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Abuzer Coskun*

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Research Article

Platelet/Mpv and Neutrophil/Lymphocyte Ratio in Prediction of Three Vascular Disease and Bypass in Patients with Acute Coronary Artery Syndrome

Abuzer Coskun [1*], Burak Demirci [1], Sevki Hakan Eren [2]

[1] SBU Istanbul Bağcılar Training and Research Hospital, Emergency Medicine Clinic, Istanbul, Turkey.

[2] Gaziantep University Medical Faculty, Department of Emergency, Gaziantep, Turkey.

Corresponding Author: Abuzer Coskun, SBU Istanbul Bağcılar Training and Research Hospital, Emergency Medicine Clinic, Istanbul, Turkey.

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Abstract

Acute coronary syndrome (ACS) is the most important reason for admission to the emergency department all over the world. It was aimed to evaluate the effects of Platelet/Mean Platelate Volume ratio (PMR) and Neutrophil/lymphocyte ratio (NLR) levels in terms of complications after ACS, triple vessel disease (TVD), bypass and mortality.

This cross-sectional cohort study included 913 patients over the age of 18, who were admitted to the emergency department with a pre-diagnosis of ACS and admitted to the clinic between January 2013 and December 2017. Three groups were formed according to the patients' ACS diagnoses. These groups were compared in terms of PMR and NLR values, bypass, TVD and mortality.

The mean age of 913 patients included in the study was 63.84±12.18 years and 346 (37.9%) were female. NLR of the patients was 3.81±4.26% and PMR was 31.0±8.63% (p=0.001). By-pass was presebt in 46 (33.1%) and TVD in 90 (64.7%) patients, both of which were most common in the NSTEMI group (p=0.001). Mortality was observed in 20 (14.4%) NSTEMI cases and 37 (9.9%) STEMI cases (p=0.001). The most common complication after ACS was ischemic heart failure (p=0.001). Gensini score of patients who underwent bypass was 70.11±56.96 points, left ventricular ejection fraction was 45.82±11.34%, NLR was 8.46±7.76%, and PMR was 35.74±2.70%, which was significantly higher than those without bypass (p=0.001). In the TVD group, NLR was 6.01±5.33% and PMR was 37.06±5.11%. It was found to be significantly higher than the group without TVD (p=0.001).

In patients with acute coronary syndrome, PMR and NLR values are fast, easy to apply, inexpensive and reliable laboratory tests in predicting bypass, triple-vessel disease and mortality.

Keywords: acute coronary syndrome; emergency department; platelet/mean platelate to volume ratio; neutrophil/lymphocyte ratio; bypass; three vessel disease

Introduction:

Coronary artery disease is still the most common cause of both morbidity and mortality worldwide. Despite the developing treatment possibilities, the prolongation of the average life expectancy also increases the number of elderly patients and the number of recurrent cardiovascular patients [1]. Acute coronary syndromes (ACS) usually occur when coronary blood flow is interrupted in previously narrowed arteries by atherosclerosis [2].

Cellular events occurring in platelets, white blood cells, vascular endothelium, smooth muscle cells and macrophages are important components of atherogenesis [3]. ACS is caused by thrombus formed in the coronary arteries [4]. Thrombus formation by the adhesion and aggregation of platelets is followed by a stable coronary fibrin-thrombus formation with the activation of the coagulation system [3]. Circulating platelets are heterogeneous in size, density, and reactivity. Increased platelet reactivity causes shortening of bleeding time and increased platelet volume. Platelet size change occurs with an increase in

megakaryocyte volume, which is accompanied by an increase in platelet production when platelet destruction rate increases [5]. Mean Platelet Volume (MPV) is a simple and reliable platelet measure index that correlates with the functional status of platelets. Some studies have revealed that MPV is a parameter independent of known risk factors such as recurrent myocardial infarctions, hypertension, dyslipidemia, increased fibrinogen and white blood cell count. High MPV levels have been found in atherothrombosis [6,7].

Chronic inflammation is present at every stage of the development of atherosclerosis. Leukocytes have a very important role in this inflammatory process. White blood cell has been studied as an inflammatory biomarker to predict outcomes in patients with coronary artery disease [8-10]. Neutrophils play a direct role in the initiation of plaque rupture [11]. White blood cell is a strong independent predictor of mortality in patients diagnosed with ACS [12]. It has been shown that the neutrophil/lymphocyte ratio (NLR) may be a systemic marker of inflammation in predicting the morbidity, mortality and risk of myocardial infarction in high-risk coronary artery disease [13].

