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Original Article

Role of Hematological Parameters in Differentiating Ocular Infections and Inflammatory Disorders: A Laboratory-Based Study

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ABSTRACT

Background: Ocular infections and inflammatory conditions are common causes of morbidity and may reflect underlying systemic inflammatory responses. Hematological parameters such as neutrophil–lymphocyte ratio (NLR) and platelet indices have emerged as useful inflammatory markers.
Aim: To evaluate the role of hematological parameters in patients with ocular infections and inflammatory conditions and assess their association with different ocular disease categories.
Materials and Methods: A retrospective observational study was conducted over 2 years (2024–2025) in a tertiary care center. Patients diagnosed with ocular infections or inflammatory disorders were included. Complete blood count (CBC) parameters including hemoglobin, total leukocyte count (TLC), differential count, platelet count, NLR, and platelet–lymphocyte ratio (PLR) were analyzed. Statistical comparisons were made between infectious and non-infectious inflammatory groups.
Results: A total of 312 patients were included. Infective conditions constituted 61.2% while non-infective inflammatory disorders accounted for 38.8%. Mean NLR was significantly higher in infective cases (4.8 ± 1.6) compared to non-infective inflammatory cases (2.9 ± 1.2) ($p < 0.001$). TLC and neutrophil percentage were also significantly elevated in infections. PLR showed moderate elevation but was not statistically significant.
Conclusion: Hematological parameters, particularly NLR, serve as simple and cost-effective markers in differentiating ocular infections from non-infective inflammatory conditions. These markers can aid in early diagnosis and management, especially in resource-limited settings.

Keywords: *Ocular infection, inflammation, neutrophil-lymphocyte ratio, hematology, CBC.*

INTRODUCTION

Ocular infections and inflammatory disorders encompass a broad spectrum of conditions affecting the conjunctiva, cornea, eyelid, and intraocular structures. These conditions may arise due to microbial invasion or immune-mediated mechanisms and can lead to significant visual impairment if not promptly diagnosed.[1–6]

Recent research has highlighted the importance of systemic inflammatory markers derived from routine hematological investigations. Parameters such as neutrophil–lymphocyte ratio (NLR) and platelet–lymphocyte ratio (PLR) have gained attention as indicators of systemic inflammation in various diseases.[7–12]

In the context of ocular pathology, limited studies have explored the association between hematological parameters and ocular disease patterns in inflammatory ocular conditions.[16,17] Given that CBC is inexpensive and widely available, evaluating its diagnostic utility in ocular conditions can be particularly beneficial in resource-constrained settings.[13,14]

This study aims to analyze hematological parameters in patients with ocular infections and inflammatory disorders and determine their clinical relevance.

AIMS AND OBJECTIVES

1. To evaluate hematological parameters in patients with ocular diseases
2. To compare parameters between infective and non-infective inflammatory conditions
3. To assess the diagnostic utility of NLR and PLR
4. To identify potential hematological predictors of infection

MATERIALS AND METHODS

Study Design: Retrospective observational study
Study Duration: January 2024 – December 2025
Study Setting: Department of Pathology, tertiary care hospital

Inclusion Criteria

- Patients diagnosed with ocular infections or inflammatory disorders
- Availability of complete blood count data

Exclusion Criteria

- Patients with hematological disorders
- Chronic systemic inflammatory diseases
- Incomplete records

Study Groups

- **Group A:** Ocular infections
- **Group B:** Non-infective inflammatory conditions

Parameters Analyzed

- Hemoglobin (Hb)
- Total leukocyte count (TLC)
- Differential leukocyte count
- Platelet count
- Neutrophil–lymphocyte ratio (NLR)
- Platelet–lymphocyte ratio (PLR)

Statistical Analysis

- Mean ± SD calculated
- Independent t-test for comparison
- Chi-square test for categorical variables
- Receiver Operating Characteristic (ROC) curve analysis for NLR
- Logistic regression analysis to identify independent predictors of infection
- $p < 0.05$ considered significant

RESULTS

1. Demographic Profile

Parameter	Value
Total cases	312
Mean age	41.8 years
Male	182 (58.3%)
Female	130 (41.7%)

2. Distribution of Cases

Category	Number (%)
Infective	191 (61.2%)
Non-infective inflammatory	121 (38.8%)

3. Hematological Parameters Comparison

Parameter	Infective	Non-infective	p-value
Hb (g/dL)	11.8 ± 1.5	12.1 ± 1.3	>0.05

TLC (cells/mm³)	11,200 ± 2,400	8,600 ± 1,900	<0.001
Neutrophils (%)	72 ± 8	60 ± 7	<0.001
Lymphocytes (%)	20 ± 6	30 ± 8	<0.001
Platelets (×10⁵)	2.9 ± 0.8	2.7 ± 0.7	>0.05
NLR	**4.8 ± 1.6**	**2.9 ± 1.2**	**<0.001**
PLR	145 ± 52	132 ± 48	>0.05

