

Original Research Article

The Role of Hematological Indices in Patients with Acute Coronary Syndrome

Abstract

Background: Acute coronary syndrome (ACS) including ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina - is an umbrella term for life-threatening situations that occur when the blood supply to the heart is altered due to destabilization of a previously stable atherosclerotic plaque. This alteration hinders the heart muscle from functioning properly and even could lead to death. This study aimed to identify the role of hematological indices in patients with acute coronary syndrome.

Methods: This prospective cohort study was carried out on 75 patients; they were divided into 3 groups each of them included 25 patients. Group I represent patients with myocardial infarction (MI), group II represents patients with unstable angina (UA) and control group included 25 subjects. All patients were subjected to complete history taking, clinical examination and routine laboratory investigation. Patients also were subjected to electrocardiography, transthoracic echo Doppler and coronary angiography.

Results: Regarding hematological indices for prediction of MI, the ROC revealed :NLR \geq 4.45 with sensitivity 96%, specificity 92%, Area under the curve 0.99 and accuracy 94%. RDW \geq 14.15 with sensitivity 96% specificity 72%, Area under the curve 0.973 and accuracy 84%. PLR \geq 88.8 with sensitivity 96%, specificity 96%, Area under the curve 0.994 and accuracy 96%. MPV \geq 9.65 with sensitivity 68%, specificity 52%, Area under the curve 0.646 and accuracy 60%. PDW \geq 15.15 with sensitivity 96%, specificity 96%, Area under the curve 0.998 and accuracy 96%.

Conclusions: There is a high demand for a reliable, accessible, noninvasive, and hematological prognostic marker in ACS, which would identify patients of high cardiovascular risk in secondary prevention and tailor the therapy to their needs. The inflammatory processes play a key role in the development of atherosclerosis, destabilization of atherosclerotic plaques and formation of clots on the plaque surface. There is a significance role of NLR, PLR, PDW, MPV, and RDW in the prognosis of ACS.

Keywords: Hematological, Indices, Coronary syndrome.

UNDER PEER REVIEW

Introduction:

Acute coronary syndrome (ACS) including ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina - is an umbrella term for life-threatening situations that occur when the blood supply to the heart is altered due to destabilization of a previously stable atherosclerotic plaque. This alteration hinders the heart muscle from functioning properly and even could lead to death ^[1]. ACS can also manifest as sudden cardiac arrest due to ischemia-induced tachyarrhythmias ^[2]. The pathophysiology of ACS is extremely heterogeneous; however, in majority of the cases it is associated with rupture of an atherosclerotic plaque and partial or complete thrombosis of the infarct-related artery ^[3].

Ruptured plaques contribute to thrombus formation by inflammatory mechanisms, which include the role of activated and inactivated platelets and platelet- leukocyte adhesions, leading to the development of ACS ^[4].

Therefore, inflammatory biomarkers related to platelets and leukocytes can be used as prognostic tools and for risk stratification of ACS patients a measure of variations in the volume of red blood cells. Moreover, these biomarkers are also an essential predictor of severity coronary artery disease and elevated white blood cell count (WBC) which was found to be a relevant death risk factor during the first 30 days and 6 months following the myocardial infarction. In addition, it also predicts platelet distribution width (PDW) which indicates a varied size of platelets, and furthermore it also serves as a useful prognostic factor for long-term mortality in patients after AMI ^[5].

Mean platelet volume (MPV) is an indicator of platelet size and activation marker. In the recent years, numerous papers have been published regarding the value of platelet to lymphocyte ratio (PLR), mean platelet volume to lymphocyte ratio (MPVLR) and neutrophil

to lymphocyte ratio (NLR) in predicting short and long-term mortality in patients with ST-elevation (STEMI) and with non-ST elevation (non-STEMI) [6].

The lymphocyte count is inversely association with inflammation, while the low lymphocyte count is a poorer prognostic marker in ACS patients [7]. This study aimed to identify the role of hematological indices in patients with acute coronary syndrome.

Patients and Methods:

This prospective cohort study was carried out on 75 patients admitted to cardiology department in Tanta University hospitals with acute coronary syndrome (ACS) in the period from December 2019 to August 2020. All patients gave an informed consent to participate in the study.

