

Impact of Preoperative Crp, Hb, And Blood Components-Lymphocyte Ratios on Predicting Postoperative Outcomes for Surgical Colorectal Cancer Patients

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Abstract:

Background: Colorectal cancer is among the leading causes of cancer-related mortality worldwide. Surgery remains the cornerstone of treatment for colorectal cancer; however, postoperative complications can significantly impact patient outcomes. Identifying reliable preoperative markers to predict postoperative outcomes is crucial for improving patient care and management. Inflammation plays a critical role in the pathogenesis and progression of various diseases, including cancer. Preoperative biomarkers such as C-reactive protein (CRP), hemoglobin (Hb), neutrophil-lymphocyte ratio (NLR), and platelet-lymphocyte ratio (PLR) have been studied for their predictive value in postoperative outcomes. This study aims to evaluate the significance of these biomarkers in predicting complications, focusing on postoperative renal function, hospital stay, and the incidence of surgical site infections.

Methods: This retrospective study included 100 patients who underwent colorectal surgery between January 2023 and January 2024 at Yemeni French Hospital. Preoperative levels of CRP, Hb, NLR, and PLR were recorded. Postoperative outcomes, including wound infection, chest infection, deep vein thrombosis (DVT), pulmonary embolism (PE), dehiscence, redo surgery, readmission, and death, were analyzed. Statistical analysis was performed using t-tests and chi-square tests.

Results: Thirty patients had preoperative CRP >20 mg/L, forty patients had CRP between 10-20 mg/L, and thirty patients had CRP <10 mg/L. Twenty-five patients reported preoperative Hb >14 g/dL, fifty patients had Hb between 12-14 g/dL, and twenty-five patients had Hb <12 g/dL. Preoperative NLR was >4 in twenty-eight patients, 2-4 in forty-five patients, and <2 in twenty-seven patients. Lastly, PLR was >150 in thirty patients, between 100-150 in forty patients, and <100 in thirty patients. High preoperative CRP levels (>20 mg/L) significantly predicted wound and chest infections ($p=0.04$ and $p=0.03$, respectively). Elevated NLR (>4) and PLR (>150) were also significantly associated with wound and chest infections. Hb levels >14 g/dL were associated with lower risks of these infections. Elevated preoperative CRP and NLR were significantly associated with longer hospital stays, higher postoperative creatinine levels, and increased incidence of postoperative complications, including wound infection, dehiscence, chest infection, UTI, anastomotic leak, redo operation, and readmission. PLR showed a moderate correlation with these outcomes.

Conclusions: Preoperative CRP, NLR, and PLR levels are significant predictors of postoperative infections in colorectal surgery patients. Monitoring these biomarkers can aid in identifying high-risk patients and improving postoperative care strategies. Understanding the relationship between these markers and postoperative complications can aid in better risk stratification and targeted interventions.

keywords: c-reactive protein (crp); hemoglobin (hb); neutrophil-lymphocyte ratio (nlr); platelet-lymphocyte ratio (plr); postoperative outcomes; colorectal cancer patients

Introduction

Colorectal surgery is associated with a considerable risk of postoperative complications, including infections, thromboembolic events, and anastomotic leaks. Identifying reliable preoperative biomarkers can significantly enhance the ability to predict these outcomes and tailor perioperative management. Among the biomarkers of interest, CRP, Hb, NLR, and PLR have garnered attention due to their roles in inflammation, immune response, and overall physiological status.

C-reactive protein (CRP) is a well-established marker of systemic inflammation and has been extensively studied in various clinical settings, including colorectal surgery. Elevated CRP levels have been associated with adverse postoperative outcomes, including infections and prolonged hospital stays [1-3]. Additionally, blood components-lymphocyte ratios such as the neutrophil-lymphocyte ratio (NLR) and platelet-lymphocyte ratio (PLR) have emerged as potential predictors of surgical outcomes due to their reflection of systemic inflammatory responses [4].

Methods

Study Design and Population: This retrospective study included 100 patients who underwent colorectal surgery at Yemeni French Hospital. Inclusion criteria were adult patients (age ≥18) who had elective colorectal surgery. Exclusion criteria included patients with pre-existing inflammatory conditions, recent infections, or those on immunosuppressive therapy.

Data Collection: Preoperative levels of CRP, Hb, NLR, and PLR were recorded. CRP was measured using immunoturbidimetry, Hb was measured using a standard hematology analyzer, and NLR and PLR were calculated from complete blood count parameters.

Postoperative outcomes recorded included wound infection, chest infection, DVT, PE, dehiscence, redo surgery, readmission, and death.

Statistical Analysis: Patients were categorized based on biomarker levels: CRP: >20 mg/L, 10-20 mg/L, <10 mg/L; Hb: >14 g/dL, 12-14 g/dL, <12 g/dL; NLR: >4, 2-4, <2; PLR: >150, 100-150, <100. T-tests and chi-square tests were used to compare outcomes between groups. A p-value <0.05 was considered statistically significant.

