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### RESEARCH ARTICLE

## PROGNOSTIC SIGNIFICANCE OF NEUTROPHIL LYMPHOCYTE RATIO AT ADMISSION IN ACUTE MYOCARDIAL INFARCTION

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#### Abstract

**Introduction:** Acute myocardial infarction (AMI) is the most common contributor of morbidity and mortality worldwide. Leukocytosis, predominantly neutrophilia has previously been described following AMI. Neutrophils exacerbate vascular plugging, secrete inflammatory mediators that aggravate myocardial ischemia. The Neutrophil-to-Lymphocyte ratio (NLR) stands out as the most reliable hematological marker for forecasting mortality or myocardial infarction in individuals at elevated risk for coronary artery disease and also serves as a strong indicator of long-term mortality among patients admitted with ST-segment elevation myocardial infarction (STEMI) as well as those receiving percutaneous coronary intervention (PCI)<sup>1,2</sup> To ascertain the prognostic significance of Neutrophil Lymphocyte Ratio (NLR) on the severity, morbidity, and mortality in patients with acute myocardial infarction during hospitalization, the current study is being conducted.

##### Materials and Methods:

**Study population:** All patients who are diagnosed with acute myocardial infarction and are admitted to departments of General Medicine and cardiology in Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation during the study period. Blood samples were collected within 24 hours of hospital admission, and investigations were performed to assess total leukocyte count, differential count and neutrophil/lymphocyte ratio. Outcomes were subsequently assessed, and the results obtained were subjected to statistical analysis.

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**Results:** Out of 100 patients, 76% were male, 41% were smokers, 43% were alcoholics, 56% were hypertensives and 38% were dyslipidemic. 8% developed arrhythmias, 19% developed cardiogenic shock and 7% expired. There was a statistically significant negative correlation between Ejection fraction and Neutrophil lymphocyte ratio

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ntly predict  
s, including  
arrhythmias, heart failure, and recurrent MI predicting the development of cardiogenic shock and poor long-term

outcomes. A simple analysis of TNC and NLR at admission helps to identify AMI patients who are at a higher risk of death and developing heart failure and help in risk stratification.

### Introduction:-

Various fundamental sciences, and clinical research have produced evidence in favor of a connection between inflammation and Myocardial infarction. Peripheral leukocyte count analysis is a cheap and accessible method for determining inflammation<sup>3,12</sup> and is linked to greater rates of short-term mortality and heart failure.<sup>4</sup> The majority of leukocytes in peripheral blood are neutrophils. Activated neutrophils infiltrate into the infarcted zone<sup>5,6</sup> during acute myocardial infarction, which contributes to the creation of a fibrotic scar that can produce arrhythmias.<sup>7,13,14</sup> In addition, platelet and neutrophil aggregates increase vascular clogging in the microcirculation<sup>8</sup> and cause the no-reflow phenomenon.<sup>1,2</sup> Inflammatory mediators are also secreted by neutrophils, worsening myocardial ischemia and widening the infarct area.

The Neutrophil-to-Lymphocyte ratio (NLR) stands out as the most reliable hematological marker for forecasting mortality or myocardial infarction in individuals at elevated risk for coronary artery disease and also serves as a strong indicator of long-term mortality among patients admitted with ST-segment elevation myocardial infarction (STEMI) as well as those receiving percutaneous coronary intervention (PCI)<sup>1-2</sup>

The prognosis of myocardial infarction patients can be predicted using a straightforward assessment of the Neutrophil Lymphocyte Ratio (NLR) at admission. To ascertain the prognostic significance of NLR on the severity, morbidity, and mortality in patients with acute myocardial infarction during hospitalisation, the current study is being conducted.

