



Prognostic value of neutrophil/lymphocyte, platelet/lymphocyte and MPV in patients diagnosed with pulmonary embolism

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Abstract

Aim: Pulmonary Embolism (PE) is an obstructive illness of the pulmonary artery system that occurs in varying degrees and locations and is caused by embolization of thrombus or non-thrombotic substances that originate in the deep veins of the lower limbs. Pulmonary embolism is a preventable disease that has a high probability of recurrence, high mortality, and morbidity. The differential diagnosis and clinical treatment of pulmonary embolism have a very important place in emergency service applications. The purpose of the present study was to retrospectively examine the patients who applied to Inonu University Turgut Ozal Medical Center Emergency Service between 2014 and 2019 and were diagnosed with PE.

Materials and Methods: In the present study, the data were collected retrospectively from a total of 144 patients including 80 female and 64 male patients who applied to Turgut Ozal Medical Center (TOMC) Emergency Department with the complaints of sweating, chest pain, cough, hemoptysis, and syncope between January 2014 and August 2019 and diagnosed with PE with the I-26 diagnostic code according to the ICD 10 coding system. The quantitative data obtained from the patients were summarized as mean and standard deviation or median, as well as minimum and maximum, and the qualitative data were summarized as numbers and percentages. The compatibility of the data with the normal distribution was evaluated with the Kolmogorov Smirnov test and the homogeneity of the variances was examined with the Levene test. The Independent Samples t-test and Mann Whitney U test were used to analyze the data. The IBM SPSS Statistics version 26.0 for Windows package program was used in the analyses. A $P < 0.05$ value was taken as statistically significant.

Results: No significant differences were detected in terms of systolic arterial blood pressure, diastolic arterial blood pressure, and laboratory variables of leukocyte, lymphocyte, neutrophil, neutrophil/lymphocyte, and platelet/lymphocyte ratios between the PE patients with and without right ventricular dilatation on ECHO. Statistically significant differences were detected for platelet, MPV, and CRP between the patients with and without right ventricular dilatation in ECHO.

Conclusion: It is considered that these findings will provide data on the prognosis and general condition of patients and will help the clinician to make an earlier and easier prediction about the clinical prognosis of patients.



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Introduction

Pulmonary Embolism (PE) is an obstructive illness of the pulmonary artery system that occurs in varying degrees and locations and is caused by embolization of thrombus or non-thrombotic substances that originate in the deep

veins of the lower limbs. The occlusion in the pulmonary arterial system occurs usually because of a thrombus or thrombus fragment ruptured from the deep leg veins as a complication of the Deep Vein Thrombosis (DVT) [1]. The clinical manifestations of Pulmonary Embolism can be asymptomatic or in a broad perspective that ranges from massive progression to sudden death. Clinical signs and symptoms may vary depending on the size, number, localization of the emboli, development of infarction, res-

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olution rate, recurrence, age of the patient, and reserve of cardiopulmonary functions. Pulmonary Embolism is a preventable disease that has a high probability of recurrence, high mortality, and morbidity [2].

The absence of definitive clinical findings and parameters in Pulmonary Embolism necessitates that the physician performs clinical, laboratory, and imaging synthesis to confirm the diagnosis. For this reason, new studies are conducted to find additional diagnostic tests. In recent years, the importance of platelet indices (mean platelet volume, platelet distribution width, and platelet count) in pulmonary embolism has been investigated in many studies in terms of diagnostic value and prognosis. Platelets play important roles in the pathophysiology of thrombosis. Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) are easily measurable parameters showing platelet activity in complete blood count [3, 4]. MPV is considered to be among the most important parameters in platelet activation [4, 5]. The ratio of these two subgroups to each other (NLR) is utilized as a biomarker of inflammation since the natural reaction of circulating leukocytes to stress generates increased neutrophil and reduced lymphocyte count [6, 7]. Similarly, the Platelet-Lymphocyte Ratio (PLO) was found as an important inflammatory marker [8].

In the present study, the purpose was to examine the place of this disease in mortality and prognosis in people diagnosed with acute PE as a life-threatening and common disease in the society by evaluating the PLR, NLR, and MPV values at the time of admission to the Emergency Department.

Materials and Methods

A total of 80 men and 64 women, who applied to Turgut Ozal Medical Center (TOMC) Emergency Department with the complaints of sweating, chest pain, cough, hemoptysis, and syncope between January 2014 and August 2019 and were diagnosed with PE with the I-26 diagnostic code according to the ICD 10 coding system, were included in the study. The data on 144 male patients were collected retrospectively. The information of the patients diagnosed with PE was obtained from the hospital information system using the "Enlil Medical Information System". The approval of the Ethics Committee of Inonu University Faculty of Medicine was obtained for the study with the date 05.03.2019 and the decision number 2019/5-5.

