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Research Article

IMPORTANCE OF TOTAL NEUTROPHIL COUNT, NEUTROPHIL-TO-LYMPHOCYTE RATIO AND PLATELET-TO-LYMPHOCYTE RATIO IN PREDICTING IMMEDIATE OUTCOMES OF ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

Background: Acute myocardial infarction (AMI) remains a major cause of morbidity and mortality worldwide. Inflammation plays an important role in the pathogenesis of myocardial infarction and influences infarct size, ventricular dysfunction and subsequent complications. Simple hematological parameters obtained from a routine complete blood count, particularly total neutrophil count (TNC), neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), may provide useful information regarding systemic inflammatory and thrombotic activity. This study evaluated the association of these parameters with immediate outcomes in patients with AMI.

Methods: This observational cross-sectional study included 138 patients aged >18 years diagnosed with AMI and admitted to the Departments of General Medicine, Cardiology and Emergency Medicine at the National Institute of Medical Sciences and Research, Jaipur. Patients with infection, malignancy, hematological disorders, autoimmune disease, pre-existing valvular disease, previous myocardial infarction, steroid therapy and other causes of chest pain were excluded. TNC, total lymphocyte count, platelet count, NLR and PLR were assessed at admission. Clinical characteristics, ECG findings, troponin I, ejection fraction, TIMI score and Killip class were recorded. Patients were evaluated for major adverse cardiovascular events (MACE).

Results: The mean age was 57.60 ± 12.77 years, and 91 (65.9%) patients were male. MACE occurred in 15 patients (10.9%). Patients with MACE had significantly higher TNC (5.61 ± 1.26 vs 4.78 ± 1.93 $\times 10^9$/L; p=0.034) and lower lymphocyte counts (1.06 ± 0.40 vs 2.37 ± 0.91 $\times 10^9$/L; p<0.001). NLR was significantly higher among patients with MACE (5.83 ± 2.04 vs 2.41 ± 1.70; p<0.001), as was PLR (313.67 ± 101.53 vs 143.34 ± 95.20; p<0.001). ROC analysis demonstrated that NLR had the highest predictive performance for MACE (AUC 0.912), followed by PLR (AUC 0.887) and TNC (AUC 0.742). An NLR cut-off >3.95 demonstrated 86.7% sensitivity and 84.6% specificity.

Conclusion: TNC, NLR and PLR were significantly associated with immediate adverse outcomes in patients with AMI. Among the evaluated hematological parameters, NLR demonstrated the highest predictive accuracy. These inexpensive and readily available markers may serve as useful adjuncts to conventional clinical assessment and risk stratification.

KEYWORDS: Acute Myocardial Infarction, Neutrophil Count, Neutrophil-to-Lymphocyte Ratio, Platelet-to-Lymphocyte Ratio, Inflammation, Major Adverse Cardiovascular Events, Prognostic Markers.

Introduction

Acute myocardial infarction (AMI) is one of the most serious manifestations of coronary artery disease and remains an important cause of morbidity and mortality worldwide[1,2].

The clinical course of AMI is determined not only by the extent of coronary obstruction and myocardial necrosis but also by the systemic inflammatory response that accompanies acute myocardial injury[1,2].

The interaction between inflammation and thrombosis is particularly important in AMI. Activated platelets participate directly in coronary thrombus formation and interact with leukocytes, linking thrombosis and inflammation[2,5].

The neutrophil-to-lymphocyte ratio (NLR) reflects the balance between innate inflammatory activation and adaptive immune regulation. The platelet-to-lymphocyte ratio (PLR) incorporates platelet and lymphocyte responses and has been investigated as a composite marker of inflammation and thrombosis[3–6].

Previous studies have reported associations between elevated NLR and adverse outcomes in acute coronary syndromes. Similarly, elevated PLR has been investigated as a marker of thrombo-inflammatory risk[3–6].

Conventional prognostic tools such as the TIMI score remain important in AMI risk assessment. Hematological indices derived from routine blood investigations may provide complementary information without requiring additional specialized testing[7].