Patients with the following diseases: severe liver disease, autoimmune diseases, cancer, hematological disorder, severe valvular disease, inflammatory or infectious diseases, history of bleeding diathesis and patients taking the following drugs: corticosteroids, cytotoxic drugs, thrombolytic therapy, glycoprotein IIb/IIIa inhibitors were excluded.

Patients divided into 3 equal groups: Group I represent patients with myocardial infarction (MI), group II represents patients with unstable angina (UA) and control group included 25 subjects.

All patients in this study were subjected to the following:

Full medical history taking included personal history, past history of rheumatic fever, rheumatic activity, diabetes mellitus, hypertension and cerebrovascular stroke, obesity co-morbid diseases including severe liver disease, autoimmune diseases, cancer, hematological disorders, severe valvular diseases, inflammatory or infectious diseases and history of bleeding diathesis. Medical history as corticosteroids, cytotoxic drugs, thrombolytic therapy, glycoprotein IIb/IIIa inhibitors. Clinical examination: thorough clinical examination

including [Pulse and blood pressure, neck veins, edema of lower limbs, chest and abdominal examination, cardiac examination including inspection, palpation and auscultation]. Laboratory investigations including: Troponin level in the blood, a complete blood count done and the following measured: white blood cells (WBC) (Normal 4500-11,000/mm³), neutrophil to lymphocyte ratio (NLR) (Normal male 0.43-2.75 and normal female 0.37-2.87) and red cell distribution width (RDW) (Normal <15%).

Platelet indices that is: platelet to lymphocyte ratio (PLR) (Normal male 36.63~149.13 and normal female 43.36~172.68), mean platelet volume (MPV) (Normal 7.5 - 12.0 fl) and platelet distribution width (PDW) (Normal 8.3% to 56.6%).

Electrocardiography: ECG was done on admission at a paper speed of 25mm/s and amplification of 10mm/mv.

Depicted ECG changes were either: ST depression > 0.5 mm in 2 contiguous leads, T wave inversion, pathological Q waves or normal ECG (no ST deviation).

Transthoracic Echo Doppler study: the conventional Echo was performed by experienced echo cardiographer in accordance with the recommendations of the American Society of Echocardiography (ASE) and European Association of Echocardiography (EAE).

Coronary angiography: all MI and UA patient will undergo CA and document number of diseased vessels.

ACS patients were identified by using the following criteria: non-ST elevation myocardial infarction (NSTEMI) was confirmed if patients had raised cardiac enzymes without detectable ST segment elevation in the electrocardiogram (ECG). ST elevation myocardial infarction (STEMI) was confirmed if patient complained of typical chest pain lasting more than 20 min along with any one of the following characteristics: ST-segment elevation of at least 1 mm, formation of new Q wave, left bundle branch block formation in two or more contiguous leads, and/or two times increase in the cardiac enzymes. Unstable angina (UA)

was confirmed if there were detectable ischemic changes on an ECG with no increase in cardiac enzymes. Major adverse cardiac events (MACE) are defined positive if the patient developed any of the following events: reinfarction, cardiac arrhythmias, stroke and death.

Statistical analysis

Data were analyzed using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 21). The normality of data was first tested with one-sample Kolmogorov-Smirnov test. Qualitative data were described using number and percent. Association between categorical variables was tested using Chi-square test. Continuous variables were presented as mean \pm SD (standard deviation) for normally distributed data. The two groups were compared with Student t test. Significant variables entered into Logistic regression model using the forward wild statistical technique to predict the most significant determinants and to control for possible interactions and confounding effects. Sensitivity and specificity at different cut off points were tested by roc curve. P-Value \leq .05 was considered statistically significant.

Results:

As regarding age, the mean age between the three groups was 58.56 ± 6.32 , 55.96 ± 6.69 and 54.08 ± 1.49 respectively with statistically non-significant difference. Meanwhile for gender, group I there were 14 (56%) males, group II there were 16 (64%) males and 13 (52%) males in control group with non-statistically significant difference between the three groups

Regarding DM, in group I, there were 18 diabetic patients, 14 in group II and 9 in control group with only statistically significant difference between group I and control groups, p 0.011.

