

## PLATELET COUNT AND PLATELET INDEX AS PROGNOSIS MARKERS IN ADULT SEPTIC PATIENTS

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### ABSTRACT

Sepsis is a major health problem with recent increase of incidence. One of life-threatening complications of sepsis is Disseminated Intravascular Coagulation (DIC). DIC in sepsis can trigger an increase of platelet destruction which can be assessed by platelet count and platelet index. Hence, this research aimed to analyze the correlation of platelet count and platelet index to the prognosis of adult septic patients. This research was then performed with a retrospective longitudinal study design. This research used the medical record data of adult septic patients at the Dr. Wahidin Sudirohusodo General Hospital in Makassar. The data of platelet count and platelet index were collected from routine blood of the patients for the first time they were diagnosed with sepsis. In total, this research was performed on 100 adult septic patients. Fifty of those patients had a good prognosis (cured), while the other fifty patients had a poor prognosis (died). Statistical results showed that the platelet count in the adult sepsis patients with a poor prognosis was significantly lower than those in patients with a good prognosis with median/minimum-maximum of 157,000/12,000-626,000 and 329,000/96,000-801,000, respectively ( $p=0.00$ ). It was also known that there was no significant difference of MPV values between patients with poor prognosis and patients with good prognosis with Mean $\pm$ SD of  $9.54\pm 1.44$  and  $10.08\pm 2.09$ , respectively ( $p=0.138$ ). Unlike MPV values, PDW values in patients with poor prognosis were significantly higher than those in patients with good prognosis with Mean $\pm$ SD of  $16.7\pm 6.26$  and  $11.25\pm 2.13$ , respectively ( $p=0.00$ ). Thus, it can be concluded that there was an inverse correlation between platelet count and PDW value ( $r = -0.58$ ). PDW value, as a result, could be used as a prognosis marker for adult septic patients. However, it was recommended to perform further research as a prospective study by removing the possibility of bias.

**Key words:** Sepsis, platelet, MPV, PDW, prognosis

### INTRODUCTION

Sepsis is a systemic response of the body to infections that can cause acute organ dysfunction and shock. Sepsis is also considered as a major health problem with recent increase of incidence. Sepsis even can cause one death in four people with sepsis.<sup>1</sup>

Moreover, the World Health Organization (WHO) reported in 2013 that the number of sepsis cases in the world reached 30 million cases with a mortality rate of 60-80% in developing countries. Subroto and Loehoeri in 2003 also found that the incidence of sepsis in several referral hospitals in Indonesia was approximately 15-37.2% with a mortality rate of 37-80%.<sup>2,3</sup>

Sepsis, furthermore, can also cause disruption in almost all organ systems, with hemostasis as one of the worst disruption. This hemostasis disorder is caused by several factors, such as the malfunction of the coagulation cascade, the amount of pro- and anti-inflammatory cytokines released by

mononuclear cells and endothelial cells, the consecutive formation of thrombus, the stimulation of plasminogen, and the activation of antithrombin-III leading to fibrinolysis. These factors then trigger Disseminated Intravascular Coagulation (DIC) as the main cause of thrombocytopenia in septic patients.<sup>4,5</sup>

In addition, Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) are platelet indexes as the main components of a routine blood test. Mean Platelet Volume is the average size of platelets in the blood, while the Platelet Distribution Width is the heterogeneity degree of platelet size. Both of these parameters will increase if thrombocytopenia occurs as in sepsis.<sup>4,5</sup>

There were some studies on the correlation of platelet indexes and sepsis which reported that there was a correlation between an increase of platelet indexes (MPV and PDW) and a poor prognosis in septic patients. Another previous research by Kim *et al.* in 2015 even argued that an increase of MPV values within 72 hours after hospital admission could

be considered as a risk factor of independent prognosis in patients with severe sepsis and/or septic shock. Significant difference of MPV and PDW values between patients with sepsis and patients with septic shock was also found in a research by Gao *et al.* in 2014. On the other hand, a research by Sadaka *et al.* in 2014 revealed no significant correlation between platelet indexes and prognosis of septic patients.<sup>4,6-8</sup> However, there has been no research to determine the correlation between platelet indexes and sepsis prognosis in Makassar. Therefore, this research aimed to analyze the correlation of platelet count and platelet indexes (MPV and PDW) as the prognosis of adult septic patients.

