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Platelet distribution width (PDW) and platecrit (PCT) as the new biomarkers of the myocardial infarction

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Abstract

Introduction Despite the advancement of medicine in the field of diagnostics and treatment of myocardial infarction, the annual mortality rate exceeds 40%, which is why it is still being strived to develop better and more specific markers of myocardial damage, which would allow for faster diagnosis and thus would improve the prognosis in this group of patients.

Objective The objective of the study was to assess the relationship between the platelet with distribution (PDW) and plateletcrit (PCT) and the occurrence of myocardial infarction.

Results People who suffered from a heart attack had higher PLT and PCT values than those who did not.

Conclusions Author study research has not confirmed the relationship between PDW and PCT and the occurrence of myocardial infarction.

Keywords: myocardial infarction

Introduction

Myocardial infarction is one of the most serious diseases of the cardiovascular system. The main cause of this disease is partial or complete occlusion of the coronary vessel by the thrombus formed at the site of the ruptured atherosclerotic plaque, resulting in acute ischemia and myocardial necrosis. The incidence of a heart attack in Poland is up to 40% higher compared to other EU countries, while the average age is 73 years for women and 63 years for men. The diagnosis of myocardial infarction is based primarily on the assessment of the patient's clinical symptoms and the determination of markers characteristic for this disease entity (troponin, myoglobin, keratin kinase). Despite the advancement of medicine in the field of diagnostics and treatment of myocardial infarction, the annual mortality rate exceeds 40%, which is why it is still being strived to develop better and more specific markers of myocardial damage, which would allow for faster diagnosis and thus would improve the prognosis in this group of patients.

Platelets

Platelets (thrombocytes, PLTs) are the smallest, morphotic elements of the discoid shape devoid of the cell nucleus. They play an important role in blood clotting. There are approximately 140,000 - 450,000 thrombocytes in 1 mm3 of blood.

Platelet activation and adhesion is stimulated during rupture of unstable atherosclerotic plaque. Platelet aggregation involves their attachment to collagen fibers and von Willebrand factor at the site where the coronary vessel wall has been damaged. The resulting thrombotic environment contributes to the formation of a thrombus, which is responsible for closing the vessel lumen. Platelet activity can be assessed by measuring two parameters from the peripheral blood - the platelet distribution width and the plateletcrit.

Platelet Distribution Width (PDW) - the measurement is determined using a platelet curve, and the correct values for this indicator are from 9 to 14 fl or range 40 - 60% (for every 10 platelets, volume 4 to 6 tiles differ from the rest). PDW indicates a variation in platelet size.

Plateletcrit (PCT) - this indicator indicates the percentage of thrombocytes in the total blood volume. The norm of platelet cover is from 0.14 to 0.36%.

The platelet volume distribution (PDW) and plateletcrit (PCT) are the two important indicators that allow you to assess the platelet activity. Both PDW and PCT are platelet

determinants, which are determined in a simple and fast way during laboratory tests. Excessive platelet activity occurs at the time of tissue damage and the inflammatory process. During increased platelet activity, an increase in blood clotting is observed, which increases the likelihood of a blood clot, and in the event of atherosclerotic plaque rupture, increases the risk of myocardial infarction.

Methods

The tests were carried out at the Cardiology Clinic at Państwowy Szpital Kliniczny No. 4 in Lublin. The study covered 244 people. The study group (124 people) were people hospitalized in the Cardiology Clinic because of myocardial infarction from January 2018 to June 2018. The remaining respondents (120 people) belonged to the control group. The study group and control group were similar in terms of numbers, age and sex. The studies were conducted retrospectively. They were based on medical records.

Objective

The objective of the study was to assess the relationship between the platelet with distribution (PDW) and plateletcrit (PCT) and the occurrence of myocardial infarction.