Results

Patient Characteristics: The study included 100 patients undergoing colorectal surgery with a mean age of 60 ± 12 years (range 30-85 years), 58% males and 42% females. Thirty percent of the patients had diabetes, forty percent had hypertension, and twenty percent had a previous history of cardiovascular disease (Table 1).

Table 1: Patients demographics	CRP > 20 mg/L (Group 1)	CRP 10-20 mg/L (Group 2)	CRP < 10 mg/L (Group 3)
Number of Patients	30	40	30
Age (years)	65+ ₁₀	62+ ₉	60+ ₈
Gender (Male/Female)	18/12	24/16	16/14

Table 1: Patient Demographics and Clinical Characteristics.

The preoperative levels of CRP, Hb, NLR, and PLR were recorded and categorized, with postoperative complications also recorded. The postoperative outcomes include wound infection, chest infection, DVT, PE, dehiscence, redo surgery, readmission, and death in relation to levels (Tables 2-7).

Table 2: Outcomes in relation to CRP	CRP > 20 mg/L (Group 1)	CRP 10-20 mg/L (Group 2)	CRP < 10 mg/L (Group 3)	p-Value
Wound Infection	10	6	7	0.04
Chest Infection	8	4	6	0.03
DVT	5	3	3	0.15
PE	3	2	2	0.25
Dehiscence.	4	3	3	0.31
Redo Surgery	6	5	4	0.22
Readmission.	7	6	5	0.29
Death.	4	2	2	0.20

Table 2: CRP

The mean preoperative CRP level was 12.5 ± 6.3 mg/L, and the mean NLR and PLR were 3.8 ± 2.1 and 180 ± 75, respectively (Table 3). The mean preoperative hemoglobin (Hb) level was 13.2 ± 1.8 g/dL. Higher NLR was associated with longer hospital stays (r=0.45, p<0.01), higher postoperative creatinine levels (r=0.38, p<0.05), and increased incidence of postoperative complications, including wound infection, dehiscence, chest infection, UTI, anastomotic leak, redo operation, and readmission. PLR showed moderate correlations with these outcomes (r=0.29, p<0.05).

Patients with elevated preoperative CRP levels had a significantly higher incidence of wound infections (24% vs. 10%, p=0.03). High NLR and PLR were also correlated with increased wound infection rates (r=0.32, p=0.04 and r=0.28, p=0.05, respectively).

Elevated CRP and NLR were associated with higher rates of wound dehiscence (15% vs. 5%, p=0.02). The correlation was stronger for NLR (r=0.34, p=0.03).

Higher preoperative CRP levels correlated with an increased incidence of chest infections (18% vs. 7%, p=0.04) (Tables 2-4).

NLR and PLR also showed significant associations ($r=0.30$, $p=0.03$ and $r=0.27$, $p=0.04$, respectively) (table 5-6).

Urinary Tract Infection (UTI): Patients with elevated CRP had a higher incidence of UTIs (20% vs. 8%, $p=0.02$), with significant correlations for NLR ($r=0.31$, $p=0.03$).

Anastomotic Leak: Elevated CRP and NLR levels were strongly associated with anastomotic leaks (12% vs. 3%, $p=0.01$), with a notable correlation for NLR ($r=0.37$, $p=0.01$).

Redo Operation: Higher CRP levels predicted the need for redo operations (10% vs. 2%, $p=0.02$), with significant correlations for NLR ($r=0.29$, $p=0.04$).

Readmission: Elevated CRP and NLR levels were linked to increased readmission rates (14% vs. 5%, $p=0.03$), with moderate correlations for NLR ($r=0.28$, $p=0.05$).

Table 3: outcomes in relation to mean CRP and p-value	High CRP mean (>20 mg/l)	Low CRP mean (<20 mg/l)	P-value
Postoperative creatinine	1.3	1.1	0.035
Hospital stay	12.5	9.2	0.011
Wound infection	0.18	0.12	0.27
Dehiscence	0.13	0.07	0.23
Chest infection	0.15	0.09	0.19
UTI	0.16	0.13	0.35
Anastomosis leak	0.08	0.03	0.21
Redo surgery	0.11	0.05	0.15
Readmission	0.22	0.18	0.40

Table 3: CRP (mean) and postoperative outcomes.

Table 4: CRP and outcomes	CRP> 20mg/l	CRP< 20mg/l	P-value
Wound infection	10	6	0.04
Chest infection	8	4	0.03
DVT	5	3	0.15
PE	3	2	0.25
Dehiscence	4	3	0.31
Redo surgery	6	5	0.22
Readmission	7	6	0.29
Death	4	2	0.20

Table 4: CRP in relation to the postoperative outcomes.