In our study, we aimed to reveal the importance of platelet/MPV ratio (PMR) and NLR in the prediction of acute coronary syndrome in the evaluation of by-pass, three vessel disease and mortality.

Materials and methods:

Study design and population

This retrospective study included 913 patients over the age of 18 (346 women, mean age 63.84±12.18 years, range 22-94 years), who were admitted to the emergency department with chest pain between January 2013 and December 2017, and were hospitalized with the prediagnosis of acute coronary syndrome. The study was performed in accordance with the Declaration of Helsinki, after the approval of the local ethics committee.

In addition to patients with cerebrovascular disease, low coma score, hospitalized in the intensive care unit, taking psychiatric medication, acute liver failure, dialysis history due to acute renal failure, infections such as meningitis, encephalitis and acute tuberculosis, malignancy and pregnant patients; patients without angiography, ejection fraction, hemogram and biochemistry blood results were excluded from the study.

According to the acute coronary syndrome status of the patients, three groups were formed: unstable angina (UA), ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI). Patients with ST-elevation myocardial infarction were divided into seven groups according to inferior, posterior, anterior, lateral, high lateral, diffuse anterior myocardial infarction and absence of ST-elevation. Unstable patients were determined according to the Braunwald classification [14] and high-risk patients were included in the study.

The patients were divided into two groups according to whether they had triple vessel disease (TVD), mortality, atrial fibrillation and bypass operation. The patients were divided into 3 groups as right bundle branch block, left bundle branch block and no development of bundle branch block.

In terms of complications developing after acute coronary syndrome, patients were divided into 8 groups as ischemic heart failure, ventricular tachycardia, atrioventricular block, cardiac tamponade, pleural effusion, pulmonary edema, ventricular fibrillation and no complications.

Cardiac troponin I was evaluated first at the patient's arrival to the emergency department, and then at 6 and 24 hours. The troponin values taken were recorded as I, II, and III.

Laboratory Design

Cardiac troponin, hemogram and biochemical blood samples were taken at the time of admission to the emergency department. Hemogram blood was measured using Sysmex DI-60 CBC Analyzer (Istanbul, Turkey). Biochemistry blood was analyzed with the Beckman Coulter Automated AU-680 (Beckman Coulter, Inc., Fullerton, CA, USA). Hemogram and biochemistry results were studied in 45-60 minutes. Troponin I STAT Elecsys and Cobas e 411 Hitachi Roche analyzers was used to measure Troponin I levels. Troponin levels of the patients were measured at 0, 6 and 24 hours.

Three-vessel disease (TVD): It was defined as more than 50% occlusion of the right coronary artery, circumflex artery, and left anterior descending artery.

Gensini Scoring System (GS): GS was used to grade the extent and severity of atherosclerosis in the coronary arteries for all patients. A Gensini score between 1-20 was considered mild coronary atherosclerosis, and a score >20 was considered severe coronary atherosclerosis [15].

Coronary Angiography: All patients included in the study underwent coronary angiography. Coronary angiography was performed via the femoral or radial artery using the standard Judkins technique. Stenosis of ≥50% for the left main coronary artery and ≥70% for other epicardial vessels was considered as severe occlusive coronary artery disease. Gensini scores were calculated to determine the extent of coronary artery disease according to the angiography results of the patients.

Electrocardiography: 12-lead Electrocardiography was performed with Cardiofax ECG-9132K (Nihon Kohden, Tokyo, Japan) at the bedside during admission to the emergency department.

Echocardiography: Transthoracic echocardiography was performed with Philips Epiq 7 Ultrasound device and left ventricular ejection fractions were evaluated and recorded as a % value.

Statistical Analysis

Data from this study were analyzed with the software package SPSS 20.0 (SPSS Inc., Chicago, IL, USA). Shapiro Wilk's was used to investigate the normal distribution of the variables. Since the variables did not come from a normal distribution, the Mann Whitney U test and Kruskal Wallis-H test were used when examining the differences between the groups. Chi-square analysis was applied when examining the relationships between nominal variable groups. Receiver operating characteristic (ROC) curve analysis of PMR and NLR values was also performed for sensitivity and specificity values of by-pass, triple vessel disease, and mortality. When interpreting the results, $p<0.05$ values were considered statistically significant.