Despite the growing body of evidence, variations in the predictive performance of NLR, PLR and absolute neutrophil count remain evident across populations. The present study was therefore undertaken to assess the relationship between TNC, NLR and PLR and immediate outcomes in patients with AMI and to compare their predictive performance for MACE.

Aim and Objectives

Aim

To assess the relationship of total neutrophil count, neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio with immediate outcomes of acute myocardial infarction.

Objectives

- To estimate TNC, NLR and PLR among patients with AMI.
- To evaluate the association between these hematological parameters and immediate outcomes of AMI.
- To compare the predictive performance of TNC, NLR and PLR for MACE.

Materials and Methods

Study Design and Setting

This observational cross-sectional study was conducted among patients with AMI presenting to the Departments of General Medicine and Cardiology and the Emergency Department at the National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India. A total of 138 patients were included over 18 months.

Participants

AMI was diagnosed according to the Fourth Universal Definition of Myocardial Infarction (2018)[1].

Sample Size and Sampling

The calculated sample size was 138 participants using a 95% confidence level and a 5% margin of error. Purposive sampling was used.

Data Collection

Baseline demographic and clinical characteristics including age, sex, cardiovascular risk factors, blood pressure, heart rate, ECG findings, troponin I, Killip class and TIMI score were recorded. Venous blood samples were obtained at admission for complete blood count assessment. TNC, total lymphocyte count and platelet count were recorded.

NLR = Absolute neutrophil count / Absolute lymphocyte count
PLR = Platelet count / Absolute lymphocyte count

Ejection fraction was assessed by echocardiography. Immediate outcomes included MACE, including in-hospital mortality, reinfarction, heart failure, cardiogenic shock, arrhythmias and no-reflow phenomenon.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Comparisons between patients with and without MACE were performed using appropriate statistical tests. ROC curve analysis assessed predictive performance. Odds ratios with 95% confidence intervals were calculated using logistic regression. A p-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 138 patients with AMI were included. The mean age was 57.60 ± 12.77 years. There were 91 males (65.9%) and 47 females (34.1%). The mean systolic blood pressure was 122.81 ± 23.13 mmHg, mean diastolic blood pressure was 79.94 ± 12.88 mmHg and mean heart rate was 84.81 ± 13.35 beats/min.

Table 1: Baseline demographic and clinical characteristics of the study population

Parameter	Overall population (n=138)
Age, years	57.60 ± 12.77
Male, n (%)	91 (65.9%)
Female, n (%)	47 (34.1%)
Systolic BP, mmHg	122.81 ± 23.13
Diastolic BP, mmHg	79.94 ± 12.88
Heart rate, beats/min	84.81 ± 13.35
TNC, ×10⁹/L	4.87 ± 1.88
TLC, ×10⁹/L	2.23 ± 0.96
Ejection fraction	0.37 ± 0.10
Troponin I, ng/mL	7.56 ± 7.05

Table 2: Hematological parameters according to occurrence of MACE

Parameter	No MACE (n=123)	MACE (n=15)	p-value
TNC, ×10⁹/L	4.78 ± 1.93	5.61 ± 1.26	0.034
TLC, ×10⁹/L	2.37 ± 0.91	1.06 ± 0.40	<0.001
Platelet count, ×10⁹/L	274.38 ± 64.40	304.17 ± 63.64	0.105
NLR	2.41 ± 1.70	5.83 ± 2.04	<0.001
PLR	143.34 ± 95.20	313.67 ± 101.53	<0.001

Table 3: Clinical severity parameters according to occurrence of MACE

Parameter	No MACE	MACE	p-value
Ejection fraction	0.38 ± 0.09	0.29 ± 0.08	0.002
Troponin I, ng/mL	6.84 ± 6.20	12.44 ± 9.14	0.011
TIMI score	3.42 ± 1.28	6.07 ± 1.03	<0.001
Killip class	2.19 ± 0.66	3.20 ± 0.68	<0.001
Hospital stay, days	4.32 ± 1.84	6.07 ± 2.44	0.004