Regarding dyslipidemia, there were 17 patients in group I, 10 in group II and 5 in control group with significant difference between group I and controls and group I and group II p 0.001 and 0.047 respectively.

There were 18 hypertensive patients in group I, 17 in group II and 6 in control group with statistically significant difference between group I and controls and group II and controls p 0.001 and 0.002 respectively.

There were 8 smokers in group I, 13 in group II and 5 in control group with statistically significant difference between group II and controls p 0.018.

There were 6 patients in group I with positive family history of CAD, 5 in group II and 4 in control group with non-statistically significant difference between the three groups. (Table 1)

Table 1: Demographic data and risk factors among the studied groups

Variables	MI group (n=25)	UA group (n=25)	Control group (n=25)	P value		
				P1	P2	P3
Age (years) Mean ± SD	58.56±6.32	55.96±6.69	54.08±1.49	0.163	0.559	0.164
Sex						
Male	14 (56%)	16 (64%)	13 (52.0%)	0.777	0.390	0.564
Female	11 (44%)	9 (36%)	12 (48.0%)			
Smoking	8 (32%)	13 (52%)	5 (20.0%)	0.333	0.018*	0.152
Hypertension	18 (72%)	17 (68%)	6 (24.0%)	0.001*	0.002*	0.758
Dyslipidemia	17 (68%)	10 (40%)	5 (20.0%)	0.001*	0.123	0.047*
DM	18 (72%)	14 (56%)	9 (36.0%)	0.011*	0.156	0.239
Positive FH	6 (24%)	5 (20%)	4 (16.0%)	0.480	1.0	0.733

t: student t- test, x2: Chi square test, *significant p≤0.05, P1: comparison between MI group and control group, P2: comparison between UA group and control group, P3: comparison between MI group and UA group, DM: diabetes mellitus.

Regarding HB mg/dl, in group I, the mean was 13.53±1.56, 11.38±1.30 in group II and 15.03±0.93 in controls with statistically significant difference between the three groups with P value ≤0.001 for all.

Regarding WBCs, in group I, the mean was 11.63±3.72, 9.55±3.43 in group II and 7.39±2.17 in controls with statistically significant difference between the three groups with P value =≤0.001, 0.011 and 0.045 respectively.

Regarding NLR, in group I, the mean was 9.19±2.92, 6.70±2.76 in group II and 3.08±0.92 in controls with statistically significant difference between the three groups with P value =≤0.001, ≤0.001 and 0.003 respectively.

Regarding RDW, in group I, the mean was 17.27 ± 2.32 , 15.35 ± 1.62 in group II and 13.28 ± 1.15 in controls with statistically significant difference between the three groups with P value =0.001 for all.

Regarding PDW, in group I, the mean was 18.02 ± 1.49 , 17.06 ± 0.97 in group II and 10.14 ± 2.13 in controls with significant difference between the three groups with P value ≤ 0.001 , 0.033 and 0.01 respectively.

Regarding PLR, in group I, the mean was 181.54 ± 34.28 , 127.40 ± 22.57 in group II and 65.32 ± 12.19 in controls with statistically significant difference between the three groups with P value ≤ 0.001 for all. (Table 2)

Table 2: Hematological indices among the studied groups

Hematological indices	MI group (n=25)	UA group (n=25)	Control group (n=25)	P value		
				P1	P2	P3
HB mg/dl	13.53 ± 1.56	11.38 ± 1.30	15.03 ± 0.93	$\leq 0.001^*$	$\leq 0.001^*$	$\leq 0.001^*$
WBCs	11.63 ± 3.72	9.55 ± 3.43	7.39 ± 2.17	$\leq 0.001^*$	0.011*	0.045*
NLR	9.19 ± 2.92	6.70 ± 2.76	3.08 ± 0.92	$\leq 0.001^*$	$\leq 0.001^*$	0.003*
RDW	17.27 ± 2.32	15.35 ± 1.62	13.28 ± 1.15	$\leq 0.001^*$	$\leq 0.001^*$	0.001*
PLR	181.54 ± 34.28	127.40 ± 22.57	65.32 ± 12.19	$\leq 0.001^*$	$\leq 0.001^*$	$\leq 0.001^*$
MPV	10.21 ± 1.15	10.15 ± 0.95	9.50 ± 1.33	0.048*	0.052	0.842
PDW	18.02 ± 1.49	17.06 ± 0.97	10.14 ± 2.13	$\leq 0.001^*$	0.033*	0.01*

WBCs: white blood cells, NLR: Neutrophil-Lymphocyte Ratio, RDW: Red Cell Distribution Width, PLR: Platelet to lymphocyte ratio, MPV: Mean platelet volume, PDW: Platelet distribution width, MI: myocardial infarction, UA: unstable angina.