Results:

The mean age of 913 patients included in the study was 63.84±12.18 years and 346 (37.9%) were female. The mean age of the patients was significant compared to the acute coronary syndrome groups (p=0.001). In addition, the gensini score was 32.2±38.63 points (p=0.001) and the left ventricular ejection fraction was 52.99±12.61% (p=0.001). In the lipid profile of the patients, triglyceride was not statistically significant. Whereas, cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL) were significant. Patients' liver enzymes and creatine kinase were insignificant. Laboratory values resulted as, platelet 268.5±81.8 10^3/UL (p=0.001), MPV 8.69±1.30 fL (p=0.001), neutrophil 5.67±2.36 10^3/UL (p=0.001), Lymphocyte 2.04±0.98 10 ^3/UL (p=0.006), Neutrophil / Lymphocyte Ratio (NLR) 3.81±4.26% (p=0.001) and Platelet / MPV Ratio (PMR) 31.0±8.63% (p=0.001). In addition, the values of cardiac troponins at 0, 6 and 24 hours were statistically significant (**Table 1**).

		Acute Coronary Syndrome				
		All patients n:913 ***mean±SD***	**UA n:399** ***mean±SD***	**STEMI n:375** ***mean±SD***	**NSTEMI n:139** ***mean±SD***	***P-value***
Basaline Characteristcis						
Age, year		63.84±12.18	61.7±12.77	64.82±11.75	67.32±10.41	**0.001**
Sex, Female/Male		346/567	149/250	139/236	58/81	0.598
Gensini Score		32.2±38.63	13.96±25.39	51.83±42.57	32.04±32.9	**0.001**
Ejection Fraction (%)		52.99±12.61	59.81±9.56	47.65±11.60	47.75±13.55	**0.001**
Labaratory Finding						
Lipid profile	**TG,** mg/dl	137.43±84.74	140.13±83.46	136.2±80.82	133.0±99.2	**0**.100
	CHOL, mg/dl	171.27±56.50	172.79±55.85	173.96±57.95	159.62±53.25	**0.030**
	HDL, mg/dl	34.63±12.93	35.25±11.71	34.7±14.04	32.66±13.07	**0.004**
	LDL, mg/dl	107.63±42.37	109.38±40.42	108.71±45.84	99.68±37.17	**0.041**
Biochemistry	**BS,** mg/dL	133.31±56.22	111.96±27.75	144.36±67.81	164.75±59.9	**0.001**
	AST, mg/dL	25.74±15.65	24.51±13.25	26.69±17.43	26.68±16.77	0.566
	ALT, mg/dL	22.48±19.02	21.63±16.53	23.35±21.35	22.58±19.09	0.952
	ALP, mg/dL	94.41±50.51	91.82±43.3	96.71±56.73	95.64±51.95	0.950
	CK, U/L	134.4±108.7	131.9±105.6	136.3±113.1	136.86±106.1	0.799
	CKMB, U/L	33.7±27.6	31.61±23.58	35.35±30.1	35.22±30.87	0.176
Hemogram	**Platelet,** 10^3uL	268.5±81.8	246.1±66.9	265.5±67.8	341.4±85.2	**0.001**
	MCV, fL	88.75±7.72	88.63±8.02	88.85±7.69	88.84±6.88	0.692
	MCH, pg	29.34±2.31	29.27±2.4	29.45±2.22	29.24±2.27	0.273
	MCHC, g/dL	32.87±0.75	32.83±0.77	32.95±0.75	32.91±0.71	0.598
	RDW, %	15.0±2.32	15.04±2.4	15.01±2.34	14.87±1.98	0.927
	MPV, fL	8.69±1.30	8.33±1.05	8.63±1.21	9.87±1.49	**0.001**
	Neutrophil, 10^3uL	5.67±2.36	5.18±1.79	5.40±2.13	7.81±3.12	**0.001**
	Lymphocyte, 10^3uL	2.04±0.98	2.11±0.99	2.05±1.0	1.82±0.91	**0.006**
Neutrophil / Lymphocyte Ratio		3.81±4.26	3.17±3.35	3.74±4.62	5.83±4.97	**0.001**
Platelet / MPV Ratio		31.0±8.63	29.9±8.64	30.87±8.65	34.53±7.56	**0.001**
Cardiac Troponins	**Tn I-1 (0 h),** ng/mL	2.83±0.81	0.03±0.03	3.11±5.29	1.87±2.2	**0.001**
	Tn I-2 (6 h)	3.55±1.62	0.08±0.22	7.27±5.91	4.74±6.15	**0.001**
	Tn I-3 (24 h)	3.23±0.58	0.15±0.33	17.1±14.6	9.87±13.02	**0.001**

UA: Unstable Angina, STEMI: ST Elevation Myocardial Infarction, NSTEMI: Non ST Elevation Myocardial Infarction, TG: Triglyceride, CHOL: Cholesterol, HDL: High-Density Lipoprotein, VDL: Low-Density Lipoprotein, BS: Blood sugar, AST: Aspartate Aminotransferase, ALT: Alanine Aminotransferase, ALP: Alkaline Phosphatase, CK: Creatine Kinase, CKMB: Creatine Kinase-MB, MCV:Mean Corpuscular Volume, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration, RDW: Red Cell Distribution Width, MPV: Mean Platelet Volume, Tn:Troponin, SD: Standard Deviation, h:hour.