**METHODS**

This research was a retrospective longitudinal study collecting data of adult septic patients at the Medical Record Installation of the Dr. Wahidin Sudirohusodo General Hospital in Makassar from January 2016 to June 2017. Data of routine blood test were collected from adult septic patients the first time when diagnosed with sepsis. The data were then classified into good prognosis and poor prognosis. The prognosis was considered to be good if the patients were allowed to go home by the doctors in charge after signs of improvement or recovery were observed. Meanwhile, the prognosis was considered to be poor if the patients died within 28 days after diagnosed with sepsis. The analysis was then carried out by comparing the group of adult septic patients

with good prognosis to the group with poor prognosis.

This study involved adult septic patients aged 18-75 years who had been diagnosed by the clinician and also had data of platelet index results (MPV and PDW). The patient data would be excluded if the patients not only had hematologic malignancy, chemotherapy, bleeding, autoimmune thrombocytopenic purpura, hypersplenism, pregnancy, thrombocyte transfusions, or fresh frozen plasma transfusion but also requested to go home before allowed by a Patient Responsible Doctor (PRD) in charge. MPV values, PDW values, and platelet counts were collected from the results of routine blood tests by hematology analyzers, Sysmex XN-1000 and ABX Pentra 80 devices on the first day the patient was diagnosed with sepsis.

This research has been approved by the Health Research Ethics Commission of University of Hassanudin/Dr. Wahidin Sudirohusodo General Hospital No 242/H4.8.4.5.31/PP36-KOMETIK/2018.

**RESULTS AND DISCUSSION**

This research used data of 100 adult septic patients, with 50 of them had a good prognosis and the other 50 m had a poor prognosis. It was also found that 53 of patients were males and 47 of them were females (Table 1).

Moreover, there were significant differences in age, platelet count, and length of stay between adult sepsis patients with good prognosis and those with poor prognosis (see Table 1). Results of T-test

**Table 1.** Characteristics of the adult septic patients with good prognosis and poor prognosis

Characteristics	Adult Septic Patients with Good Prognosis (n=50)	Adult Septic Patients with Poor Prognosis (n=50)	p-value
Age (years)			
17-25 years	9 (18%)	4 (8%)	
26-45 years	11 (22%)	6 (12%)	
46-65 years	21 (44%)	28 (56%)	
> 65 years	9 (18%)	12 (24%)	
Mean	48±16	55±15	0.03*
Sex			
Male	27 (54%)	26 (52%)	
Female	23 (46%)	24 (48%)	0.84**
Platelet count (µL)			
Median	329,000	157,000	0.00***
(min-max)	(96,000-801,000)	(12,000-626,000)	
Length of stay (days)	12 (3-28)	4 (1-15)	0.00***

Note: \*: T-test; \*\*: Chi-Square Test; \*\*\*: Mann-Whitney test  
Source: secondary data

**Table 2.** Differences of MPV values based on prognosis in sepsis

MPV (fL)	Mean	SD	Median	Min-Max	p-value*
Good prognosis	9.54	1.44	9.75	6.40-13.6	0.138
Poor prognosis	10.08	2.09	9.90	6.30-16.4	

Note: SD: Standard Deviation. \*: T-test. MPV: Mean Platelet Volume (normal value of 6-11 fL)  
Source: secondary data

**Table 3.** Differences of PDW values based on prognosis in sepsis

PDW (%)	Mean	SD	Median	Min-Max	p-value*
Good prognosis	11.25	2.13	11.45	7.80-17.10	0.00
Poor prognosis	16.7	6.26	14.75	7.80-35.50	

Note: SD: Standard Deviation. \*: T-test. PDW: Platelet Distribution Width (normal value of 11-18%)  
Source: secondary data

showed that there was no significant difference of MPV values between adult sepsis patients with a good prognosis and those with a poor prognosis (p=0.138) (Table 2).

Furthermore, results of T-test showed that there was a significant difference of the PDW values between the adult septic patients with good prognosis and those with poor prognosis (p = 0.00) (Table 3).

