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RESEACH

ANALYSIS OF MEAN PLATELET VOLUME AS A MARKER FOR MYOCARDIAL INFARCTION AND NON-MYOCARDIAL INFARCTION IN ACUTE CORONARY SYNDROME

(Analisis Mean Platelet Volume Sebagai Pembeda Infark Miokard dan Non-Infark Miokard di Sindrom Koroner Akut)

Wandani Syahrir, Liong Boy Kurniawan, Darmawaty Rauf

ABSTRAK

Sindrom Koroner Akut (SKA) merupakan manifestasi akut dari plak aterosklerosis pembuluh darah koroner yang koyak atau pecah. Platelet berperan penting pada patogenesis aterosklerosis dan SKA. Nilai MPV yang tinggi mencerminkan ukuran platelet yang lebih besar dan lebih reaktif. Penelitian ini merupakan penelitian retrospektif potong lintang di Rumah Sakit Dr. Wahidin Sudirohusodo Makassar dengan mengambil data pasien dengan diagnosa SKA (STEMI, NSTEMI dan UAP). Sampel SKA kemudian dibagi menjadi kelompok Infark Miokard (STEMI dan NSTEMI) dan non-Infark Miokard (UAP). Nilai platelet dan MPV diambil dari hasil pemeriksaan darah rutin pertama sejak pasien masuk Instalasi Gawat Darurat RSUP Dr. Wahidin Sudirohusodo. Nilai platelet dan MPV dibandingkan berdasarkan kelompok SKA. Sebanyak 251 data pasien SKA Infark Miokard dan non-Infark Miokard diperoleh masing-masing 191 data pasien Infark Miokard dan 60 data pasien non-Infark Miokard. Hasil uji statistik Mann-Whitney tidak didapatkan perbedaan bermakna nilai platelet antara pasien SKA Infark Miokard dan non-Infark Miokard ($263,4 \pm 93,2$ vs $285,2 \pm 98,7$; p=0,215). Namun didapatkan perbedaan bermakna nilai MPV antara pasien SKA Infark Miokard dan non-Infark Miokard ($8,3 \pm 1,13$ vs $7,9 \pm 1,2$; p=0,013). Hasil penelitian didapatkan nilai MPV di SKA Infark Miokard lebih tinggi daripada SKA non-Infark Miokard. Peneliti menyarankan penggunaan MPV sebagai tolok ukur yang berkemampuan dalam membantu penegakan diagnosa infark miokard.

Kata kunci: Mean platelet volume, sindrom koroner akut, infark miokard, aterosklerosis

ABSTRACT

Acute Coronary Syndrome (ACS) is an acute manifestation of ruptured atherosclerotic plaque in the coronary vascular. Platelets play an important role in the patogenesis of atherosclerosis and ACS. The high value of Mean Platelet Volume (MPV) reflects larger size and more reactive platelets. This study was a retrospective cross-sectional study performed at the Dr. Wahidin Sudirohusodo Hospital. Data of patients diagnosed as ACS (STEMI, NSTEMI and UAP) were collected from medical records. The ACS samples were divided into myocardial infarction group (STEMI and NSTEMI) and non-myocardial infarction group (UAP). Platelet count and MPV data were taken from the first complete blood count test collected when the patients admitted to the Emergency Department of the Dr. Wahidin Sudirohusodo Hospital. Platelet counts and MPV values were compared according to the ACS groups. Data of 251 ACS patients were obtained, 191 were myocardial infarction and 60 were non-myocardial infarction patients. Mann-Whitney test showed no significant difference in platelet count between myocardial infarction group and non-myocardial infarction group (263.4 \pm 93.2 vs 285.2 \pm 98.7; p=0.215). However, there were significant differences of MPV values in myocardial infarction group and non-myocardial infarction group (8.3 + 1.13 vs 7.9 + 1.2; p=0.013). This study showed that the MPV value was higher in myocardial infarct group than in non-infarct myocardial infarction group. It is proposed that MPV value is potential to be a marker for myocardial infarction diagnosis.

Key words: Mean platelet volume, acute coronary syndrome, myocardial infarction, atherosclerosis

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INTRODUCTION

Acute Coronary Syndrome (ACS) is a condition that involves pain/discomfort in the chest or other symptoms caused by lack of oxygen to the heart muscle (myocardium). Reduced coronary blood flow then can lead to myocardial ischemia. An oxygen supply that stops for approximately 20 minutes even can make myocardium undergo necrosis (myocardial infarction). Acute coronary syndrome, moreover, can be divided into two groups, namely myocardial infarction (STEMI and NSTEMI) and non-myocardial infarction group (UAP).¹ The World Health Organization (WHO) reported that there are 32.4 million cases of myocardial infarction and stroke every year in the world. In Indonesia, mortality caused by heart disease, according to WHO data, reaches 191-541 people per 100,000 male population and 112-334 people per 100,000 female population.²