Table 1: *Basal and laboratory characteristics of patients with acute coronary syndrome*

In the analysis of patients according to acute coronary syndrome groups, no significant relationship was found with gender (p=0.598). By-pass was present in 46 (33.1%) and TVD in 90 (64.7%) patients, both of which were most common in the NSTEMI group (p=0.001). Mortality was observed in 20 (14.4%) NSTEMI cases and 37 (9.9%) STEMI cases (p=0.001). Atrial fibrillation and right bundle branch block were common in NSTEMI (p=0.001), while left bundle branch block was common in unstable angina (p=0.001). In addition, the most common complication after acute coronary syndrome was ischemic heart failure. This was followed by pulmonary edema and ventricular tachycardia (p=0.001, **Table-2**).

		Acute Coronary Syndrome			
		UA n (%)	**STEMI n (%)**	**NSTEMI n (%)**	**p-value**
Gender	**Female**	49(37.3)	139(37.1)	58(41.7)	0.598
	Male	250(62.1)	236(62.9)	81(58.3)	

By-pass	**No**	394(98.7)	365(97.3)	93(66.9)	**0.001**
	Yes	5(1.3)	10(2.7)	46(33.1)	
Three-vessel Disease	**No**	383(96)	327(87.2)	49(35.3)	**0.001**
	Yes	16(4)	48(12.8)	90(64.7)	
Mortality	**No**	396(99.2)	338(90.1)	119(85.6)	**0.001**
	Yes	3(0.8)	37(9.9)	20(14.4)	
Atrial Fibrillation	**No**	378(94.2)	317(84.5)	75(54)	**0.001**
	Yes	23(5.8)	58(15.5)	64(46)	
Branch Block	**No**	300(75.2)	255(68)	83(59.7)	**0.001**
	Right Bundle Branch Block	17(4.3)	41(10.9)	41(29.5)	
	Left Bundle Branch Block	82(20.6)	79(21.1)	15(10.8)	
Complication	**No**	359(90)	58(15.5)	32(23)	**0.001**
	Ischemic Heart Failure	14(3.5)	185(4.3)	40(28.8)	
	Ventricular Tachycardia	5(1.3)	35(9.3)	16(11.5)	
	Atrioventricular Block	5(1.3)	41(10.9)	6(4.3)	
	Cardiac Tamponade	6(1.5)	8(2.1)	11(7.9)	
	Pulmonary Edema	8(2)	36(9.6)	18(12.9)	
	Pleural Effusion	2(0.5)	4(1.1)	13(9.4)	
	Ventricular Fibrillation	0	8(2.1)	3(2.2)	

UA: Unstable Angina, STEMI: ST Elevation Myocardial Infarction, NSTEMI: Non ST Elevation Myocardial Infarction

Table 2: *Chi-square analysis of acute syndrome groups with variables*

In the analysis of patients who underwent bypass procedure, age 68.85±10.0 years (p=0.001), gensini score 70.11±56.96 points (p=0.001), left ventricular ejection fraction 45.82±11.34% (p=0.001), NLR 8.46±7.76% and PMR was 35.74±2.70% (p=0.001). It was found to be significantly higher than those who did not have by-pass.

The relationship with gender and mortality was insignificant. However, its association with atrial fibrillation, TVD, right bundle branch block, ischemic heart failure, ventricular tachycardia, pulmonary edema, and non-ST elevation acute coronary syndromes was significant (p=0.001, **Table-3**).