Results

The goal of the first stage of the analysis was to verify the differences between groups of healthy people (control group) and people with myocardial infarction (study group) in terms of platelet parameters. All three measurements showed statistically significant differences between the study group and the control group at PLT and PCT levels. People from the study group were characterized by higher PLT and PCT parameters. In addition, in the second measurement there was a statistically significant difference between the groups in the PDW parameter. Its higher level was characterized by the study group, however it should be noted that these differences were small (rg = 0.157) (Table 1).

Table 1. Differences between the study group and the control group in the values of plate parameters

	The study group				The control group				Test of U Mann - Whitney		
	M	*SD*	*N*	M_{ranga}	*M*	*SD*	*N*	M_{ranga}	*U*	*p*	r_g
PLT I	263,27	80,90	124	142,76	219,63	53,49	120	101,57	**4928**	**0,000**	**0,292**
PCT I	0,21	0,06	123	145,07	0,17	0,05	120	98,36	**4543**	**0,000**	**0,333**
PDW I	57,33	7,59	124	127,32	56,16	7,51	120	117,52	6842,5	0,278	0,069
MPV I	7,90	0,95	124	124,78	7,83	0,82	120	120,14	7157	0,607	0,033
PLT II	249,74	68,64	117	134,63	219,63	53,49	120	103,76	**5191**	**0,001**	**0,225**
PCT II	0,19	0,05	117	136,24	0,17	0,05	120	102,2	**5003,5**	**0,000**	**0,249**
PDW II	58,46	7,34	117	129,93	56,16	7,51	120	108,34	**5741**	**0,015**	**0,157**
MPV II	7,86	0,76	117	120,67	7,83	0,82	120	117,38	6825	0,711	0,024
PLT III	265,85	81,83	93	129,19	219,63	53,49	120	89,8	**3516,5**	**0,000**	**0,317**
PCT III	0,21	0,05	93	133,15	0,17	0,05	120	86,73	**3148**	**0,000**	**0,374**
PDW III	57,57	7,56	93	114,18	56,16	7,51	120	101,43	4912	0,134	0,103
MPV III	7,94	0,86	93	110,70	7,83	0,82	120	104,13	5236	0,440	0,053

PLT - platelets, PCT - plateletcrit; PDW - platelet width distribution; MPV - mean platelet volume; WBC - leukocytes; CRP - acute phase protein; N - number of people in the trial; M - median; SD - standard deviation; Mranga - medium rank; U - Mann-Whitney U test result; rg - Glass two-series correlation coefficient; p - significance level

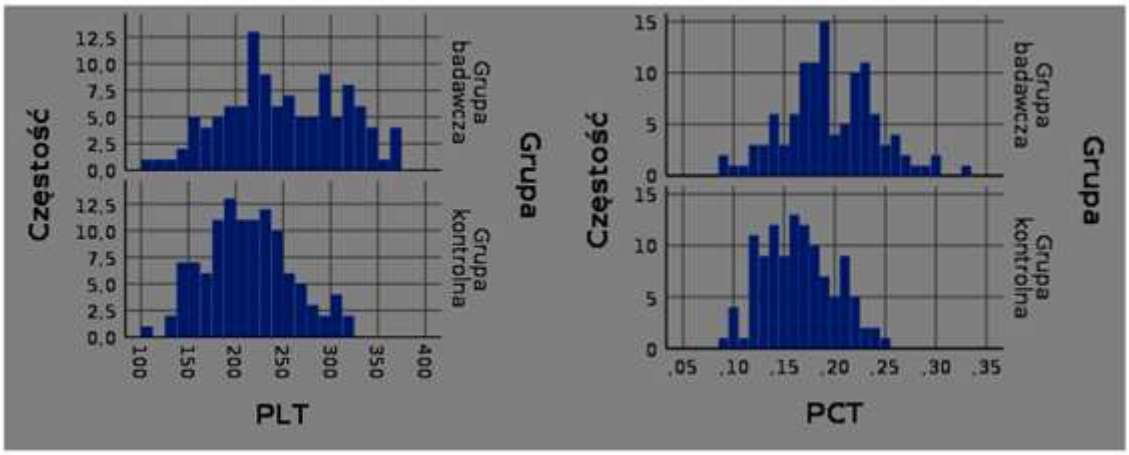
In order to answer the question of whether platelet parameters can serve as biomarkers of myocardial infarction, MANOVA's multivariate analysis of variance was used twice, estimating the regression coefficients for the last model. Because the distributions of the analyzed variables were not normal, box charts were used to remove the outliers. Table 2 presents descriptive statistics for the studied groups, when the outliers were removed. Significant differences between the values of plate parameters in individual groups were found. People who suffered from a heart attack had higher PLT and PCT values than those who did not.