Regarding LVEF, the mean was 48.40 ± 8.06 in group I, 54.28 ± 6.11 in group II and 64.64 ± 5.31 controls with statistically significant difference between the three groups, P value ≤ 0.001 , ≤ 0.001 and 0.006 respectively. Regarding Troponin, the mean was 1.72 ± 0.49 in group I, 0.064 ± 0.03 in group II and 0.059 ± 0.03 in controls with significant difference between group I and controls and group I and group II with P value ≤ 0.001 for both. (Table 3).

Table 3: LVEF and troponin level among the studied groups

Variables	MI group (n=25)	UA group (n=25)	Control group (n=25)	P value		
				P1	P2	P3
LVEF	48.40 ± 8.06	54.28 ± 6.11	64.64 ± 5.31	$\leq 0.001^*$	$\leq 0.001^*$	0.006*
Troponin	1.72 ± 0.49	0.064 ± 0.03	0.059 ± 0.03	$\leq 0.001^*$	0.604	$\leq 0.001^*$

LVEF: Left ventricular ejection fraction, MI: myocardial infarction, UA: unstable angina.

Regarding One vessel, in group I, there were 5 (20%) patients while in group II there were 12 (48%) patients with statistically significant difference between the two groups, P value 0.037.

Regarding Two vessels, in group I, there were 9 (36%) patients while in group II there were 7 (28%) patients with non-significant difference between the groups, P value = 0.544.

Regarding multi-vessels, in group I, there was 11 (44%) patients while in group II there were 6 (24%) patients with statistically non-significant difference between the groups, P value 0.136. (Figure1)