### Materials and Methods:-

We conducted a hospital based Prospective Observational Cross-sectional study at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation over a period of 24 months. All patients who were diagnosed with acute myocardial infarction and were admitted to General Medicine and cardiology departments were studied. 100 patients with myocardial infarction with Chest pain lasting more than 20 minutes, diagnostic ECG changes with characteristic ECG alternations consisting of new pathological Q wave or ST segment and T wave changes, and elevated Troponin- T (more than 40ng/L) were included in the study. Patients presenting after 48hrs and those with acute infections were excluded from the study. A detailed history and examination were conducted. Blood samples were collected within 24 hours of hospital admission, and investigations were performed to assess total leukocyte count, differential count, neutrophil/lymphocyte ratio. Outcomes were subsequently assessed, and the results obtained were subjected to statistical analysis.

This study employed both descriptive and inferential statistics to evaluate participant demographics and clinical characteristics. Categorical variables (e.g., age group, gender, hypertension, smoking, alcohol use) were summarized using frequencies and percentages, while continuous variables were reported as means with standard deviations. Simple logistic regression assessed associations between clinical parameters (e.g., leukocyte count, neutrophil count, glucose, NLR) and outcomes like mortality, arrhythmia, and cardiogenic shock. Odds ratios with p-values indicated the strength and significance of associations. Pearson correlation revealed a significant inverse relationship between ejection fraction and NLR. Statistical significance was determined at a p-value of <0.05.

### Results:-

A total of 100 patients were included in the study with mean age 56.4+/-9.6 years. Out of them, 76% were male, 41% were smokers, 43% were alcoholics, 56% were hypertensives and 38% were dyslipidemic. The mean values of laboratory investigations and ejection fraction are shown in Table 1.

**Table 1:-** Mean values of laboratory and imaging investigations results:

Parameter	Mean value
Hemoglobin	13.66 Gm%
Random blood glucose (In mg/dl)	175.8
Total leukocyte count (per 1000mm)	12,503
Total neutrophil count (Per 1000mm)	10,030
Neutrophil/lymphocyte ratio	8.12
Ejection fraction	47.36%

Out of 100, 86 patients received thrombolysis, while 14 did not. In our study, the most common types of MI are Anterior MI (43%) and Inferior MI (44%), both representing a significant portion of the cases. Other types include Extensive Anterior MI (6%), Anterior Lateral MI (2%), Anterior Septal MI (3%), Extensive Anterior Inferior MI (1%) and Inferior Lateral MI (1%) all of which are less frequent.

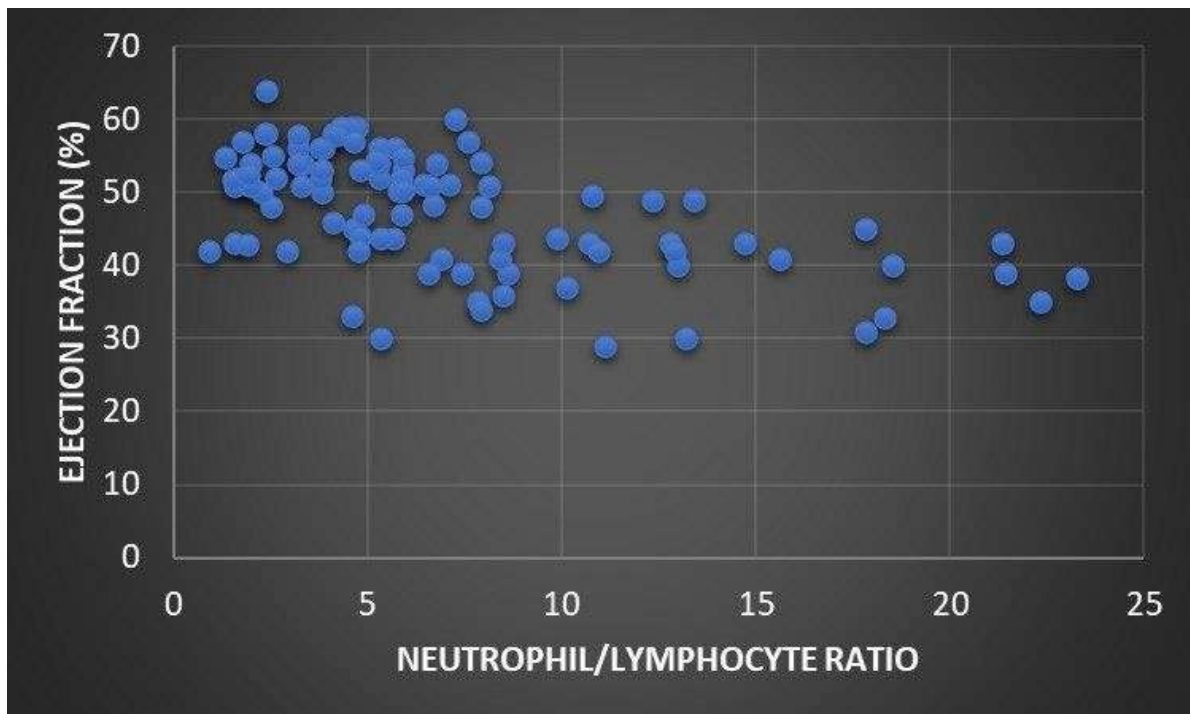
**Heart failure and cardiogenic shock:**

