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Original Research Article

Study of the Prognostic Value of Neutrophil–Lymphocyte Ratio in the Early Outcome of Myocardial Infarction

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Abstract

Background: Myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide. While various clinical markers and risk scores exist for early prognostication, emerging evidence highlights the importance of inflammatory markers in predicting adverse outcomes. The neutrophil–lymphocyte ratio (NLR), a simple and cost-effective hematological index, has gained increasing attention as a potential prognostic indicator for cardiovascular events. However, definitive data regarding its utility in early risk stratification following an acute MI remain limited.

Methods: This prospective observational study included 120 adult patients diagnosed with acute MI (ST-elevation or non-ST-elevation) and admitted to a tertiary care center. Blood samples were collected on admission to evaluate complete blood counts and calculate the NLR. Relevant clinical data, including demographics, risk factors, and echocardiographic parameters, were recorded. Patients were categorized into quartiles based on their admission NLR. The primary outcome was a composite of major adverse cardiac events (MACE) within 30 days, including mortality, recurrent MI, and acute heart failure. Secondary outcomes included length of hospital stay and left ventricular ejection fraction (LVEF) at discharge. Logistic regression analyses were performed to ascertain the independent prognostic value of NLR.

Results: A higher NLR on admission was significantly associated with increased rates of MACE ($p < 0.001$). Patients in the highest NLR quartile demonstrated a greater incidence of mortality and heart failure compared to those in the lower quartiles. Multivariate regression identified elevated NLR as an independent predictor of early adverse outcomes after adjusting for established risk factors such as age, Killip class, and left ventricular systolic function.

Conclusion: These findings suggest that admission NLR is a valuable, non-invasive prognostic biomarker for early risk stratification in patients with acute MI. Incorporating NLR into existing clinical assessment may enhance decision-making and potentially improve outcomes.

Keywords: Myocardial Infarction, Neutrophil–Lymphocyte Ratio, Prognosis, Inflammation, Early Outcome, MACE.

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Introduction

Myocardial infarction (MI) is one of the most prevalent and life-threatening cardiovascular emergencies worldwide, largely due to its high morbidity and mortality [1]. Early identification of patients at elevated risk for adverse events remains a cornerstone of successful clinical management and resource allocation. Traditionally, prognostication in acute MI relies on parameters such as the Killip classification, left ventricular ejection fraction (LVEF), and biochemical markers like troponins [2]. Nonetheless, these tools may be limited by availability, cost, or timing constraints, prompting ongoing research into novel and readily accessible biomarkers [3]. Inflammation plays a critical role in the pathogenesis and progression of atherosclerosis, plaque rupture, and subsequent myocardial injury [4]. A heightened inflammatory state following MI has been linked to increased myocardial damage, adverse ventricular remodelling, and higher likelihood of complications [5]. In recent years, the neutrophil–lymphocyte ratio (NLR)—calculated from the absolute neutrophil and lymphocyte counts in a standard complete blood count—has emerged as a potential indicator of systemic inflammation [6]. An elevated NLR may reflect increased innate

immune activity coupled with a suppression of adaptive immunity, capturing a snapshot of inflammatory imbalance with a single, cost-effective test [7].

Several studies have suggested that NLR correlates with long-term cardiovascular outcomes, including mortality and major adverse cardiac events (MACE). However, the prognostic utility of NLR specifically in the early phase after MI is still under investigation [8]. Understanding how NLR behaves in the acute setting and its relationship to short-term outcomes such as mortality, heart failure, and recurrent ischemic events could be invaluable for clinicians aiming to optimize immediate management decisions, including the need for urgent revascularization or more aggressive medical therapy.

The present study thus seeks to evaluate the prognostic value of NLR in the early outcome of patients admitted with acute MI. By categorizing patients into quartiles based on their admission NLR and examining both clinical and echocardiographic parameters, we aim to determine whether higher NLR levels independently predict a higher incidence of MACE within 30 days. Additionally, we will explore whether integrating NLR into existing clinical tools offers incremental prognostic benefit. Given the simplicity and cost-effectiveness of complete blood count analysis, elucidating the role of NLR may have broad implications for routine clinical practice.

Materials and Methods

Study Design and Setting: This prospective, observational study was conducted at a tertiary care teaching hospital over a 12-month period. Approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrolment.

Patient Population: Patients aged ≥18 years presenting with acute ST-elevation MI (STEMI) or non-ST-elevation MI (NSTEMI) were screened. The diagnosis was established on the basis of clinical presentation, electrocardiographic changes, and positive cardiac biomarkers (troponins). Exclusion criteria included any active infection, chronic inflammatory or autoimmune disease, malignancy, or haematological disorder. Patients who had received corticosteroids or immunosuppressive therapy in the preceding three months were also excluded.