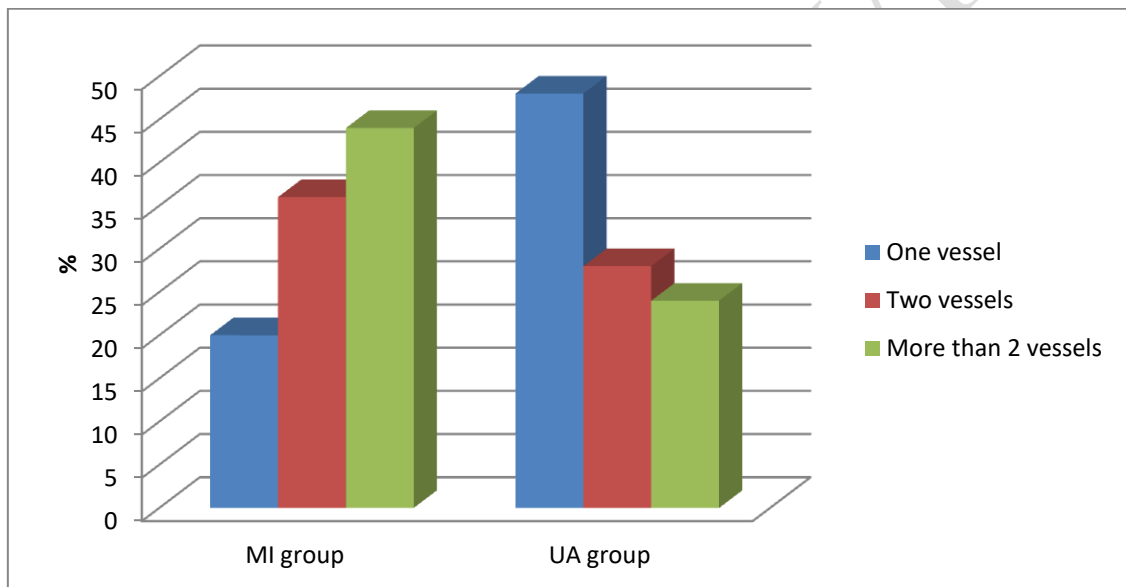


Figure 1: Coronary angiography among MI and UA groups

Regarding follow up, 2 patients had reinfarction in group I and no one in group II, 8 had arrhythmias in group I and 6 in group II, 5 patients died in group I and in group II, with statistically non-significant difference, p values 0.49, 0.529 and 1 respectively. Seven patients had stroke in group I and 2 in group II with statistically significant difference between the two group, p value 0.048. (Table 4)

Table 4: MACE among MI and UA groups

	MI group (n=25)	UA group (n=25)	P value
Reinfarction	2 (8.0%)	0 (0%)	0.490

Arrhythmias	8 (32.0%)	6 (24.0%)	0.529
Stroke	7 (28.0%)	2 (8.0%)	0.048*
Death	5 (20.0%)	4 (16.0%)	1.0

ROC curve analysis was done to pick up the best cut off value of different hematological indices for prediction of MI which revealed: NLR \geq 4.45 with sensitivity 96%, specificity 92%, Area under the curve 0.99 and accuracy 94%. RDW \geq 14.15 with sensitivity 96% specificity 72%, Area under the curve 0.973 and accuracy 84%. PLR \geq 88.8 with sensitivity 96%, specificity 96%, Area under the curve 0.994 and accuracy 96%. MPV \geq 9.65 with sensitivity 68%, specificity 52%, Area under the curve 0.646 and accuracy 60%. PDW \geq 15.15 with sensitivity 96%, specificity 96%, Area under the curve 0.998 and accuracy 96%.

(Figure 2)