**Table 2:-** Distribution of patients according to Killip's class in the study (N=100).

Killip's class	Number of patients	Percent
I	37	37.0
II	18	18.0
III	25	25.0
IV	20	19.0
Total	100	100.0

The majority of patients, 37% (37 out of 100), fall into Killip's Class I, indicating no clinical signs of heart failure. This is followed by 25% in Class III, suggesting acute pulmonary edema, and 19% in Class IV, indicating cardiogenic shock. Class II, characterized by mild to moderate heart failure, accounts for 18% of patients. This distribution reflects a spectrum of heart failure severity, with the largest group having no overt heart failure and a substantial proportion experiencing more severe conditions.

**Graph 1:-** Correlation between Ejection fraction and Neutrophil/Lymphocyte ratio in Acute MI patients and a scatter plot depicting the correlation:



The correlation coefficient was found to be -0.566 with a P value of <0.01 indicating a statistically significant negative correlation between Ejection fraction and Neutrophil/lymphocyte ratio which means with increase in NLR a decrease in EF was observed and the risk of heart failure was increased. Also, a significant correlation was found between prediction of shock and total neutrophil count (p value-0.001), NLR and (p value- 0.02)

**Arrhythmia:**

Out of 100, majority, 92% (92 out of 100), did not have any arrhythmias. Of those who did, 4% (4 out of 100) had ventricular tachycardia (VT), 3% (3 out of 100) had ventricular fibrillation (V fib), and 1% (1 out of 100) had supraventricular tachycardia (SVT). This indicates that arrhythmias are relatively uncommon in the study population, with the most frequent type being VT. On statistical analysis, we found a statistically significant association with Neutrophil/lymphocyte ratio with arrhythmia (p value < 0.05).

#### Mortality:

Out of 100 patients, majority, 92% (92 out of 100), survived, while 8% (8 out of 100) experienced death. This indicates that the majority of individuals in the study survived, with a relatively small proportion experiencing mortality. Increased NLR is associated with increased risk of mortality with odds ratio 1.02 and p value 0.01.

**Table 3:-** Our study parameters and their prediction of death among MI patients.

Parameters	Shock		Arrhythmia		Mortality	
	Unadjusted Odd's ratio	P value	Unadjusted Odd's ratio	P value	Unadjusted Odd's ratio	P value
Total leukocyte count	1.18	0.001	1.17	0.04	1.09	0.03
Total Neutrophil count	1.17	0.001	1.18	0.03	1.19	0.02
Neutrophil/lymphocyte ratio	1.001	0.02	1.02	0.01	1.02	0.01

#### Discussion:-

Acute myocardial infarction (AMI) remains a leading cause of morbidity and mortality worldwide, presenting significant challenges in diagnosis, management, and prognosis. Despite advancements in therapeutic strategies, AMI continues to have high mortality rates and a substantial burden of complications, collectively termed major adverse cardiac events (MACE). These include recurrent myocardial infarction, arrhythmias, heart failure, and cardiogenic shock, which profoundly affect patient outcomes.