Bypass				
		No n (%)	**Yes n (%)**	**p-value**
Age, year		63.48±12.25	68.85±10.0	**0.001**
Gensini Skoru		29.56±35.51	70.11±56.96	**0.001**
Ejeksiyon Fraksiyonu%		53.51±12.55	45.82±11.34	**0.001**
Neutrophil / Lymphocyte Ratio		3.47±3.68	8.46±7.76	**0.001**
Platelet / MPV Ratio		30.67±8.80	35.74±2.70	**0.001**
Gender	**Female**	321(37.7)	25(41)	0.350
	Male	531(62.3)	36(59)	
Three-vessel Disease	**No**	735(86.3)	24(39.3)	**0.001**
	Yes	117(13.7)	37(60.7)	
Mortality	**No**	799(93.8)	54(88.5)	0.097
	Yes	53(6.2)	7(11.5)	
Atrial Fibrillation	**No**	730(85.7)	38(62.3)	**0.001**
	Yes	122(14.3)	23(37.7)	
Branch Block	**No**	608(71.4)	30(49.2)	**0.001**
	Right Bundle Branch Block	77(9)	22(36.1)	
	Left Bundle Branch Block	167(19.6)	9(14.8)	
Complication	**No**	443(52)	6(9.8)	**0.001**
	Ischemic Heart Failure	225(26.4)	14(23)	
	Ventricular Tachycardia	47(5.5)	9(14.8)	
	Atrioventricular Block	49(5.8)	3(4.9)	
	Cardiac Tamponade	17(2)	8(13.1)	
	Pulmonary Edema	58(5.6)	14(23)	
	Pleural Effusion	14(1.6)	5(8.2)	
	Ventricular Fibrillation	9(1.1)	2(3.3)	

ST-Elevation Myocardial Infarction	**No**	488(57.3)	52(85.2)	**0.004**
	İnferior MI	146(17.1)	3(4.9)	
	Posterior MI	8(0.9)	0	
	Anterior MI	144(16.9)	4(6.6)	
	Lateral MI	12(1.4)	0	
	Common Anterior MI	42(4.9)	2(3.3)	
	High Lateral MI	12(1.4)	0	

MI: Myocardial Infarction

Table 3: *Chi-square analysis with variables of patients to be bypassed*

Age, gender, and left ventricular ejection fraction were not significant in the three-vessel disease analysis. Whereas, gensini score was 42.08±44.08 points (p=0.001), NLR 6.01±5.33% (p=0.001) and PMR 37.06±5.11% (p=0.001) were found to be significantly higher than the group without TVD. In addition, mortality was significant with atrial fibrillation, right bundle branch block, complications and STEMI (p=0.001, **Table-4**).

Three-vessel Disease				
		No n (%)	**Yes n (%)**	**p-value**
Age, year		63.64±12.29	64.78±11.61	0.422
Gensini Skoru		30.28±37.15	42.08±44.08	**0.001**
Ejeksiyon Fraksiyonu%		53.07±12.68	52.60±12.28	0.626
Neutrophil / Lymphocyte Ratio		3.36±3.86	6.01±5.33	**0.001**
Platelet / MPV Ratio		29.77±8.67	37.06±5.11	**0.001**
Gender	**Female**	292(38.5)	54(35.1)	0.242
	Male	467(61.5)	100(64.9)	
Mortality	**No**	717(94.5)	136(88.3)	**0.007**
	Yes	42(5.5)	18(11.7)	
Atrial Fibrillation	**No**	663(87.4)	105(68.2)	**0.001**
	Yes	96(12.6)	49(31.8)	
Branch Block	**No**	530(69.8)	108(70.1)	**0.001**
	Right Bundle Branch Block	70(9.2)	29(18.8)	
	Left Bundle Branch Block	159(20.9)	17(11)	
Complication	**No**	409(53.9)	40(26)	**0.001**
	Ischemic Heart Failure	183(24.1)	56(36.4)	
	Ventricular Tachycardia	37(4.9)	19(12.3)	
	Atrioventricular Block	44(5.8)	8(5.2)	
	Cardiac Tamponade	19(2.5)	6(3.9)	
	Pulmonary Edema	43(5.7)	19(123)	
	Pleural Effusion	13(1.7)	6(3.9)	
	Ventricular Fibrillation	11(1.4)	0	
ST-Elevation Myocardial Infarction	**No**	433(57)	107(69.5)	**0.005**
	İnferior MI	134(17.7)	15(9.7)	
	Posterior MI	4(0.5)	4(2.6)	
	Anterior MI	127(16.7)	21(13.6)	
	Lateral Mı	11(1.4)	1(0.6)	
	Common Anterior MI	38(5)	6(3.9)	
	High Lateral MI	12(1.6)	0	

MI: Myocardial Infarction

Table-4: *Chi-square analysis of three vessel disease with variables*

According to the ROC curve analysis of the patients, the optimal cut-off values of PMR and NLR (AUC: Area Under the Curve, 95% CL: 95% Confidence Interval) to determine the positivity of by-pass, TVD and mortality; By-pass; NLR: Sensitivity 90.2% and specificity 78.4%; (AUC; 0.896, 95% CI; 0.869-0.924, p=0.001). PMR: Sensitivity 96.7% and specificity 81.2%; (AUC; 0.713, 95% CI; 0.676-0.749, p=0.001 (**Figure 1**).