Table 2. Descriptive statistics of plate parameters in the study group and control group

	The study group			The control group		
	M	SD	N	M	SD	N
PLT I	254,72	61,778	82	212,29	45,209	113
PCT I	0,2	0,046	82	0,16	0,036	113
PLT II	238,52	51,098	82	212,29	45,209	113
PCT II	0,19	0,039	82	0,16	0,036	113
PLT III	251,01	55,199	82	212,29	45,209	113
PCT III	0,2	0,039	82	0,16	0,036	113

M - average; SD - standard deviation; N - number of people in the trial;

Comparison of PLT and PCT distributions in the first measurement between the control and study groups is presented in Graph 1.

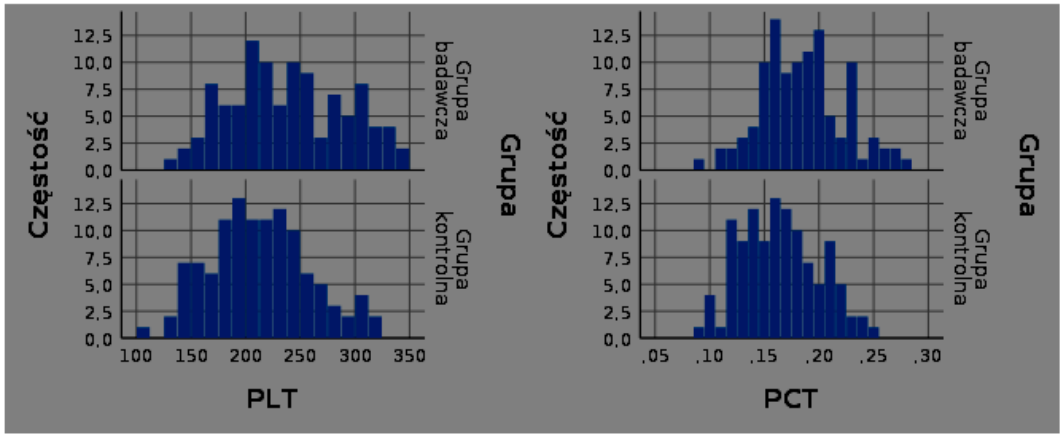


Graph 1. Comparison of PLT and PCT distributions in the first measurement between control and study groups.

The effect value ŋ2 calculated for the above differences indicated a 71% chance that a random person from the study group would have higher PLT and PCT parameters than a person from the control group.

The chance that a person from the control group will have a higher level of platelet parameters is too great to consider the first measurement of PLT and PCT as an independent marker of myocardial infarction.

In the second measurement, PLT increased by 26.23 (95% CI [12.57, 39.90]), PCT by 0.022 (95% CI [0.011, 0.033]), while PCT increased by 0.022 (95% CI [0.011, 0.033]). Comparison of PLT and PTC distributions in the second measurement between control and study groups is presented in Graph 2.