Identifying reliable prognostic markers is critical for improving risk stratification and tailoring interventions. Biomarkers such as the neutrophil-to-lymphocyte ratio (NLR) have emerged as simple, cost-effective tools reflecting systemic inflammation and metabolic stress, both of which play pivotal roles in AMI pathophysiology. NLR reflects the balance between the neutrophilic inflammatory response and lymphocytic immune regulation. As AMI involves a complex interplay of inflammation and stress-induced immune responses, NLR serves as a simple yet effective biomarker for assessing the severity and prognosis of the condition.

NLR is derived from routine complete blood counts, calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. Elevated NLR reflects a heightened inflammatory state coupled with lymphopenia, a marker of stress-induced immune suppression (Park et al., 2018)<sup>9</sup>. In the context of AMI, these changes are linked to the pathophysiology of acute coronary syndromes (ACS), including plaque rupture, thrombosis, and myocardial injury, which activate systemic inflammation and stress responses.

Numerous studies have highlighted the utility of NLR in predicting outcomes in patients with AMI, including mortality, heart failure, arrhythmia, and other complications. Its clinical significance lies in its cost-effectiveness, accessibility, and ability to provide actionable insights into the inflammatory milieu of the patient, making it particularly valuable in resource-constrained settings (Sharma et al., 2023)<sup>10</sup>.

#### Pathophysiological Basis of NLR in AMI:

The role of NLR as a prognostic marker is deeply rooted in the inflammatory and stress responses associated with AMI. During an AMI event, myocardial ischemia and infarction trigger the release of cytokines and chemokines, leading to the recruitment and activation of neutrophils. These neutrophils contribute to further tissue damage through the release of reactive oxygen species, proteolytic enzymes, and pro-inflammatory mediators, which exacerbate myocardial injury and promote adverse remodelling (Park et al., 2018)<sup>9</sup>.

Simultaneously, lymphopenia is observed as a consequence of increased apoptosis of lymphocytes, driven by elevated cortisol levels and catecholamine surge during acute stress. Lymphocytes play a protective role in cardiovascular health by modulating inflammatory responses and promoting tissue repair. The imbalance between these two cell populations, represented by an elevated NLR, reflects a state of heightened inflammation and impaired immune regulation, both of which are associated with poor outcomes in AMI (Wang et al., 2024)<sup>11</sup>.

#### **NLR and Mortality in AMI:**

One of the most significant applications of NLR is its ability to predict mortality in AMI patients. Studies have consistently demonstrated that elevated NLR is independently associated with increased all-cause and cardiovascular mortality. For example, Park et al. (2018)<sup>9</sup> reported that patients with higher NLR levels had a significantly increased risk of mortality compared to those with lower NLR levels. Their multivariate regression analysis revealed that NLR remained a strong predictor of death even after adjusting for traditional risk factors such as age, hypertension, diabetes, and left ventricular ejection fraction (EF). In a similar study by Sharma et al. (2023)<sup>10</sup>, NLR was significantly elevated in non-survivors compared to survivors of STEMI.

#### **NLR and Left Ventricular Dysfunction:**

Left ventricular dysfunction is a common and serious complication of AMI, contributing to the development of heart failure and increased mortality. Elevated NLR has been shown to correlate with reduced left ventricular ejection fraction (LVEF), suggesting its role as a marker of myocardial injury severity. In this study, a statistically significant negative correlation was observed between NLR and LVEF, with higher NLR values associated with lower ejection fractions<sup>9</sup>.