Analysis on the correlation between platelet counts and PDW values showed an inverse correlation between the sepsis patients with good prognosis and those with poor prognosis (p <= 0.00). In other words, the lower the platelet count would lead to the higher the PDW value (Table 4).

**Table 4.** Correlation between platelet counts and PDW values in adult septic patients

	Good Prognosis	Poor Prognosis
p-value	0.00	0.00
R	-0.52	-0.58

Source: secondary data

The total subjects in this research were 100 patients consisting of 50 adult septic patients with good prognosis and 50 adult septic patients with poor prognosis). The adult septic patients with poor prognosis were predominantly found at an older age with a mean of 55±15 years, a lower platelet count, and shorter length of stay than those with good prognosis. Similarly, a research by Sadaka *et al.* in the USA reported that non-surviving adult septic patients were mostly found at older ages with lower platelet count compared to surviving sepsis patients.<sup>8</sup>

The T-test results on MPV values in adult septic patients did not show any significant difference

between the patients with good prognosis and those with poor prognosis (p=0.138) (Table 2). This was in line with the results of a research by Sadaka.<sup>8</sup> Contrastingly, Kim *et al.* found a significant difference of MPV values between non-surviving and surviving adult septic patients. This might be because in this research and research by Sadaka, the MPV values were measured on the first day the patients were diagnosed with sepsis, while in research by Kim *et al.* the MPV values were analyzed at the time of admission and increased after 72 hours.<sup>7,8</sup>

In fact, an increase of MPV was considered as a sign of an increase of platelet size which generally indicates compensation for platelet production in the bone marrow due to thrombocytopenia as occurs in sepsis. MPV was inversely proportional to platelet maturity.<sup>9</sup>

Furthermore, the results of this research showed that PDW values in adult septic patients with poor prognosis were significantly higher than those with good prognosis (p=0.00) (Table 3). Similarly, a research by Gao *et al.* reported an increase of PDW value in surviving adult patients with septic shock compared to non-surviving patients.<sup>10</sup>

PDW values will increase when there are increased platelet turnover and immature platelet production. Platelet destruction that occurs in sepsis subsequently causes a decrease of platelet counts, which triggers the body to increase platelet production and cause an increase in PDW values as the compensation of platelet consumption. Increased PDW can also be caused by the activation of platelets.<sup>9</sup>

In this research, MPV values in the adult septic patient group with good prognosis were not significantly different from those in the adult septic

patient group with poor prognosis. On the other hand, PDW values in the adult sepsis patient group with poor prognosis were significantly higher than those in the adult septic patient group with good prognosis. This was because the MPV and PDW values gradually changed, thus differences of the values of MPV and PDW were likely to correspond with the development of the disease. However, in this research, the data collection was only carried out when the patient was firstly diagnosed with sepsis. Consequently, changes of the MPV value were not well assessed and it became one of the limitations in this research.<sup>11,12</sup>

In addition, the correlation analysis platelet count and PDW value in adult septic patients with poor prognosis showed a significant inverse correlation with a p-value of 0.00 and r-value of -0.58. Under normal conditions, platelet production will increase along with a decrease of platelet count. Thrombocytopenia in sepsis subsequently triggers platelet production which can cause an increase of the MPV and PDW platelet index.<sup>4</sup>

Unfortunately, this research still had some limitations since it merely used secondary data from medical record, so it was difficult to avoid bias. Moreover, sampling was only carried out at the beginning of the diagnosis of sepsis, so changes of platelet indexes along with the development of the disease were undetermined.

## CONCLUSION AND SUGGESTION

PDW and MPV values were higher in adult septic patients with poor prognosis than those in adult septic patients with good prognosis. However, PDW value was the only platelet index that showed significant difference between adult septic patients with poor prognosis and those with good prognosis. In addition, there was an inverse correlation between platelet counts and PDW values in adult septic patients with good prognosis and in those with poor prognosis. Hence, platelet counts and PDW values could be used as prognosis markers for adult septic patients. Nevertheless, it was suggested to carry out

further prospective studies to confirm these results by removing the possibility of bias.

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