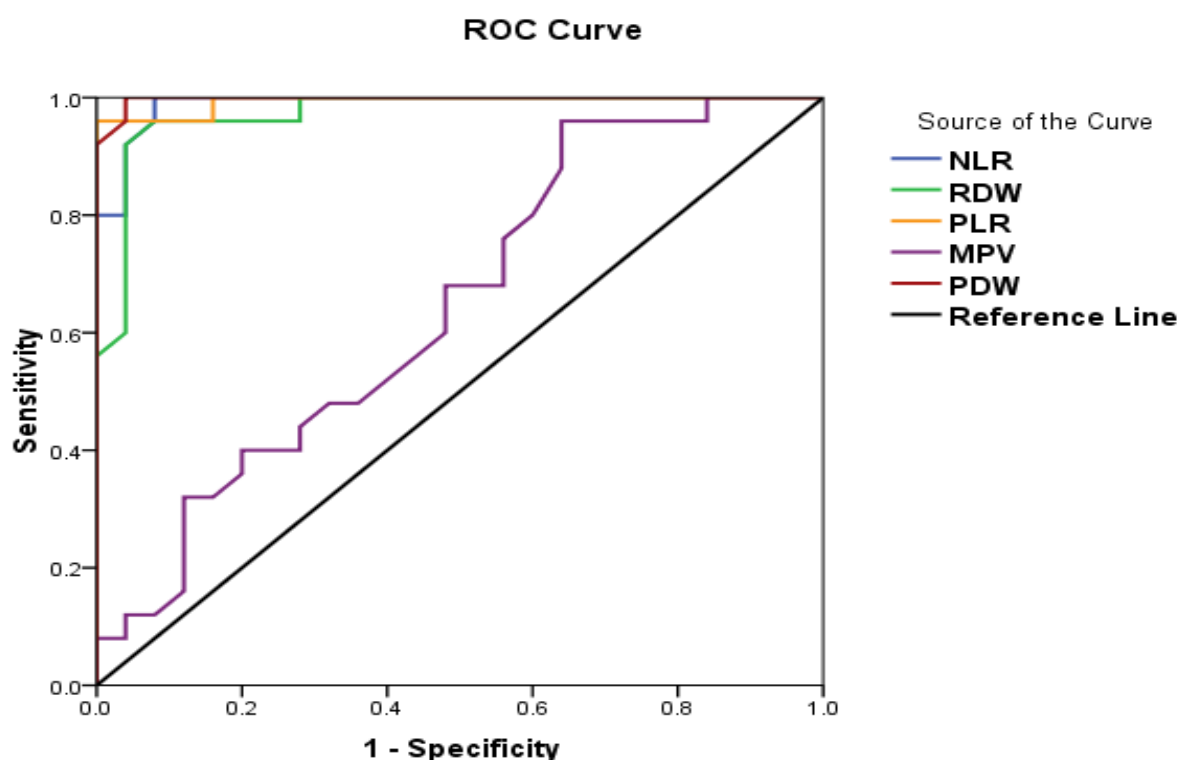


Figure 2: ROC for prediction of MI by hematological indices

A multivariate logistic regression model was performed to ascertain the predictors of MI, it showed that NLR, RDW, PLR, PDW and multivessel disease are independent predictors for MI (significant p value ≤ 0.05). (Table 5)

Table 5: Multivariate logistic regression analysis for independent predictors of MI

Independent predictors	β	Std. Error	P value	RR (95% CI)
NLR	1.65	0.654	0.012*	5.2 (1.4-18.7)
RDW	1.29	0.665	0.045*	3.6 (1.9-13)
PLR	3.31	0.970	0.001*	27.3 (4.1-150)
PDW	1.22	0.612	0.046*	3.4 (1.02-11.2)
Multivessels	1.31	0.64	0.041*	3.7 (1.1-12.9)

RR: Relative risk, CI: confidence interval

A multivariate logistic regression model was performed to ascertain the predictors of mortality, it showed that NLR, PLR, multivessel disease and LVED are independent predictors for mortality (significant p value ≤ 0.05). (Table 6)

Table 6: Multivariate cox regression analysis for independent predictors of Mortality

Independent predictors	P value	HR (95% CI)
NLR	0.021*	1.42 (1.1-1.9)
PLR	0.013*	1.03 (1.01-1.05)
Troponin	0.087	2.1 (0.9-4.7)
Multivessels	0.014*	5.1 (1.5-44)
LVEF	0.003*	0.72 (0.58-0.89)

HR: hazard ratio, CI: confidence interval

Discussion:

The role of hematological indications about white blood cells (WBC), neutrophil to lymphocyte ratio (NLR), red cell distribution width (RDW), and platelet indices, that is, platelet to lymphocyte ratio (PLR), as well as the mean platelet volume (MPV), and the platelet distribution width (PDW) in ACS patients is a new era for study ^[8].

As regarding age, the mean age between the three groups was 58.56 ± 6.32 , 55.96 ± 6.69 and 54.08 ± 1.49 respectively with statistically non-significant difference.

This was similar to Chen et al. (2018) ^[9] who studied hematological indices (Neutrophil to lymphocyte ratio) as a predictor of myocardial damage and cardiac dysfunction in acute coronary syndrome patients. Total of 715 patients with myocardial infarction who underwent PCI with stent within 72 hours of symptom onset with mean age was $61.38 (\pm 9.84)$ years and found statistically non-significant difference between studied groups.

Gender, group I there were 14 (56%) males, group II there were 16 (64%) males and 13 (52%) males in control group with non-statistically significant difference between the three groups.

In contrast to Timóteo et al. (2015)^[10] who studied the Predictive impact of hematological parameters in Acute Coronary Syndromes on 787 patients 70% males and found statistically significant difference between studied groups (p value 0.012).

There were 18 hypertensive patients in group I, 17 in group II and 6 in control group with statistically significant difference between group I and controls and group II and controls p 0.001 and 0.002 respectively.

Regarding DM, in group I, there were 18 diabetic patients, 14 in group II and 9 in control group with only statistically significant difference between group I and control groups, p 0.011.

There were 8 smokers in group I, 13 in group II and 5 in control group with statistically significant difference between group II and controls p 0.018.

This was similar to Adam et al. (2018)^[11] who studied Efficacy of Hematological and Coagulation Parameters in the Diagnosis and Prognosis of Patients with Acute Coronary Syndrome and found statistically non-significant difference between MI group and UA group regarding risk factors (diabetes, hypertension and smoking) with p value > 0.05.