The pathophysiological link between NLR and left ventricular dysfunction lies in the inflammatory response during AMI. Neutrophils infiltrate the ischemic myocardium, releasing mediators that exacerbate tissue damage, impair myocardial perfusion, and promote adverse remodeling. Concurrently, lymphopenia reduces the immune system's ability to counteract excessive inflammation, resulting in worse cardiac function (Wang et al., 2024)<sup>11</sup>.

#### **NLR and Major Adverse Cardiac Events (MACE):**

NLR has also been associated with the prediction of major adverse cardiac events (MACE), including recurrent myocardial infarction, malignant arrhythmias, heart failure, and death. The inflammatory nature of AMI predisposes patients to these complications, and NLR serves as a surrogate marker for the severity of the underlying inflammatory process.

Wang et al. (2024) demonstrated that combining NLR with other biomarkers, such as the triglyceride-glucose index, improved the predictive accuracy for in-hospital MACE in STEMI patients undergoing PCI<sup>11</sup>. Their model incorporating NLR showed superior performance compared to traditional risk scores, highlighting its utility in refining risk stratification and guiding clinical decision-making.

Additionally, Sharma et al. (2023) reported that high NLR values were associated with a significantly increased incidence of arrhythmias, cardiogenic shock, and prolonged hospital stays in STEMI patients<sup>10</sup>. These findings suggest that NLR can aid in identifying high-risk patients who may benefit from closer monitoring and more aggressive therapeutic interventions.

#### **NLR and Cardiogenic Shock:**

Cardiogenic shock, a life-threatening complication of AMI, is characterized by reduced cardiac output and end-organ hypoperfusion. In this study, elevated NLR was significantly associated with the development of cardiogenic shock. Similar findings have been reported in previous research, where high NLR values predicted the onset and severity of cardiogenic shock in AMI patients (Sharma et al., 2023)<sup>10</sup>.

The link between NLR and cardiogenic shock lies in the systemic inflammatory response that drives vasodilation, capillary leakage, and myocardial dysfunction. Neutrophil activation and infiltration play a central role in this process, contributing to microvascular obstruction and further myocardial damage. The ability of NLR to predict cardiogenic shock emphasizes its potential as a marker for early risk stratification and targeted interventions in high-risk patients (Park et al., 2018)<sup>9</sup>.

Mortality and major adverse cardiac events (MACE) remain critical challenges in the management of acute myocardial infarction. Predictors such as elevated NLR, hyperglycemia, reduced LVEF, and advanced Killip class

provide valuable insights into patient risk and guide therapeutic decisions. By integrating these markers into clinical practice, healthcare providers can improve risk stratification, optimize treatment strategies, and enhance outcomes for AMI patients. Further research is needed to refine prognostic models and explore novel therapeutic approaches targeting inflammation and metabolic stress in this population.

### Conclusion:-

This study highlights the demographic, clinical, and prognostic profiles of acute myocardial infarction (MI) patients, predominantly middle-aged to elderly males, with hypertension, smoking, alcohol use, and dyslipidemia as common risk factors. Most patients received thrombolytic therapy, with anterior and inferior MIs being the most frequent. While arrhythmias and shock were relatively uncommon, heart failure severity varied widely, with a significant portion presenting in advanced Killip classes. Key laboratory markers — including elevated leukocyte count, neutrophil count, neutrophil/lymphocyte ratio (NLR), — were significantly associated with increased risks of mortality, arrhythmia, and cardiogenic shock. Notably, a significant negative correlation between ejection fraction and NLR suggests that higher systemic inflammation predicts poorer cardiac function. These findings emphasize the prognostic value of inflammatory and metabolic markers in acute MI and underscore the importance of early risk stratification to improve outcomes.

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### Disclosure statement:

There are no conflicts of interest to disclosure for the authors.

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