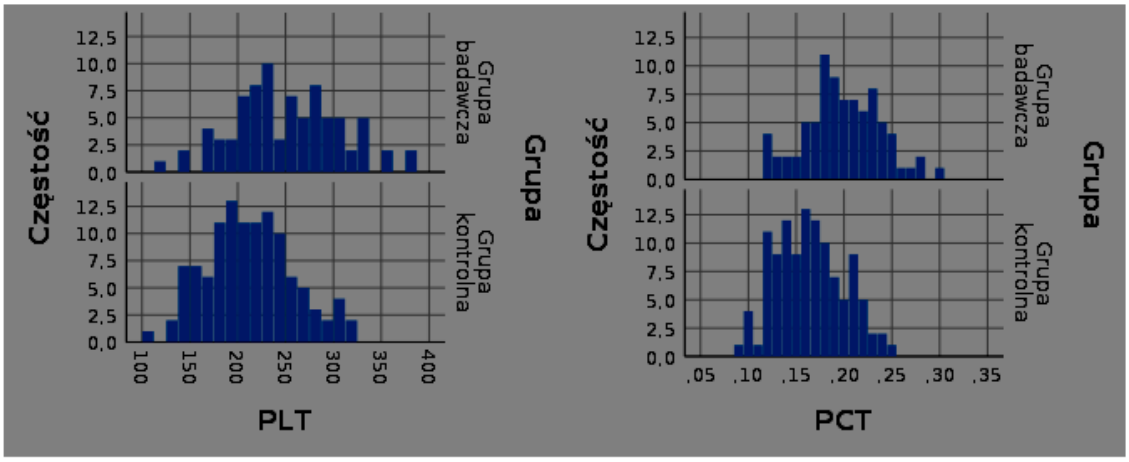


Graph 2. Comparison of PLT and PCT distributions in the second measurement between control and study groups

The value of the ŋ2 effect calculated for the above differences indicated a 65% chance that a person who had a myocardial infarction would have higher PLT and PCT parameters than a random person from the control group.

The chance that a person from the control group will have a higher level of platelet parameters is too great to consider the second measurement of PLT and PCT indicators as an independent marker of myocardial infarction. The comparison of PLT and PCT distributions in the third measurement between control and study groups is presented in Figure 3.

The value of the ŋ2 effect indicates that there is a 74% chance of random selection from a group of people who have had a heart attack, such a person who will have a higher PCT score than a randomly selected person from the control group, in addition about 70% chance of random selection from the group of the examined person with a higher PLT level. The chance that a person from the control group will have a higher level of platelet parameters is too great to consider the third measurement of PLT and PCT indicators as an independent marker of myocardial infarction.



Graph 3. Comparison of PLT and PCT distributions in the second measurement between control and study groups

Conclusions

The study was conducted to assess the relationship between PDW and PCT, and the occurrence of myocardial infarction. This assessment was to be used in the future to determine a new, better, biochemical indicator of myocardial infarction.

Author study research has not confirmed the relationship between PDW and PCT and the occurrence of myocardial infarction.

The results of statistical analyzes in the author's study are not consistent with the research conducted by Cetin et al. [8]. The authors also investigated whether the width of platelet and plateletcrit could be considered as new biomarkers of ST segment elevation myocardial infarction in young patients. They showed that PDW and PCT indicators are independent STEMI markers. The authors' results differ significantly from those obtained by Cetin et al. (2017). It is worth considering what was the main reason for this phenomenon. One reason may be a non-uniform blood measurement for laboratory tests. The blood for marking of the level of myocardial infarction markers should be collected immediately after the first symptoms of myocardial infarction, then after 6 and after 12 hours. Unfortunately, we are not able to determine exactly how much time has passed since the occurrence of the basic symptoms of the disease in order to accurately estimate how the concentration values of platelet parameters and other markers change. Often, the patient reporting to the Hospital Emergency Department is unable to specify it precisely. Therefore, the presented studies are not perfect and do not allow for unequivocal formulation of the clinical significance of the studied phenomenon. Further research and analyzes are needed, as well as an increase in the

number of people tested, so that it can be clearly determined whether PDW and PCT can be recognized as independent biomarkers of myocardial infarction.

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