Data Collection and Definitions: A standardized case report form was used to gather demographic information, risk factors (hypertension, diabetes mellitus, dyslipidemia, smoking status), and relevant clinical parameters (Killip class, heart rate, blood pressure). Laboratory tests—complete blood count, renal function, lipid profile, and cardiac enzymes—were conducted on admission. The NLR was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. Patients were categorized into quartiles (Q1 to Q4) based on the admission NLR distribution.

Echocardiographic Assessment: All patients underwent a comprehensive transthoracic echocardiogram (TTE) during hospitalization. Left ventricular ejection fraction (LVEF) was measured using the Simpson's biplane method. Regional wall motion abnormalities and presence of left ventricular thrombus or significant valvular lesions were also evaluated.

Outcomes and Follow-up: The primary outcome was the incidence of major adverse cardiac events (MACE) within 30 days. MACE was defined as a composite of mortality, recurrent MI, and acute decompensated heart failure requiring intravenous therapy. Secondary outcomes included length of hospital stay, LVEF at discharge, and need for urgent revascularization (percutaneous coronary intervention or coronary artery bypass graft). Follow-up data were collected through medical records, telephone interviews, and outpatient visits.

Statistical Analysis: All data were analysed using SPSS (version 26, IBM Corp., USA). Continuous variables were presented as mean ± standard deviation or median (interquartile range) depending on normality of distribution, while categorical variables were expressed as percentages.

Between-group comparisons were performed using ANOVA or Kruskal–Wallis tests for continuous variables and chi-square tests for categorical variables. Logistic regression analyses were employed to identify independent predictors of MACE. A p-value < 0.05 was considered statistically significant.

Results

Overall Findings and Baseline Characteristics: A total of 120 patients with acute MI met the inclusion criteria and were followed for 30 days. Figure 1 outlines the flow of patient enrollment. Mean age was 59.2 ± 12.1 years, and 68% were males. Common comorbidities included hypertension (56%), diabetes mellitus (42%), and dyslipidemia (38%). Table 1 summarizes the baseline demographic and clinical characteristics, stratified according to NLR quartiles (Q1: lowest; Q4: highest).

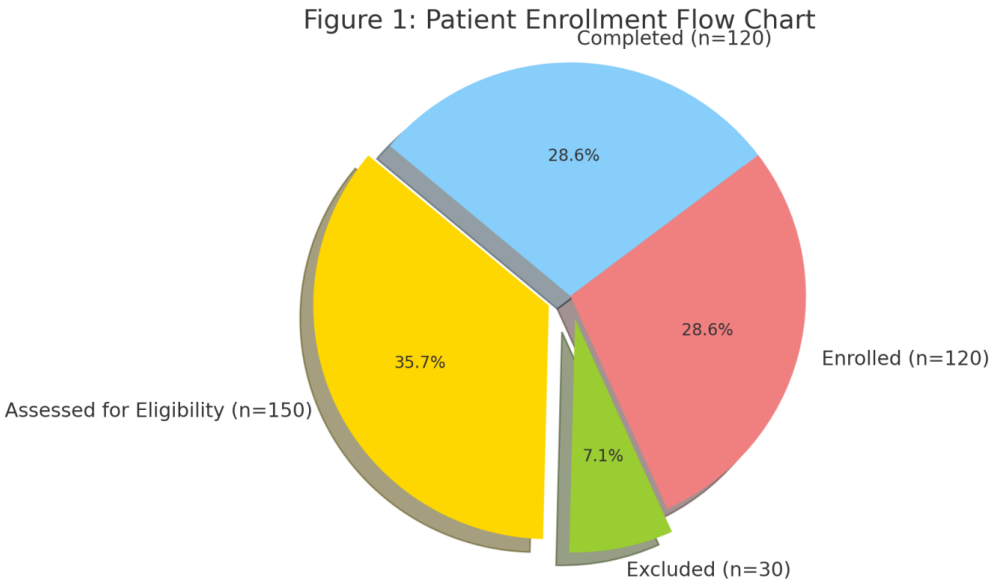

Figure 1. Patient Enrollment Flow Chart

Table 1: Baseline Characteristics by Nlr Quartile

Variable	Q1 (n=30)	Q2 (n=30)	Q3 (n=30)	Q4 (n=30)	p-value
Age (years)	55.2 ± 10.8	57.8 ± 11.2	60.1 ± 12.0	63.5 ± 12.3	0.06
Male (%)	19 (63)	20 (67)	21 (70)	22 (73)	0.82
Hypertension (%)	14 (47)	17 (57)	16 (53)	20 (67)	0.21
Diabetes Mellitus (%)	11 (37)	13 (43)	12 (40)	14 (47)	0.76
STEMI (%)	21 (70)	22 (73)	23 (77)	24 (80)	0.64
NLR (median [IQR])	2.1 [1.8–2.3]	3.0 [2.7–3.2]	4.1 [3.7–4.5]	6.1 [5.4–7.3]	<0.001

