurrence risk. Such an approach would clarify whether specific hematological abnormalities can be incorporated into practical recurrence prediction models for colorectal cancer surveillance (Menyhart et al., 2024).

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