Furthermore, an acute coronary syndrome is mostly considered as an acute manifestation of coronary artery atherosclerotic plaque that is torn or broken. This incidence usually will be accompanied by platelet aggregation and coagulation pathway activation, thereby forming a plaque that is rich in platelets. Platelets have a central role in the pathogenesis of acute coronary syndromes. The development of ACS disease, according to several researches, can be correlated with Mean platelet volume (MPV). Mean platelet volume is the average size of platelets in blood. Thus, MPV values reflect activation of platelets.³⁻⁸

In addition, mean platelet volume is often used as one of the parameters measured during a routine blood test, as a standard, simple and inexpensive examination. Therefore, MPV can be expected as an effective and efficient marker to differentiate types of ACS.

This research aimed to analyze MPV values in ACS patients of myocardial infarction (STEMI and NSTEMI) group and non-myocardial infarction group (UAP).

METHODS

This research was a retrospective research with cross-sectional approach. This research used data derived from the medical records of ACS patients in the Dr. Wahidin Sudirohusodo Hospital, Makassar from January 2014 to December 2015. This research also had received ethical approval from the Committee of Medical and Health Research Ethics in Faculty of Medicine, University of Hasanuddin, RSPTN UH, Dr. Wahidin Sudirohusodo (No. 633/H4.8.4.5.31/PP36-KOMETIK/2016).

Furthermore, ACS patients diagnosed with STEMI, NSTEMI, or UAP by a cardiologist based on history, physical examination and investigations were included in this research. Meanwhile, ACS patients with a history of coronary intervention/coronary artery bypass, a history of post-heart failure, disorders of Hemostasis and coagulation system, as well as incomplete medical record data were excluded. Next, platelets and MPV values were derived from the first platelet examination data of those patients using the impedance method and flow cytometry apparatus, Sysmex XN-1000 hematology autoanalyzer (Sysmex America Inc., Lincolnshire, Illinois) taken when they were treated in the ER of the Dr. Wahidin Sudirohusodo Hospital with chest pain complaints. Those ACS patients then were divided into myocardial infarction (STEMI and NSTEMI) group and nonmyocardial infarction (UAP) group.

Afterwards, data analysis was performed by using computer system. Statistical methods used in this research were descriptive and analytic. The descriptive method was performed by calculating the frequency of data distribution. The statistical test used was nonparametric Kolmogorov-Smirnov test. Results of the Kolmogorov-Smirnov test showed that the data were not normally distributed. As a result, the correlation of MPV value to myocardial infarction (STEMI and NSTEMI) and non-myocardial infarction (UAP) was tested by using Mann-Whitney test. Results of the Mann-Whitney test would have indicated a significant correlation if p had been <0.05.

RESULTS AND DISCUSSION

The total number of the research subjects was 251 ACS patients, consisted of 191 myocardial infarction patients and 60 non-myocardial infarction patients.

Based on Table 1, most of the research subjects were males as many as 192 patients (76.5%). The highest percentage of myocardial infarction was 60.2% for males and 15.9% for females. Moreover, the data show that ACS was mostly suffered by the group of patients aged 40–59 years old as many as 140 patients (55.8%). Nevertheless, there was 7 patients (2.8%) aged <40 years old with the youngest age of 28 years old. It indicates that ACS can also be found in young adults. In a previous research conducted by Han et al⁹ in Korea depicted that the mean age of ACS patients was 61.9 \pm 12.3,9. Unlike the previous research, in this research, the number of ACS patients in the age group of \geq 60 years old was only 104 patients (41.4%). ACS was mostly found in the age group of 40-59 years old,

Table 1. Characteristics of the ACS patients in this research

	Variables	Myocardial Infarction (%) 191(76.1%)	Non- Myocardial Infarction (%) 60(23.9)	Total Number (%) 251(100)
Sex	Males	151(60.2)	41(16.3)	192 (76.5)
	Females	40(15.9)	19(7.6)	59 (23.5)
Age	< 40 years	3(1.2)	4(2.6)	7 (2.8)
	40-59 years	106(42.2)	34(13.5)	140 (55.8)
	\geq 60 years	82(32.6)	22(8.8)	104 (41.4)

Table 2. Analysis of platelet levels by type of ACS

	Myocardial Infarction Non- Myocardial Infarction		Myocardial Infarction Non- Myocar		
Variables	Median (min-max)	Mean ± SD	Median (min-max)	$\mathbf{Mean} \pm \mathbf{SD}$	P *
Platelets (x10 ³ /µL)	253.0 (83.0–736.0)	263.4 + 93.2	266.5 (148.0–644.0)	285.2 ± 98.7	0.215

* Mann-Whitney Test

as many as 140 patients (55.8%). Similarly, a research conducted by Harun et al¹⁰ in Makassar showed that the percentage of ACS patients aged> 40 years was 95.96%.¹⁰

Furthermore, this research also found that 76.5% of ACS samples were males. The result was in line with the guidebook on the management of acute coronary syndrome stating that one of ACS risk factors was male sex.¹ Like this result, a previous research conducted by Haerani Harun et al also indicated that the highest percentage of ACS in Makassar was found in males.¹⁰

The above results of the Mann-Whitney test on platelet levels by ACS types showed that there was no significant difference in platelet levels between all types of ACS (p> 0.05). It meant that platelet levels in ACS patients were not significantly different.