(IQR = Interquartile Range)

NLR Quartiles and Early Outcomes: Within the first few days of admission, patients in higher NLR quartiles tended to present with more extensive myocardial damage based on peak troponin levels and higher Killip class. At 30-day follow-up, a significant stepwise increase in MACE was observed across NLR quartiles, with Q4 having the highest incidence of MACE ($p<0.001$). Table 2 details the rates of mortality, recurrent MI, and acute heart failure.

Table 2: Early Outcomes by Nlr Quartile

Outcome	Q1 (n=30)	Q2 (n=30)	Q3 (n=30)	Q4 (n=30)	p-value
MACE (%)	3 (10)	5 (17)	9 (30)	14 (47)	<0.001
- Mortality (%)	1 (3)	1 (3)	3 (10)	5 (17)	0.03
- Recurrent MI (%)	1 (3)	2 (7)	3 (10)	4 (13)	0.17
- Acute Heart Failure (%)	2 (7)	4 (13)	6 (20)	10 (33)	0.02
Median LVEF at Discharge (%)	48	45	44	41	0.04
Mean Hospital Stay (days)	5.1 ± 1.2	5.4 ± 1.4	6.0 ± 1.5	6.3 ± 1.7	0.01

Patients in Q4 not only had increased mortality and heart failure but also experienced more frequent urgent revascularizations, indicative of more severe disease burden. In parallel, LVEF at discharge was significantly lower in the highest NLR quartile. Length of hospital stay increased as NLR rose, suggesting that a high inflammatory burden may delay recovery.

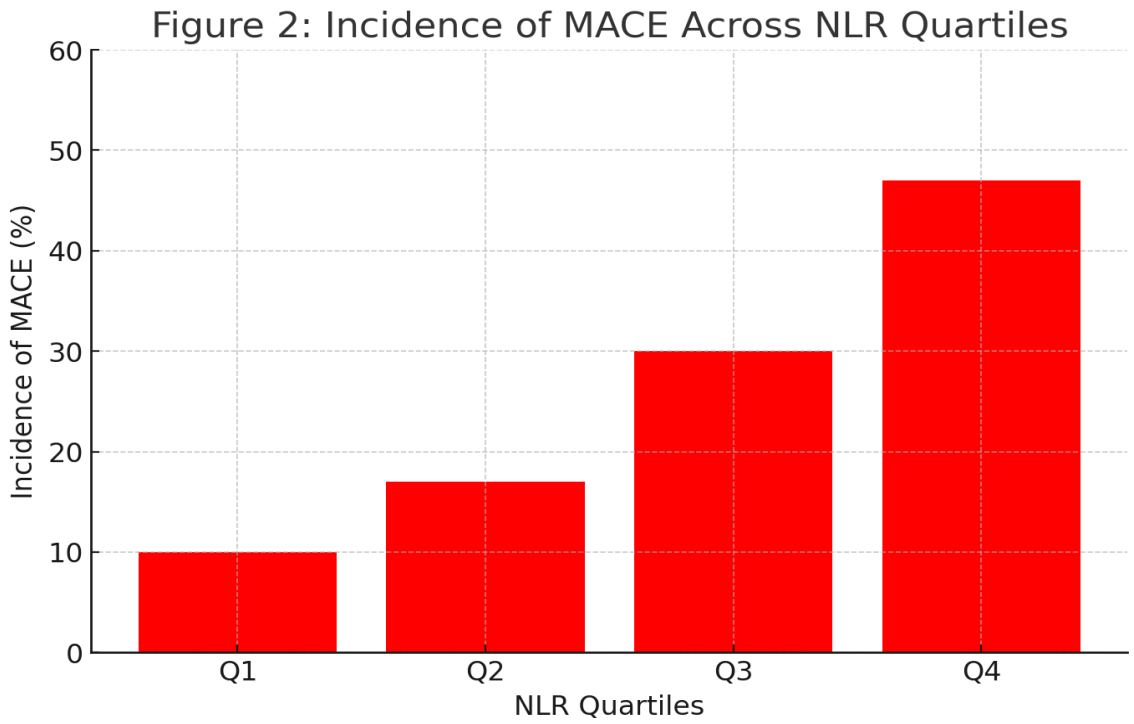

Figure 2: Incidence of MACE across NLR Quartiles (A bar chart showing Q1 ~10%, Q2 ~17%, Q3 ~30%, Q4 ~47% incidence of MACE.)