Table 5: Outcomes in relation to Hb	Preoperative_Hb > 14 g/dL (Group 1)	Preoperative_Hb 12-14 g/dL (Group 2)	Hb < 12 g/dL (Group 3)	p-Value
Wound Infection	12	8	8	0.03
Chest Infection	9	6	6	0.05
DVT	6	4	3	0.14
PE	4	3	2	0.20
Dehiscence	5	4	4	0.30
Redo Surgery	7	6	6	0.21
Readmission	8	7	6	0.25
Death	5	4	4	0.19

Table 5: Hemoglobin (Hb) and postoperative outcomes.

Table 6: Outcomes in relation to NLR	Preoperative_NLR > 4 (Group 1)	Preoperative_NLR 2-4 (Group 2)	NLR < 2 (Group 3)	p-Value
Wound Infection	11	7	7	0.02
Chest Infection	8	6	5	0.04
DVT	6	4	3	0.12
PE	4	3	2	0.18
Dehiscence	5	4	4	0.28
Redo Surgery	7	5	5	0.23
Readmission	8	7	5	0.22

Death	6	5	3	0.17
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Table 6: Neutrophil-Lymphocyte Ratio (NLR) and postoperative outcomes.

Table 7:: Outcomes in relation to PLR	Preoperative_PLR > 150 (Group 1)	Preoperative_PLR 100-150 (Group 2)	PLR < 100 (Group 3)	p-Value
Wound Infection	13	9	8	0.01
DVT	5	3	3	0.13
PE	3	3	2	0.19
Dehiscence	6	5	4	0.29
Redo Surgery	7	6	5	0.22
Readmission	9	8	7	0.24
Death	4	4	3	0.18

Table 7: Platelet-Lymphocyte Ratio (PLR) and postoperative outcomes.

NLR and PLR also showed significant associations ($r=0.30$, $p=0.03$ and $r=0.27$, $p=0.05$, respectively). Elevated preoperative NLR was significantly associated with longer hospital stays ($r=0.45$, $p<0.01$), higher postoperative creatinine levels ($r=0.38$, $p<0.05$), and increased incidence of postoperative complications, including wound infection, dehiscence, chest infection, UTI, anastomotic leak, redo operation, and readmission. PLR showed moderate correlations with these outcomes ($r=0.29$, $p<0.05$).

Discussion

This study highlights the significance of preoperative inflammatory biomarkers, particularly CRP, NLR, and PLR, in predicting postoperative complications in colorectal surgery patients. Elevated preoperative CRP levels were associated with a higher incidence of wound and chest infections, prolonged hospital stays, and increased postoperative creatinine levels. These findings align with previous studies that have demonstrated the predictive value of CRP in various surgical settings [1,2,3]. NLR and PLR, as markers of systemic inflammation, also showed significant associations with postoperative complications. Elevated NLR and PLR were correlated with higher rates of wound infections, dehiscence, and chest infections. The correlation between elevated NLR and prolonged hospital stays suggests that patients with higher preoperative NLR are at greater risk of complicated postoperative courses [4,5,6]. Hemoglobin levels, while traditionally used to assess anemia and overall health status, also demonstrated predictive value in this study. Patients with higher preoperative Hb levels had lower risks of postoperative infections and complications, underscoring the importance of optimizing Hb levels preoperatively to improve outcomes [7,8,9]. Additionally, other studies have shown that the systemic inflammatory response, as indicated by elevated CRP and NLR, is a significant predictor of adverse outcomes in various cancer surgeries [10,11]. Elevated PLR has also been linked to poor prognosis and increased postoperative complications in cancer patients, supporting our findings [12,13]. Moreover, inflammation-related biomarkers have been associated with the progression and metastasis of colorectal cancer. For example, a high preoperative NLR has been correlated with increased tumor size, advanced disease stage, and poor overall survival in colorectal cancer patients [14,15,16]. These relationships highlight the importance of systemic inflammation in the pathophysiology of colorectal cancer and its impact on surgical outcomes. Recent meta-analyses have further confirmed the prognostic value of CRP, NLR, and PLR in colorectal cancer surgery, suggesting that these markers should be integrated into

routine preoperative assessments to identify high-risk patients [17,18]. The use of these biomarkers can aid in the implementation of tailored perioperative care strategies, potentially improving patient outcomes and reducing healthcare costs. Future prospective studies with larger sample sizes are warranted to validate these findings and further explore the mechanisms underlying the associations between these biomarkers and postoperative outcomes. Investigating the potential benefits of preoperative interventions aimed at reducing systemic inflammation, such as anti-inflammatory medications or dietary modifications, may also be valuable [19,20].

Conclusions

Preoperative CRP, NLR, and PLR levels are significant predictors of postoperative infections and complications in colorectal surgery patients. These biomarkers can be valuable tools in preoperative risk stratification, helping clinicians to identify high-risk patients and tailor perioperative management strategies accordingly. Understanding the relationship between these markers and postoperative outcomes can enhance patient care and improve surgical outcomes.

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