Table 4: ROC analysis of TNC, NLR and PLR for prediction of MACE

Marker	Cut-off	Sensitivity	Specificity	AUC	95% CI	p-value
TNC	>5.2 ×10⁹/L	73.3%	68.3%	0.742	0.61–0.87	0.004
NLR	>3.95	86.7%	84.6%	0.912	0.85–0.97	<0.001
PLR	>210.5	80.0%	82.1%	0.887	0.81–0.95	<0.001

MACE and Hematological Parameters

MACE occurred in 15 of 138 patients (10.9%). Patients who developed MACE had significantly higher TNC and substantially lower lymphocyte counts.

Clinical Severity and MACE

Patients with MACE had significantly higher troponin I, TIMI score and Killip class, together with lower ejection fraction and longer hospital stay.

ROC Analysis

ROC analysis demonstrated that NLR had the highest predictive performance, followed by PLR and TNC.

NLR demonstrated excellent discrimination for MACE, with an AUC of 0.912. PLR also demonstrated strong predictive performance, whereas TNC showed fair discrimination.

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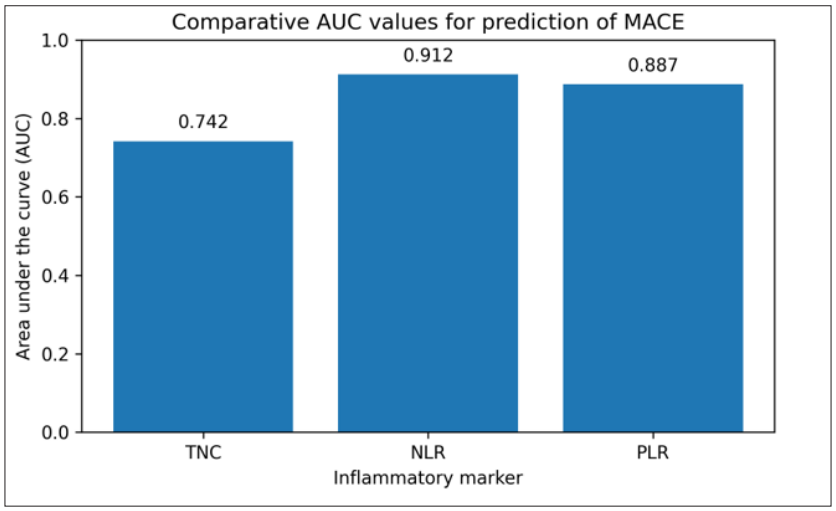

Figure 1.Comparative AUC values of TNC, NLR and PLR for prediction of MACE

Table 5: Univariate logistic regression analysis for MACE

Variable	OR (95% CI)	p-value
Age	1.05 (1.01–1.10)	0.036
Smoking	3.62 (1.34–9.81)	0.011
TNC	1.29 (0.94–1.76)	0.112
NLR	2.11 (1.52–2.94)	<0.001
PLR	1.01 (1.006–1.015)	<0.001
TIMI score	3.88 (2.01–7.49)	<0.001
Killip class	4.74 (2.02–11.10)	<0.001

Logistic Regression

Univariate logistic regression demonstrated that age, smoking, NLR, PLR, TIMI score and Killip class were significantly associated with MACE. TNC showed a positive but statistically non-significant association.

Other Clinical Associations

MACE was significantly associated with smoking ($p = 0.002$), alcohol consumption ($p = 0.018$), and family history ($p = 0.011$). Sex was not significantly associated with MACE ($p = 0.418$). ECG findings were significantly associated with MACE ($p = 0.021$), with extensive/anterior infarction patterns showing greater adverse-event frequency.

Discussion

The present study evaluated the prognostic significance of TNC, NLR and PLR in patients presenting with AMI. The principal finding was that patients who developed MACE had significantly higher TNC, substantially lower lymphocyte counts and markedly elevated NLR and PLR.

