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Neutrophil-to-Lymphocyte Ratio Useful as Cost-Effective Preliminary Prognostic Marker in ST-Elevation Myocardial Infarction

Albeir Youssef Keiser[1]*, Haitham Mohammad Al-Amir Shahat Attia[1], Yasser M. Kamal[2], Sharaf El-Deen S. Mahmoud[2]

Departments of [1]Internal Medicine and [2]Cardiology, Faculty of Medicine, Sohag University, Sohag, Egypt

***Corresponding author: Albeir Youssef Youakim, Mobile:** (+20) 01010096136**, E-mail:** albeir.yousef@yahoo.com

ABSTRACT

Background: The neutrophil-to-lymphocyte ratio (NLR) serves as a key indicator of inflammation and plays a vital role in assessing cardiovascular risk. **Objective:** This study aimed to evaluate the utility of NLR in predicting both early and short-term outcomes in patients presenting with ST-segment elevation myocardial infarction (STEMI).

Patients and Methods: One hundred patients with STEMI who were at least eighteen years of age participated in this prospective observational study. Based on their NLR, the patients were split into two groups: Group I consisted of 77 patients with high NLR (>3) and Group II included 23 patients with normal NLR (1-3).

Results: NLR can significantly predict complication during hospital admission (arrythmia, pulmonary edema, heart failure (HF) and death) (P<0.001) at cut-off (>6.92, >6.93, >6.72 and >6.94 respectively) with (66.67% and 50% respectively) sensitivity, (88.66%, 90.72%, 72.16% and 91.84% respectively) specificity. NLR can significantly predict complication at follow up (arrythmia, pulmonary edema, HF and death) (P=0.033, 0.020 and<0.001 respectively at cut-off >6.62, >6.71, >6.73 and >6.84 respectively) with (71.43%, 60.00%, 83.33% and 80.00% respectively) sensitivity, (69.23%, 69.89%, 77.17% and 87.10% respectively) specificity.

Conclusions: The NLR at a cut-off value of >6.6 was significant prognostic marker for immediate and short-term outcomes in STEMI patients. NLR exhibit a sensitivity of 71.43% and specificity of 69.23%.

Keywords: Neutrophil-to-Lymphocyte Ratio, Cost-Effective, ST-Elevation Myocardial Infarction.

INTRODUCTION

Acute myocardial infarction (AMI) remains the leading global cause of mortality and represents a critical and life-threatening cardiovascular condition [1-4]. Coronary artery disease (CAD) is primarily driven by atherosclerosis, a chronic condition characterized by plaque buildup in the coronary vessels, which typically progresses silently over many years before becoming symptomatic [5].

Recent evidence highlights that complex immune and inflammatory mechanisms play a central role in both the initiation and progression of atherosclerotic lesions [6]. In ST-segment elevation myocardial infarction (STEMI), inflammation contributes significantly to plaque rupture, thrombus formation, and the overall advancement of atherosclerosis [7,8]. In the past decade, there has been a marked rise in interest regarding the use of inflammatory biomarkers in assessing CAD [7].

Although biomarkers such as troponin lactate dehydrogenase (LDH), and creatine kinase-MB (CK-MB) are linked to adverse outcomes in both STEMI and non-STEMI presentations, there remains a gap—particularly in resource-limited settings—for accessible and economical prognostic tools [1].

Among the affordable inflammatory markers, the NLR has emerged as a promising candidate for evaluating cardiovascular risk and predicting outcomes in AMI patients [1].

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Studies have consistently shown that elevated NLR levels upon admission and during early recovery are closely associated with worse complications post-AMI [9]. Many researches aimed to explore the prognostic significance and predictive value of NLR in individuals presenting with STEMI [10-13].

The objective of this study was to determine the utility of NLR in predicting both immediate and short-term clinical outcomes in STEMI patients.