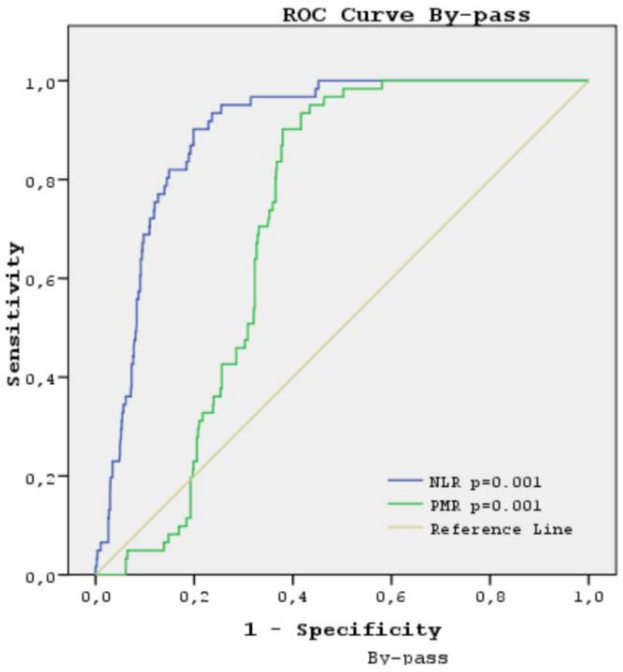

Figure 1: ROC curve analysis according to Platelet/MPV and Neutrophil/Lymphocyte Ratio bypass positivity

TVD; NLR: Sensitivity 86.7% and specificity 77.4%; (AUC; 0.802, 95% CI; 0.752-0.852, p=0.001). PMR: sensitivity 83.3% and specificity 71.9%; (AUC; 0.703, 95% CI; 0.655-0.750, p=0.001 (**Figure 2**).

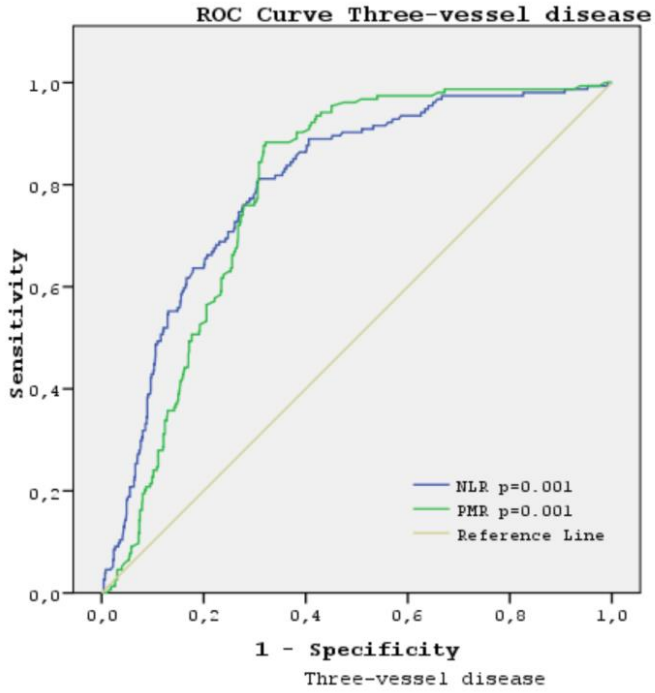

Figure 2: ROC curve analysis according to Platelet/MPV and Neutrophil/Lymphocyte Ratio three vessel disease positivity

Mortality; NLR: sensitivity 80.5% and specificity 76.3%; (AUC; 0.800, 95% CI; 0.764-0.836, p=0.001). PMR: sensitivity 84.4% and specificity 81.2%; (AUC; 0.787, 95% CI; 0.755-0.819, p=0.001 (**Figure 3**).