The mean age of the study population was 57.60 years, and males represented 65.9% of participants. The higher frequency of MACE among older patients further emphasizes age as an important determinant of early prognosis. Similar demographic patterns have been described in AMI populations[13,14].

A significant increase in TNC was observed among patients who developed MACE. Neutrophils participate in the inflammatory response and have been associated with adverse outcomes in acute coronary syndromes[3].

However, TNC alone demonstrated only fair predictive performance, with an AUC of 0.742. Furthermore, TNC was not statistically significant in the univariate logistic regression model (OR 1.29, p=0.112). This suggests that absolute neutrophil count may capture only one component of the inflammatory response.

The reduction in lymphocyte count among patients with MACE was particularly striking. Lymphopenia may reflect the physiological stress response accompanying myocardial injury and has been associated with adverse cardiovascular outcomes[4,16].

The strongest finding was the marked elevation of NLR among patients with MACE. Mean NLR was 5.83 in the MACE group compared with 2.41 in patients without MACE. NLR also showed the highest discriminatory performance in ROC analysis, consistent with previous evidence supporting its prognostic value in acute coronary syndromes[3,4].

PLR also demonstrated a strong relationship with adverse outcomes. Mean PLR was 313.67 in patients with MACE compared with 143.34 among patients without MACE.

ROC analysis yielded an AUC of 0.887, consistent with previous work evaluating PLR as a marker of coronary disease severity and adverse outcomes[5].

The difference between PLR and absolute platelet count is noteworthy. Although platelet count was numerically higher in patients with MACE, the difference was not statistically significant. This is consistent with the concept that platelet count alone may not capture platelet activation or thrombotic risk adequately[15].

The relative performance of the three markers is an important finding. NLR ranked first with an AUC of 0.912, PLR second with an AUC of 0.887 and TNC third with an AUC of 0.742. The superior performance of NLR and PLR supports the use of ratio-based inflammatory indices because they integrate multiple components of the systemic response.

Established clinical indicators also showed strong relationships with MACE. Patients with adverse outcomes had significantly higher TIMI and Killip scores, higher troponin I levels and lower ejection fraction. Established clinical risk scores and Killip classification remain important components of AMI risk assessment[7,8].

The practical advantage of NLR and PLR is their simplicity. Both can be calculated from a routine complete blood count. However, these indices are nonspecific and should be interpreted alongside established clinical findings and risk scores[3,4].

Strengths and Limitations

The major strength of this study was the simultaneous assessment of TNC, NLR and PLR and direct comparison of their predictive performance for immediate adverse outcomes.

Limitations include the single-center setting, relatively modest sample size, observational cross-sectional design and assessment of admission rather than serial hematological parameters. Potential confounding factors may influence inflammatory indices. Larger multicenter prospective studies are required to validate the observed cut-off values and determine whether incorporating NLR and PLR into established risk scores improves clinical decision-making.

Conclusion

The present study demonstrates that inflammatory hematological parameters are significantly associated with immediate outcomes in patients with acute myocardial infarction. Patients who developed MACE had higher total neutrophil counts, lower lymphocyte counts and markedly elevated NLR and PLR.

Among the evaluated markers, NLR demonstrated the highest discriminatory performance, with an AUC of 0.912, followed by PLR with an AUC of 0.887 and TNC with an AUC of 0.742. An admission

NLR and PLR are inexpensive, rapidly available and easily calculated from routine complete blood counts. They may therefore serve as useful adjunctive markers for early risk stratification in patients with AMI, particularly when interpreted alongside established clinical parameters such as TIMI score, Killip class, troponin level and ejection fraction. Their clinical utility should be validated in larger prospective and multicenter studies.

Declarations

Ethics Approval

The study was conducted after approval from the Institutional Ethics Committee of the National Institute of Medical Sciences and Research, Jaipur.

Consent

Written informed consent was obtained from participants or their legally authorized representatives as applicable.

Funding

No external funding was received for this study.

Data Availability

The data supporting the findings of this study are available from the corresponding author on reasonable request, subject to institutional and ethical restrictions.

Conflict of Interest

The authors declare no conflict of interest.

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