Platelet level, according to Kalay et al¹¹, generally increased in progressive coronary atherosclerosis group. However, according to Kurniawan et al¹², there was no significant difference in platelet level between patients who survived and died during treatment. Some previous researches on thrombocytosis even showed that there was no clear correlation between thrombosis and cardiovascular disease.^{11,12}

In addition, results of the Mann-Whitney test on MPV values by ACS types showed that there was a significant difference in MPV value between all types of ACS (p < 0,05). In Figure 1, the data distribution between two different ACS groups even was significant.

The above results showed that there were significant differences in MPV values between all



Figure 1. The distribution of MPV in myocardial infarction and non-myocardial infarction groups

types of ACS. The highest MPV value was found in the myocardial infarction group. According to a previous research conducted by Khandekar et al⁴, MPV, one of platelet profiles, was a powerful indicator to assess the incidence of endothelial damage in ACS patients. MPV value, according to Al-Obeidi et al⁵, also contributed to prothrombotic status in the incidence of ACS and large platelets even played a specific role in the incidence of infarction.^{4,5}

In general, platelet activation occurred prior to acute coronary incidences. Increased use of platelets at the site of atherosclerotic plaque, unfortunately, could cause the bone marrow to release large (mature) platelets to the periphery. High MPV values, on the other hand, had higher thrombotic potential

	Myocardial Infarction		Non- Myocardial Infarction		
Variables	Median (min-max)	Mean <u>+</u> SD	Median (min-max)	Mean <u>+</u> SD	P *
MPV (fL)	8.1(5.9 – 11.7)	8.3 ± 1.13	7.4(6.4 – 11.0)	7.9 ± 1.2	0.013

Table 3. The difference analysis of MPV by types of ACS

* Mann-Whitney Test

due to higher density, faster aggregation, higher A2 thrombosis levels, and greater expressions to the Ib and IIb/IIIa glycoprotein receptors.^{4,7} Atherosclerosis was also considered as the main factor of myocardial infarction, associated with thrombosis in the coronary arteries. Therefore, if atherosclerotic plaques were fissured, ruptured, or ulcerated and local or systemic conditions trigger thrombogenesis, platelet activation and aggregation as well as thrombin secretion would occur, ultimately leading to the formation of thrombus at rupture sites resulting in coronary artery occlusion.¹³ Thrombus would also generate disruption of coronary blood flow, resulting in an imbalance between the supply and demand of oxygen. A severe and persistent imbalance condition of the oxygen supply and demand then would result in myocardial necrosis.14-16

In addition, pathomechanism of ACS and stroke actually have in common, which beginning with the formation of thrombus. Several types of research even have described that MPV value in stroke patients had a significantly strong correlation to an increase in the severity degree of functional stroke.¹⁷

As a result, it can be said that the higher MPV value in the myocardial infarction group of Acute Coronary Syndrome may be due to the etiology of STEMI and NSTEMI, atherosclerotic plaque, triggering platelet activation. This condition then would make the bone marrow secrete immature platelets to the peripheral with a larger size than the mature ones. Meanwhile, in the non-myocardial infarction group, symptoms emerged was a manifestation of impaired blood flow to the heart, caused by narrowed coronary artery lumen, commonly triggered by atherosclerosis, thus, there was no platelet activation in this group.^{15,16}

Nevertheless, there were still many limitations in this research. First, this research only differentiated the MPV values from two types of ACS, namely myocardial infarction and the non-myocardial infarction without involving the group of healthy people as comparison. Secondly, this research also did not take the gold standard test so that the researcher could not determine the cut off value. Further researches, therefore, need to include healthy people groups as comparison and conduct a gold standard test so that the cut off value can be obtained.

CONCLUSION AND SUGGESTION

In conclusion, there were significant differences in MPV values between all types of ACS. There were significant differences between the myocardial infarction group (STEMI and NSTEMI) and the nonmyocardial infarction (UAP) group. Mean platelet volume values, thus, potentially marking myocardial infarction. Consequently, MPV is recommended as a potential parameter in aiding the diagnosis of myocardial infarction.

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