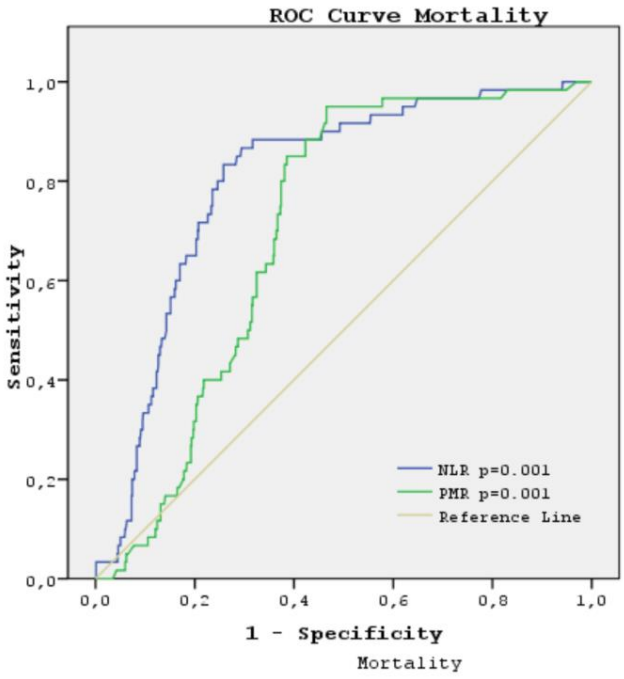

Figure 3: ROC curve analysis according to Platelet/MPV and Neutrophil/ymphocyte Ratio mortality positivity

Discussion:

Until recent years, there were separate studies with platelet, MPV, and NLR in acute coronary syndrome, but we could not find any study in the literature that evaluated PMR and NLR together. We showed that PMR and NLR levels in emergency department admissions are strongly associated with complications that may occur during and after ACS, TVD, bypass and mortality.

It is known that chronic inflammation plays a role in every step of the development of atherosclerosis, and many risk factors accelerate this inflammatory process. In recent years, NLR has been used to predict the development and prognosis of coronary artery disease. It has been shown that NLR can be a systemic marker of inflammation in predicting the morbidity, mortality and risk of myocardial infarction of high-risk coronary artery disease [16]. It has been shown that while the neutrophil count increases in acute coronary syndrome, the lymphocyte count decreases [17]. Neutrophils play a direct role in the initiation of plaque rupture [11]. Clinical studies have shown that neutrophils are activated in unstable angina and ACS [18,19].

It has been shown that an increase in neutrophil count is associated with worse angiographic results, large infarct area, and worse short-term prognosis in ACS [20-22]. NLR was previously shown as a prognostic marker in non-cardiac diseases [23]. It has also been used as a prognostic marker in patients undergoing percutaneous intervention [24]. It has been shown that increased neutrophil count is associated with worse angiographic outcomes [21], large infarct area [22], and worse short-term prognosis [23] in patients with ACS. It has been reported that NLR is an independent predictor of cardiovascular complications after primary coronary angiography [25,26]. The high rate was found to be compatible with the frequency of early and long-term complications [27]. In our study, patients with high NLR scores had a high gensini score, a high number of patients with critical stenosis, a low left ventricular ejection rate, and a high number of patients who underwent bypass. In addition, the complication rate after ACS was found to be significantly higher in patients with high NLR.

In the study in which the 30-day mortality including all etiologies was evaluated with the NLR values measured at admission of patients with acute coronary syndrome, mortality was observed at the rate of 4% in the low NLR group, 10% in the moderate NLR group, and 19% in the high NLR group at the end of the 30th day [28]. Tamhane et al. [29] evaluated the NLR values of 2833 patients diagnosed with ACS at admission, and the 6-month mortality in hospital and all-cause mortality. High NLR was found to be an independent indicator of in-hospital and 6-month mortality. In another study, when patients were grouped as low, moderate, or high according to the GRACE score, it was reported that the highest mortality rates were found in patients with NLR>4.7 among these groups. In the study evaluating the relationship between NLR and in-hospital mortality, 2 (2.3%) patients in the low NLR group and 4 (4.8%) patients in the high NLR group died [30]. In our study, NLR was found to be closely related to gender, mortality, complications after ACS, and ACS groups. While NLR was low in the UA group with low inflammation, it was found to be high in the STEMI groups and NSTEMI. Patients with a high Gensini score and a low left ventricular ejection fraction had a poor prognosis and a high mortality rate. In addition, complications after ACS, TVD, bypass and mortality rates were found to be high in patients with NLR>4.7 and above. The sensitivity and specificity of NLR for bypass, TVD, and mortality were determined, respectively (sensitivity: 90.2%, 86.7%, 80.5%; specificity: 78.4%, 77.4%, 76.3%).