Regarding HB mg/dl, in group I, the mean was 13.53±1.56, 11.38±1.30 in group II and 15.03±0.93 in controls with statistically significant difference between the three groups with P value ≤0.001 for all.

This was in concordance with Acet et al. (2015)^[12] who studied the role of different Hematological Indices (neutrophil to lymphocyte ratio, platelet to lymphocyte ratio and thrombolysis in myocardial infarction risk score) in patients with ST elevation acute myocardial infarction before primary coronary intervention and divided the patients into two groups (in group I, the mean was 14.02 ±1.65 while in group II the mean was 13.49 ±1.65 and the main difference between the groups was statistically significant with P value =0.002.

In contrary to Bekler et al. (2016) ^[13] in which a total of 251 patients (191 men and 60 women) with NST-ACS. The NST-ACS consisted of unstable angina (UA) and non-ST elevated myocardial infarction (NSTEMI) evaluated for the relationship between red cell distribution width as a Hematological Indices and identifying NSTEMI patients in NST-ACS and found statistically non-significant difference regarding Hemoglobin (g/dL) with p value = 0.222.

Regarding WBCs, in group I, the mean was 11.63 ± 3.72 , 9.55 ± 3.43 in group II and 7.39 ± 2.17 in controls with statistically significant difference between the three groups with P value ≤ 0.001 , 0.011 and 0.045 respectively.

This was in concordance with Adam et al. (2018) ^[11] in which 250 patients with ACS was assessed the role of hematological and coagulation parameters in the Diagnosis and Prognosis and found statistically significant difference between studied groups regarding White blood cell count ($\times 10^3/\mu\text{L}$) with p value < 0.001 .

Regarding NLR, in group I, the mean was 9.19 ± 2.92 , 6.70 ± 2.76 in group II and 3.08 ± 0.92 in controls with statistically significant difference between the three groups with P value ≤ 0.001 , ≤ 0.001 and 0.003 respectively.

This was similar to Tahto et al. (2017) ^[14] who studied Neutrophil-to-lymphocyte Ratio and Its Relation with Markers of Inflammation and Myocardial Necrosis in Patients with Acute Coronary Syndrome and divided 100 patients with ACS (50 males, 50 females), aged 41 to 91 years, into two groups: AMI group (n=50) and UA group (n=50) and found that the mean values of the peripheral blood NLR in the AMI group were significantly higher than those observed in patients in the UA group (p = 0.001).

Also, in concordance with Maréchal et al. (2020) ^[15] who studied the role of Neutrophil Phenotypes in Coronary Artery Disease and divided study population according to ACS

presentation and found statistically significant difference regarding NLR with p value <0.0001.

Also, similar to Im Cho et al. (2015) ^[16] who studied the role of Hematological Indices in Coronary Artery Disease after Percutaneous Coronary Intervention with a Drug-Eluting Stent and found statistically significant difference regarding NLR with p value <0.001.

Regarding RDW, in group I, the mean was 17.27 ± 2.32 , 15.35 ± 1.62 in group II and 13.28 ± 1.15 in controls with statistically significant difference between the three groups with P value =0.001 for all.

This was in concordance with Bekler et al. (2016) ^[13] who studied Relationship between red cell distribution width and long-term mortality in patients with acute coronary syndrome and divided study population according to ACS presentation and found statistically significant difference regarding Red cell distribution width, % with p value <0.001.

Also, in in concordance with Tenekecioglu et al. (2015) ^[17] who studied the association between Red blood cell distribution width and myocardial injury in acute coronary syndrome and divided study population according to ACS presentation and found the mean was 13.06 ± 1.7 for UA group while the mean was 14.6 ± 1.0 for MI group with statistically significant difference regarding Red cell distribution width, % with p value 0.006.

In contrary to Acet et al. (2015) ^[12] who studied the role of different Hematological Indices in patients with myocardial infarction before primary coronary intervention and found statistically non-significant difference regarding Red cell distribution width, % with p value 0.08.

Regarding PLR, in group I, the mean was 181.54 ± 34.28 , 127.40 ± 22.57 in group II and 65.32 ± 12.19 in controls with statistically significant difference between the three groups with P value ≤ 0.001 for all.