PATIENTS AND METHODS

This prospective observational study was conducted on 100 patients, both males and females, aged ≥18 years, who were diagnosed with STEMI and had typical anginal chest pain, elevated blood cardiac biomarkers, and electrocardiogram (ECG) abnormalities. NSTEMI, unstable angina, other inflammatory, infectious, autoimmune, neoplastic, hepatic, renal, or thyroid conditions were excluded.

Based on their NLR, the patients were split into two groups: Group I consisted of 77 patients with a high NLR (>3), while Group II included 23 patients with a normal NLR (1-3) [2].

Every patient underwent a thorough history taking, clinical examination, laboratory testing (including complete blood count (CBC) and NLR), and radiographic testing (including echocardiography and 12-lead ECG).

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As per the 2019 ESC guidelines, a 12-lead ECG should be performed within 10 minutes of first medical contact [14]. ST-segment elevation in AMI is defined by specific thresholds at the J point in two contiguous leads: ≥0.25 mV in V2–V3 for men <40, ≥0.2 mV for men ≥40, >0.15 mV for women, and >0.1 mV in other leads (excluding cases with LVH or LBBB) [15].

Attention should also be given to QRS, ST, and T wave changes [16]. For every patient admitted to the hospital, a standard 12-lead ECG, including limb leads I, II, III, aVR, aVL, aVF, and chest leads VI to V6, was acquired within 10 minutes of FMC in accordance with the 2017 European Society of Cardiology (ESC) guidelines.

The ECG recordings were examined, elevation patterns of STEMI equivalent were addressed, and ischemic ECG abnormalities indicative of ST segment elevation MI were evaluated [17].

Using a Philips HD5 ultrasound machine, our cardiology department team conducted echocardiograms while according to the ASE guidelines' standard operating procedure. The following echocardiographic factors were investigated: Quantitative estimates of the left ventricle ejection fraction (LVEF), RA-superior inferior, RA-AREA, LA -diameters, LA-area, LA-volume, interventricular septum (IVS), left ventricle posterior wall (LVPW), and LV end diastolic and systolic diameters [18].

The neutrophil-to-lymphocyte ratio

NLR is a simple, accessible inflammation marker that reflects the balance between innate (neutrophil-driven) and adaptive (lymphocyte-driven) immune responses. It is believed to represent differences between innate and adaptive inflammation, which are triggered by lymphocytes and neutrophils, respectively. An NLR of 1 to 3 is considered normal; levels below 0.7 or over 3 indicate pathogenic inflammation (innate vs. adaptive immunity, respectively)[19].

Follow-up: Patients were monitored during hospitalization and for one month following discharge to identify any complications, including heart failure (HF), arrhythmias, a left ventricular ejection fraction (EF) of less than 50%, hypotension or shock, recurrent acute coronary syndrome (ACS), mechanical complications like ventricular septal wall rupture, mitral regurgitation, and ventricular rupture, and death [20].

Ethical approval:

After receiving approval from the Sohag University Hospitals' Ethical Committee in Sohag, Egypt, the study was conducted from July 2024 to December 2024 (approval code: Soh -Med-24-06-14 MS). The patients gave their signed, informed consent. The study adhered to the Helsinki Declaration throughout its execution.

Statistical analysis

SPSS version 26 was used for statistical analysis. An independent t-test was used to compare the groups' continuous data, which were reported as mean±SD. Categorical data were presented as frequencies and percentages, with comparisons made using either the Chi-square test or Fisher's exact test, depending on suitability. Receiver operating characteristic (ROC) curve analysis was utilized to assess diagnostic accuracy by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). A P-value below 0.05 was considered statistically significant in all tests.

RESULTS

NLR was high in 77 (77%) patients and normal in 23 (23%) patients **(Table 1)**.

Table (1): NLR of the studied patients

		N=100
NLR	**Group I**	77(77.0%)
	Group II	23(23.0%)

Neutrophil according to NLR ratio was significantly higher in the group I than group II. Lymphocyte according to NLR ratio was significantly lower in group I than group II **(Table 2)**.