The ECHO and Doppler results of the patients with clinical suspicion of PE were performed. The anamnesis, including previous hematological diseases, myocardial infarction, renal diseases, liver diseases, sepsis or inflammation, and whether patients had a history of cancer, were also determined, and those with these diseases were excluded from the study. After the anamnesis information of the patients was examined, systemic and respiratory examinations were carried out. Measurements were made in line with the blood pressures of the patients. White Blood Cells (WBC), hemoglobin, thrombocyte, leukocyte, neutrophil, MPV, lymphocyte, D-dimer, CRP, and procalcitonin values of the patients were evaluated. ECGs of all patients were recorded from notes, dynamic computed

tomography, ECHOs, and venous lower extremity Doppler were scanned.

The data obtained in the imaging methods and examinations were recorded in the patient information form, and statistical analyzes were made.

Statistical analysis

When the amount of Type I error (α) is 0.05, the power of the test ($1-\beta$) is 0.8, the effect size is 0.52, and the alternative hypothesis (H_1) is bilateral, the minimum sampling size required to find a significant difference by using the t-test in independent samples, and there should be 118 patients in total with a minimum of 59 for each group.

The quantitative data were summarized as mean and standard deviation or median, and minimum and maximum, and the qualitative data were summarized as numbers and percentages. The compatibility of the data that fit the normal distribution was evaluated with the Kolmogorov Smirnov test and the homogeneity control of the variances was evaluated with the Levene test. The Independent Samples t-test and Mann Whitney U-test were used to analyze the data. The IBM SPSS Statistics version 26.0 for Windows package program was used for the analyses. A $P < 0.05$ value was considered statistically significant.

Results

64 (44.4%) of the 144 patients admitted to the emergency department with a Pulmonary Embolism diagnosis and who satisfied the inclusion criteria were male, while 80 (55.6%) were female. When the ages of the patients were evaluated, the youngest was found to be 17 years old, the oldest was 92 years old, and the mean age was 63 ± 12 years.

The blood pressure, hemogram values, procalcitonin, and CRP values of the patients were examined as those under the age of 40 and above. The results are given in Table 1 and Table 2.

Also, the platelet and diastolic blood pressure values were examined for patients who were younger than 40 years old and over 40 years old, and the results are given in Table 3.

The systolic and diastolic arterial blood pressures and laboratory variables were examined for patients with and without right ventricular dilatation by evaluating the right ventricular dilatation in the ECHO results of the patients. The results are given in Table 4.

The D-dimer values were found to be high in 86 of 96 patients diagnosed with PTE and normal in 10 individuals. It was also found that Mean Platelet Value was lower in patients with elevated D-dimer levels than in normal patients, and a statistically significant difference was detected in this respect. The MPV values of 95 patients with elevated D-dimer were also evaluated. Although the MPV value was high in 85 patients, it was normal in 10 patients. No statistically significant differences were detected between D-dimer elevation and MPV elevation. The findings in this respect are given in Table 5.

Discussion

Pulmonary Embolism is difficult to diagnose with its sudden course, nonspecific symptoms, and the absence of a

Table 1. The descriptive statistics on laboratory variables of patients under 40 and Over 40.

Variables	AGE Classification					
	Below the age of 40			Over the age of 40		
	Median	Minimum	Maximum	Median	Minimum	Maximum
Systolic arterial blood pressure (mmHg)	125	90	166	128	86	216
Leukocyte ($10^3/\mu\text{L}$)	11.00	4.07	24.40	10.30	4.20	53.60
Lymphocyte ($10^3/\mu\text{L}$)	2.20	0.61	9.14	1.73	0.20	10.05
Neutrophil ($10^3/\mu\text{L}$)	7.58	0.80	18.87	6.97	1.00	23.04
Procalcitonin	0.24	0.07	13.32	0.25	0.03	798.00
CRP (mg/dl)	2.34	0.35	19.70	2.66	0.30	29.70
Neutrophil/Lymphocyte Ratio (%)	3.94	0.22	23.03	4.38	0.29	96.00
Platelet/Lymphocyte Ratio (%)	117.27	2.16	466.67	137.80	2.50	1458.33
MPV (fL)	9.30	6.70	12.40	9.95	6.40	14.00

Table 2. The relationship between age, systemic arterial blood pressure, and laboratory variables.

Test	Systolic arterial blood pressure	Leukocyte	Lymphocyte	Neutrophil	Procalcitonin	CRP	Neutrophil / Lymphocyte	Platelet / Lymphocyte	MPV
Mann-Whitney U	1082.000	1277.500	1080.500	1300.500	68.500	1005.000	1174.000	1280.000	1135.000
Z	-1.741	-0.679	-1.746	-0.555	-0.459	-0.204	-1.239	-0.666	-1.347
P Value	0.082	0.497	0.081	0.579	0.646	0.838	0.215	0.506	0.178

*: Mann Whitney U test.

Table 3. The analysis of platelet and diastolic blood pressure variables in patients over 40 and under 40.

Variables	Age group	n	Arithmetic	Mean Std. Deviation	P*
Platelet	Below the age of 40	23	260.70	87.961	0.267
	Over the age of 40	122	237.09	94.175	
Diastolic Arterial Blood pressure	Below the age of 40	23	76.00	12.877	0.551
	Over the age of 40	121	77.42	9.961	

*: The t-test in independent samples.

Table 4. The analysis of the arterial blood pressures and laboratory variables of patients with and without right ventricular dilation as a result of the ECHO in PE.