This was similar to Oylumlu et al. (2020) ^[18] who studied the role of Platelet-to-lymphocyte ratio in prediction of long-term mortality in patients with acute coronary syndrome and divided 538 patients according to PLR and PLR, which is an easily calculated and universally available marker, may be useful in long-term risk classification of patients presenting with ACS.

Also, similar to Im Cho et al. (2015) ^[16] who studied the role of Hematological Indices in Coronary Artery Disease after Percutaneous Coronary Intervention and found statistically significant difference regarding Platelet-to-Lymphocyte Ratio with p value <0.001.

In contrary to Maréchal et al. (2020) ^[15] who studied the role of Neutrophil Phenotypes in Coronary Artery Disease and divided study population according to ACS presentation and found statistically non-significant difference regarding Platelet-to-Lymphocyte Ratio with p value 0.212.

Regarding PDW, in group I, the mean was 18.02 ± 1.49 , 17.06 ± 0.97 in group II and 10.14 ± 2.13 in controls with significant difference between the three groups with P value ≤ 0.001 , 0.033 and 0.01 respectively.

This was similar to Niu et al. (2018) ^[19] who studied the components of the complete blood count in patients with acute coronary syndrome and divide 2,693 patients with ACS according risk category and found statistically significant difference regarding platelet distribution width with p value <0.001.

Regarding Troponin, the mean was 1.72 ± 0.49 in group I, 0.064 ± 0.03 in group II and 0.059 ± 0.03 in controls with significant difference between group I and controls and group I and group II with P value ≤ 0.001 for both.

This was in concordance with Tahto et al. (2017) ^[14] who studied Neutrophil-to-lymphocyte Ratio and Its Relation with Markers of Inflammation and Myocardial Necrosis in Patients with Acute Coronary Syndrome and divided 100 patients into two groups: AMI group and

UA group and found statistically significant difference regarding hsTnI level and CK-MB activity in the serum of patients with ACS with p value <0.001.

Regarding comparison between MACE positive and MACE negative patients, it was only significant for PLR and LVEF with p values 0.002 and 0.004 (table 10). Other parameters had statistically non-significant difference between the two groups.

This was in concordance with Adam et al. ^[11] who found significant correlation between MACE and PLR and LVEF with p values 0.001 and 0.003 respectively, but also disagreed with our results regarding NLR and number of diseased vessels which were significant -in contrary to ours- with p 0.034 and 0.031 respectively.

Our result showed that NLR > 4.45, RDW > 14.15, PLR > 88.8. MPV 9.65 and PDW > 15.15 is an independent predictor for MI (significant p value ≤0.05).

This was similar to Tahto et al. (2017) ^[14] who found Average WBC count, neutrophil granulocytes, and monocytes were significantly higher in AMI group than in UA group (p = 0.001, p < 0.0005, p = 0.03, respectively) and NLR was significantly higher in AMI group in relation to patients with UA (p = 0.001).

Also, similar to Acet et al. (2015) ^[12] who found NLR and platelet distribution width (PDW) were significantly associated with a high STEMI risk (p = 0.016, p = 0.008, respectively), but PLR was not associated.

Also, in agreement with Im Cho et al. (2015) ^[16] who found patients with a high PLR (>128) and high NLR (>2.6) had the highest occurrence of adverse events in ACS setting.

Conclusions:

Based on our findings we conclude that the WBC, NLR, RDW, as well as platelet indices, that is, PLR, in addition to MPV and PDW were significantly higher in AMI patients in comparison to UA patients. These findings prove the crucial role of this inflammatory marker

in discriminating ACS clinical forms. This is shown while bearing in mind the major demand for a reliable, accessible, noninvasive, and hematological prognostic marker in ACS, which can identify patients suffering severe cardiovascular illnesses in secondary prevention and modifying the therapeutic model needed by them. Indeed, the inflammatory processes are important in developing atherosclerosis, destabilizing atherosclerotic plaques, and clot formation on the plaque surface. Hence, there's a major crucial role of NLR, PLR, PDW, MPV, and RDW in ACS prognosis.

Study limitation:

This research is a preliminary study. Reader should aware regarding the small sample size. The future study should contain more samples for better conclusion.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

Consent

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

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