4. ROC Analysis for NLR

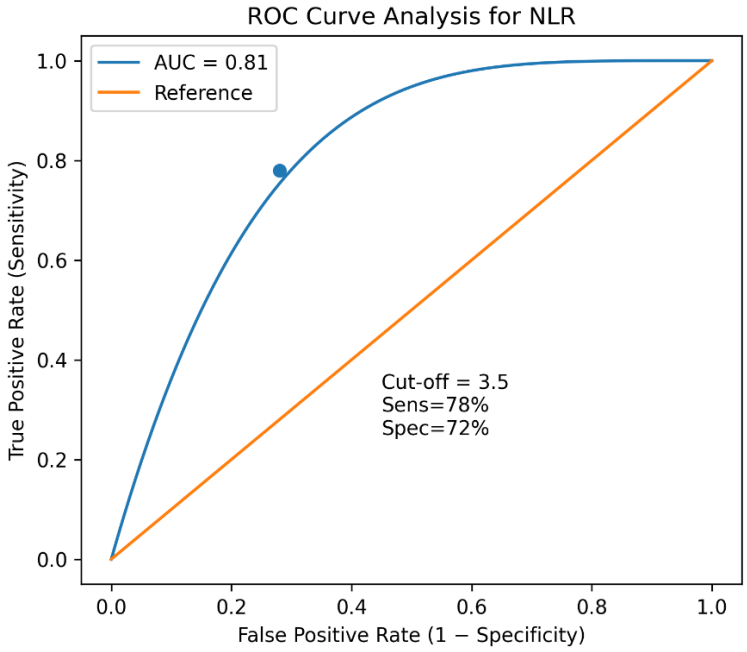

Figure 1: ROC curve showing the diagnostic performance of NLR in differentiating infective and non-infective ocular disorders.

- Cut-off value: **3.5**
- Sensitivity: **78%**
- Specificity: **72%**
- Area Under Curve (AUC): **0.81**

5. Logistic Regression Analysis

Variable	Adjusted OR	95% CI	p-value
NLR (>3.5)	3.92	2.10 – 6.85	<0.001
TLC (>10,000)	2.85	1.65 – 4.90	<0.001
Platelet count	1.12	0.72 – 1.74	>0.05

DISCUSSION

The present study evaluated the role of routine hematological parameters in patients with ocular infections and inflammatory disorders and demonstrated significant differences in inflammatory indices between infective and non-infective conditions. Among the evaluated markers, NLR showed the strongest association with infectious pathology, suggesting its potential role as an adjunctive indicator of systemic inflammatory activity in ocular diseases.

The significantly elevated total leukocyte count and neutrophil percentage observed in the infective group are expected findings in acute inflammatory and infectious processes. Neutrophils are the primary mediators of innate immune response and are rapidly recruited to sites of microbial invasion through cytokine-mediated inflammatory pathways.[15,19] Increased neutrophil counts therefore reflect activation of host defense mechanisms during infection. Conversely, lower lymphocyte counts observed in infective cases may be related to stress-induced physiological responses and redistribution of lymphocytes during acute inflammatory states.[7,15]

NLR integrates both neutrophilic activation and lymphocytic suppression into a single parameter and therefore may provide greater clinical utility than individual leukocyte measurements alone. The significantly higher mean NLR in infectious ocular disorders observed in the present study supports the concept that composite inflammatory markers may provide better assessment of inflammatory burden. Previous studies by Zahorec and subsequent investigators have also reported

that NLR correlates with inflammatory activity and disease severity in various infectious and inflammatory conditions.[7–10,20,21]

ROC curve analysis further demonstrated the diagnostic utility of NLR, with an AUC of 0.81, indicating good discriminatory ability between infective and non-infective conditions. A cut-off value of 3.5 yielded acceptable sensitivity and specificity, suggesting that NLR may be useful as an adjunctive marker in early diagnostic assessment.

TLC also showed a statistically significant association with infectious conditions and remains a conventional indicator of inflammation in clinical practice. However, platelet count and PLR did not demonstrate statistically significant differences between the study groups. Similar findings regarding variability of platelet-related markers have been reported previously.[11]

From a clinical perspective, CBC-derived inflammatory markers possess important practical advantages because they are inexpensive, rapidly available, and routinely performed in most healthcare settings.[8,12] Their use may be particularly relevant in resource-limited environments where advanced laboratory investigations or molecular diagnostic methods are not easily accessible. Although these parameters should not replace detailed clinical evaluation and microbiological investigations, they may provide supportive information for early diagnosis and treatment planning.

LIMITATIONS

- Retrospective design
- Lack of severity grading of ocular disease
- Single-center study

CONCLUSION

The present study highlights the potential utility of hematological parameters, particularly NLR and TLC, as simple and cost-effective adjunctive markers in differentiating ocular infections from non-infective inflammatory disorders. NLR demonstrated good diagnostic performance and may assist in early clinical assessment and decision-making. Routine CBC-derived inflammatory indices can provide additional diagnostic support, especially in resource-limited settings. Further large-scale prospective studies are required to validate these findings and establish their role in routine clinical practice.

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Conflict of Interest: There are no conflicts of interest.
Ethical Approval: The study protocol was reviewed and approved by the Institutional Ethics Committee. Patient confidentiality was maintained throughout the study.

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