Variables	ECHO						
	Normal			Right ventricular dilated			p*
	Median	Minimum	Maximum	Median	Minimum	Maximum	
Systolic arterial blood pressure (mmHg)	126	86	216	128	90	182	0.621
Diastolic arterial blood pressure (mmHg)	75	51	105	80	58	100	0.184
Leukocyte ($10^3/\mu\text{L}$)	4.39	4.07	25.9	10.5	4.2	53.6	0.799
Lymphocyte ($10^3/\mu\text{L}$)	2.89	0.24	5.2	1.73	0.2	10.05	0.799
Neutrophil ($10^3/\mu\text{L}$)	6.97	0.8	23.04	7.46	2.17	21.35	0.678
Platelet ($10^3/\mu\text{L}$)	254	8	584	219	2	431	0.043
MPV (fL)	9.45	6.4	12.7	10.3	6.4	14	0.009
Procalcitonin (ng/mL)	0.27	0.03	7.98	0.18	0.04	3.93	0.438
CRP (mg/dl)	3.75	0.3	29.7	2.22	0.3	21.4	0.025
Neutrophil / Lymphocyte Ratio	4.38	0.22	96	4.19	0.29	54	0.961
Platelet/Lymphocyte Ratio	146.99	2.16	1458.33	123.12	2.50	554.39	0.25

*: Mann-Whitney U test.

Table 5. The analysis of the platelet and MPV variables at D-Dimer elevation.

D-DIMER (mg/l)		n	Arithmetic Mean	Std. Deviation	P*
Platelet	Normal	10	314.60	97.214	0.008
	Elevated	86	228.91	93.835	
MPV	Normal	10	8.4990	1.53941	0.057
	Elevated	85	9.5453	1.63226	

specific test. The absence of a unique symptom, physical examination, and parameter to examine has led us to newly developed algorithms regarding imaging, laboratory, and clinic. In a study on VTE in Europe conducted in 2004, it was found that the risk of mortality increased twice for every 10 years after the age of 40 [9, 10].

The mean age of the patients who were included in the study was found to be 63, and there were 91 patients over the age of 60 out of 144. Among the patients, 64 (44.4%) were male and 80 were female (55.6%). In the present study, no differences were detected between male and female gender and when the mean age was evaluated, which was consistent with the literature data.

In terms of systolic blood pressure, leukocyte value, lymphocyte value, Neutrophil value, Procalcitonin value, CRP, Neutrophil/Lymphocyte Ratio, Platelet/Lymphocyte Ratio, and MPV, no statistically significant differences were found between the age groups. Similarly, no statistically significant differences were detected regarding the platelet and Diastolic Blood Pressure variables in terms of age groups.

No significant differences were detected regarding systolic arterial blood pressure, diastolic arterial blood pressure, and laboratory variables of leukocytes, lymphocytes, neutrophils, procalcitonin values, neutrophil/lymphocyte, and platelet/lymphocyte ratios in patients with and without right ventricular dilatation on ECHO. Statistically significant differences were detected for platelet, MPV, and CRP levels between patients with and without right ventricular dilatation on ECHO. Among the variables that had significant differences, the ECHO result of the Platelet value was lower in patients with right ventricular dilatation when compared to those without a mean value. The MPV value, on the other hand, was found to be higher in patients with right ventricular dilatation as a result of ECHO when compared to those without a mean value. Finally, the CRP value was found to be lower in patients with right ventricular dilatation as a result of ECHO when compared to those without a mean value.

In the present study, the D-dimer values were found to be high in 86 of 96 patients diagnosed with PE and whose D-dimer scores were examined and were normal in 10 patients. Mean Platelet Values were determined to be lower in patients with D-dimer elevation when compared to normal ones, and a statistically significant difference was detected in this respect. Also, the MPV values of 95 patients who had high D-dimer were examined. Although the MPV value was found to be high in 85 patients, it was normal in 10 patients. No statistically significant differences were detected between the categories of D-dimer and the MPV

variable.

In a previous study, a statistically significant increase was detected in MPV value for PE in medium and high-risk groups when compared to low-risk groups [11]. According to another study, MPV showed right ventricular dysfunction and increased in Acute Pulmonary Embolism. Platelet counts decrease in patients with acute PE [12]. In the present study, especially in PE patients who caused right ventricular dilatation on ECHO, statistically significant increases were detected in MPV, and significant decreases were detected in the platelet volume. In the light of these data, it was considered that MPV could provide data on how far the symptoms progress and the prognosis of Pulmonary Embolism.

In the present study, it was shown that platelet decreased at statistically significant levels in submassive or massive PEs, in line with the literature data; however, no statistically significant differences were detected in the b variable for age categories. Although it was shown that CRP, which is an acute phase reactant and inflammation parameter, increased in submassive-massive PTEs at statistically significant levels, no statistical differences were detected in the values of neutrophil and lymphocyte, which are among other parameters.

It is considered that these findings will provide data on the prognosis and general condition of patients and help us to make an earlier and easier prediction about their clinical prognosis.

Ethics approval

Ethical approval for this study was obtained from the Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee (Decision number: 2019/5-5).

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