Activation and aggregation of platelets play an important role in the pathogenesis of ACS. It was observed that megakaryocyte activity in the bone marrow accelerated and the number of circulating platelets and MPV increased in patients before ACS [31,32]. The transformation of stable angina into ACS, rupture of the atherosclerotic plaque and attachment of thrombus play an important role. The increase in this aggregation ability of platelets is seen as an independent risk factor for the development of coronary artery disease [33-35]. Cameron et al. [36] found that the platelet volumes were higher and the platelet count decreased in patients with AMI compared to the controls. In addition, increased MPV is associated with poor prognosis in AMI [37,38]. In addition, Chu et al. [39] showed in their meta-analysis that there is a relationship between MPV and AMI. However, there is no study in the literature showing the relationship between MPV and infarct size. In our study, a significant relationship was found between MPV and ACS groups. Therefore, it was found to be significant in ACS and PMR. There was a relationship between by-pass,

developing complications, TVD and mortality among the PMR ACS groups.

In some studies, no significant difference was found between the MPV values of male and female individuals. A definite relationship could not be obtained in studies comparing similar risk factors with platelet functions [40]. Similar results were found in our study. Studies have shown that the increase in platelet volume after acute ischemic events returns to normal in the following days. High values are associated with complications [41]. In our study, a correlation was found between PMR elevation and complications after ACS. Ischemic heart failure was the most common in all ACS groups.

Bath et al. [42] found that the DNA content of active megakaryocytes increased in the bone marrows of patients who died while waiting for coronary by-pass operation. Since it is consumed rapidly in acute coronary syndromes, platelets produced in the bone marrow are released into the circulation in large volume before they mature [43]. Platelets produced rapidly in the bone marrow have a larger mean volume. In addition, earlier consumption of small-volume platelets than large-volume platelets in coronary events may also be responsible for the increase in mean platelet volume [44]. Martin et al. [45] showed that increased mean platelet volume is a risk factor for cardiac death. As in the current study, increased mean platelet volume in ischemic heart disease was also demonstrated by Pizzuli et al. [46] and Senaran et al. [47]. Similar results were found in our study. Especially in patients with high PMR, bypass, TVD and mortality rates were significantly higher than in unstable patients.

In the angiographic evaluation, critical stenosis was detected in 159 patients (58.2%), and angiography of 52 patients (18.9%) was found to be normal. Puzzili et al. [48] found in their study that patients who required emergency angioplasty had higher MPV levels than those who did not. Smyth et al. [49] reported that MPV was significantly higher in patients with restenosis in patients who underwent successful single-vessel angioplasty, and that there may be a relationship between MPV and restenosis. Contrary to these studies, in which the angiographic appearance was evaluated with MPV, the MPVs of 377 patients in whom coronary angiograms were evaluated, the cases without coronary artery disease and the patients with one and two vessel disease were compared, and no significant difference was found [50]. Again, no difference was found in studies comparing MPVs of individuals with and without coronary artery disease risk factors [51,52]. In our study, PMR values were higher in patients with TVD and those who underwent bypass in ACS patients. We think that the above studies were performed under elective conditions, and the parameters obtained in the first 24 hours in the acute phase in our study were higher than they were. In addition, the sensitivity and specificity values of PMR for by-pass, TVD, and mortality, respectively, were determined in our study (sensitivity: 96.7%, 83.3%, 84.4%; specificity: 81.2%, 71.9%, 81.2%).

In this study, we found that PMR and NLR were elevated in ACS patients with TVD, bypass and mortality. PMR and NLR were low in the unstable angina group with low inflammation, whereas they were high in the STEMI and NSTEMI groups. This suggests that PMR and NLR values are correlated with the degree of atherosclerosis in ACS patients and are released due to inflammatory events occurring during ACS.

Conclusion:

In patients with acute coronary syndrome, PMR and NLR values are laboratory tests that are easy to apply, inexpensive and statistically reliable, giving rapid results in predicting bypass, three vessel disease and mortality. Comprehensive studies with large patient populations are needed to support this view. We believe that when used routinely, it is a valuable parameter for the prophylactic treatment of bypass, three-vessel disease and mortality that may develop after ACS.

Abbreviations:

ACS: Acute coronary syndrome

PMR: Platelet/Mean Platelate Volume ratio

NLR: Neutrophil/lymphocyte ratio

TVD: Three vessel disease

UA: Unstable angina

STEMI: ST elevation myocardial infarction

NSTEMI: non ST elevation myocardial infarction

MPV: Mean Platelet Volume

GS: Gensini Scoring System

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