Table (2): Demographic data, comorbidities, laboratory investigations, EF and ECG (site of blockage) according to NLR ratio

		Group I (n=77)	Group II (n=23)	P
Age (years)		53.75±16.92	54.35±14.72	0.879
Sex	**Male**	59(76.62%)	18(78.26%)	0.133
	Female	18(23.38%)	5(21.74%)	
Weight (kg)		67.31±12.21	68.39±12.29	0.711
Height (m)		1.79±0.09	1.77±0.07	0.491
BMI (kg/m^2)		21.14±3.93	21.84±4.32	0.465
Comorbidities	**DM**	36(46.75%)	8(34.78%)	0.310
	HTN	29(37.66%)	7(30.43%)	0.526
	Hyperlipidemia	21(27.27%)	5(21.74%)	0.595
	Smoker	43(55.84%)	8(34.78%)	0.076
	WBCs (10^9/l)	11.99±2.97	11.43±2.74	0.672
	Neutrophil (10^9/l)	12.72±3.1	4.87±1.12	**<0.001***
	Lymphocyte (10^9/l)	2.19±0.44	2.54±0.62	**0.004***
	Platelets (10^9/l)	249.04±62.11	244.74±61.00	0.789
	Creatinine (mg/dl)	1.03±0.21	1.02±0.20	0.847
	Urea (mg/dl)	15.27±3.79	14.83±3.69	0.757
	LDL (mg/dl)	75.62±8.91	77.17±8.13	0.457
	Troponin (ng/l)	2397.17±96.82	2297.13± 72.61	0.752
	EF (%)	48.61±8.59	48.43±8.94	0.932
	Triglyceride (mg/dl)	164.95±40.86	160.96±8.35	0.748
	RBS (mg/dl)	167.14±9.19	161.57±39.99	0.630
	Cholesterol (mg/dl)	192.25±36.89	195.74±31.48	0.682
EF (%)		48.49±8.55	48.43±8.94	0.977
ECG (site of blockage)	**Inferior wall MI**	51(66.23%)	14(60.87%)	0.648
	Anterior wall MI	20(25.97%)	7(30.43%)	
	Lateral wall MI	6(7.79%)	2(8.7%)	

*: Significant.

Complications during hospital admission and follow-up one month after discharge according to NLR ratio were insignificantly different between both groups **(Table 3)**.

Table (3): Overall complication during hospital admission and follow up one month after discharge according to NLR ratio

	Group I (n=77)	Group II (n=23)	P
Complication			
Arrythmia	3(3.9%)	0(0.0%)	1
Pulmonary edema	2(2.6%)	1(4.35%)	0.548
HF with LVEF <50%	2(2.6%)	1(4.35%)	0.548
Death	2(2.6%)	0(0.0%)	1
Follow up			
Arrythmia	6(8.0%)	1(4.35%)	1
Pulmonary edema	3(4.0%)	2(8.7%)	0.334
HF with LVEF <50%	5(6.67%)	1(4.35%)	1
Death	5(6.67%)	0(0.0%)	0.588

NLR can significantly predict complication during hospital admission (arrythmia, pulmonary edema, HF and death) at cut-off (>6.92, >6.93, >6.72 and >6.94 respectively) with (66.67% and 50% respectively) sensitivity, and (88.66%, 90.72%, 72.16% and 91.84% respectively) specificity **(Table 4)**.

Table (4): ROC curve of role of NLR in prediction of different complications during hospital admission

Cut off	AUC	Sensitivity	Specificity	PPV	NPV	P value
Arrythmia						
>6.92	0.863	66.67%	88.66%	15.4%	98.9%	**<0.001***
Pulmonary edema						
>6.93	0.866	66.67%	90.72%	18.2%	98.9%	**<0.001***
HF with LVEF <50%						
>6.72	0.902	66.67%	72.16%	6.9%	98.6%	**<0.001***
Death						
>6.94	0.893	50.0%	91.84%	11.1%	98.9%	**<0.001***

*: Significant.