Multivariate Analysis: After adjusting for age, sex, Killip class, diabetes status, and baseline LVEF, a high NLR remained an independent predictor of 30-day MACE (odds ratio: 2.64; 95% CI: 1.45–4.22; p<0.001). Table 3 outlines the results of the logistic regression analysis, confirming that each incremental rise in NLR was associated with a proportionate increase in the risk of adverse outcomes.

Table 3: Multivariate Logistic Regression for 30-Day Mace

Variable	Odds Ratio (95% CI)	p-value
Age (per 1-year incr.)	1.02 (0.99–1.05)	0.06
Killip Class ≥ II	2.29 (1.20–3.71)	0.01
Diabetes Mellitus	1.37 (0.88–2.16)	0.16
LVEF < 40%	2.01 (1.12–3.45)	0.02
NLR (per unit incr.)	2.64 (1.45–4.22)	<0.001

Discussion

The current study underscores the significance of the neutrophil–lymphocyte ratio (NLR) in predicting early clinical outcomes in patients with acute myocardial infarction, reaffirming the hypothesis that heightened inflammatory responses correlate with worse cardiovascular prognosis [9]. Our findings reveal a stepwise increase in MACE incidence across escalating quartiles of NLR, suggesting that even modest elevations in this biomarker may signal a more severe pathophysiological process [10]. Moreover, multivariate logistic regression identified elevated NLR as an independent predictor of adverse events, corroborating earlier studies that have similarly linked high NLR to mortality and heart failure following acute MI [11,12]. Several mechanisms potentially explain the association between a high NLR and poorer cardiac outcomes. Neutrophils contribute to plaque instability, microvascular obstruction, and reperfusion injury through the release of proteolytic enzymes, reactive oxygen species, and inflammatory mediators [13]. Concurrently, lymphopenia may reflect an impaired adaptive immune response, further tilting the balance toward a pro-inflammatory state [14]. These processes, in aggregate, can exacerbate myocardial damage and lead to detrimental ventricular remodeling, ultimately manifesting as heart failure, recurrent ischemic events, or arrhythmic complications [15].

Interestingly, our data also indicate that patients in the highest NLR quartile had a lower discharge LVEF and a longer hospital stay, highlighting the broader clinical ramifications of heightened systemic inflammation. This finding aligns with

observations that persistent inflammatory activity can hinder left ventricular functional recovery and impede early rehabilitation [9]. Although established markers such as troponin, Killip class, and LVEF remain fundamental to risk stratification, the ease of obtaining a complete blood count with differential underscores the practicality of incorporating NLR into routine clinical workflows [10,11].

The strengths of our study include a well-defined cohort of patients with acute MI, a uniform data collection methodology, and a robust statistical approach. However, certain limitations warrant consideration. First, our single-center design may limit external generalizability; variations in local patient populations, treatment protocols, and follow-up practices could influence the reproducibility of our findings [12]. Second, we measured NLR only at admission, which provided a snapshot of the inflammatory milieu. Serial measurements might offer additional insights into dynamic changes and their correlation with clinical outcomes [13]. Finally, we did not account for potential confounders such as pre-existing subclinical infections or other sources of inflammation that may have affected the NLR [14].

In conclusion, this study strongly suggests that the admission NLR holds valuable prognostic information for the early outcome of myocardial infarction. Given its simplicity, low cost, and potential utility in guiding therapeutic strategies, NLR may be a worthwhile addition to existing risk stratification tools. Future multicenter trials with extended follow-up would further clarify how best to integrate NLR into standardized protocols and whether interventions targeting the inflammatory cascade could modulate this biomarker and improve clinical outcomes [15].

Conclusion

In summary, our study demonstrates that the admission neutrophil–lymphocyte ratio (NLR) serves as a robust, independent predictor of early adverse outcomes in patients presenting with acute myocardial infarction. Patients with higher NLRs exhibited increased rates of MACE, including mortality and heart failure, and had more pronounced reductions in left ventricular ejection fraction.

Given its affordability, wide availability, and strong prognostic implications, measuring NLR on admission can augment current risk assessment strategies. Further large-scale, multicenter studies with longer follow-up are warranted to confirm these findings and explore targeted anti-inflammatory interventions to potentially improve outcomes in high-risk patients.

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