NLR can significantly predict complication at follow up (arrythmia, pulmonary edema, HF and death) at cut-off >6.62, >6.71, >6.73 and >6.84 respectively) with (71.43%, 60.00%, 83.33% and 80.00% respectively) sensitivity, and (69.23%, 69.89%, 77.17% and 87.10% respectively) specificity **(Table 5)**.

Table (5): ROC curve of role of NLR in prediction of different complications at follow up

Cut off	AUC	Sensitivity	Specificity	PPV	NPV	P value
Arrythmia						
>6.62	0.666	71.43%	69.23%	15.2%	96.9%	**0.033***
Pulmonary edema						
>6.71	0.711	60.00%	69.89%	9.7%	97%	**0.020***
HF with LVEF <50%						
>6.73	0.628	83.33%	77.17%	19.2%	98.6%	**<0.001***
Death						
>6.84	0.910	80.00%	87.10%	25.00%	98.8%	**<0.001***

*: Significant.

DISCUSSION

One of the most prevalent illnesses in poor nations is AMI [21]. Traditionally, myocardial infarction has been classified as either non-ST elevation or ST elevation [22].

Our findings showed that group I had much more neutrophils than group II, but group I had significantly fewer lymphocytes than group II. There were negligible differences between the two groups in WBCs, platelets, creatinine, urea, LDL, troponin, triglycerides, random blood sugar (RBS), and cholesterol. Similarly, **Hou *et al.*** [23] showed that there was no significant difference between groups I and II in terms of troponin, creatinine, cholesterol, and LDL.

We found that the WBCs and fasting blood glucose were significantly higher in group I, while the triglyceride was significantly lower in group I than in group II. **Yoon *et al.*** [24] provided support for our findings by stating that the platelets and creatinine levels were not significantly different between both groups, while the neutrophil and lymphocyte levels were significantly higher in group I.

The EF difference between groups I and II in this investigation was negligible. **Yang *et al.*** [25] and **Curran *et al.*** [26] showed no significant difference in EF between the NLR > 3.22 group and the NLR < 3.22 group, which supports our findings.

The study found that there was no significant difference in the site of blockage between the two groups, with inferior wall myocardial infarction being the most prevalent site in both groups I and II. According to **Paul *et al.*** [27] the most frequent obstruction in individuals with STEMI was inferior wall myocardial infarction.

Hospital problems, such as arrhythmia, pulmonary edema, HF, or death during hospitalization

or within a month of discharge, did not significantly differ between groups I and II. According to **Yoon *et al.*** [24] there was no discernible difference in cardiovascular mortality or complications between groups I and II. Furthermore, the major cardiac events did not differ significantly between groups I and II, according to **He *et al.*** [28]. However, group I experienced a considerably higher rate of arrhythmia and mortality than group I.

With 71.43% sensitivity, 69.23% specificity, 15.2% PPV, and 96.9% NPV, NLR can significantly predict complications during hospital admission at cut-off >6.6 in the current study. **Hou *et al.*** [23] demonstrated that the ideal NLR cut-off value for forecasting in-hospital HF incidence was 6.58, with a sensitivity of 59.55% and a specificity of 60.90%, which is consistent with our findings. In line with our research, **Tavares *et al.*** [29] showed that an NLR of 6.15 predicted severe adverse cardiac events with 61.4% sensitivity and 58.4% specificity, while a cutoff of 6.44 predicted in-hospital mortality with 63.9% sensitivity and 60.2% specificity.

One of the study's limitations was the very small sample size. There was only one center for the study not contrasting the NLR with other STEMI prognostic indicators.

CONCLUSIONS

The NLR at a cut-off value of >6.6 was significant prognostic marker for immediate and short-term outcomes in STEMI patients. NLR exhibit a sensitivity of 71.43% and specificity of 69.23%.

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