

Neutrophil-to-Lymphocyte Ratio, Monocyte-to-Lymphocyte Ratio, Platelet-to-Lymphocyte Ratio, and, Mean Platelet Volume-to-Platelet Count Ratio with Procalcitonin in Sepsis Patients

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ABSTRACT

The standard diagnosis of sepsis is blood culture examination which takes a relatively long time and is only a few positive results. Various biomarkers have been developed to diagnose sepsis. One of them is procalcitonin. Although considered a better marker of sepsis, PCT is relatively high cost and is not readily available in many hospitals. In recent times, a number of simple parameters, which come from complete blood counts are quite cheap, fast and common. Its use as a biological marker has been studied, namely the neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR). Mean Platelet Volume - Platelet count (MPV / PC). This study will look at the suitability of the neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR). Mean Platelet Volume - Platelet count (MPV / PC) with procalcitonin levels in patients diagnosed with sepsis at Wahidin Sudirohusodo Hospital, Sepsis Patients. The study population was all inpatients with a diagnosis of sepsis at Dr. Wahidin Sudirohusodo in Makassar criterion Age > 18 years, and has data on routine blood laboratory results and procalcitonin. Sampling was done by consecutive random sampling. Based on a study of 48 sepsis patients aged 20-81 years, the mean age was (47.7 ± 12.7). The number of respondents consisted of 26 men (54.2%) and 22 women (45.8%). There was no compatibility between NLR and Procalcitonin ($r = -0.078$ $p > 0.05$), MLR with Procalcitonin ($r = -0.052$ $p > 0.05$), PLR with Procalcitonin ($r = -0.179$ $p > 0.05$). And the final result is that there is a significant positive agreement between MPV / PC and procalcitonin, ($r = 0.317$ $p < 0.001$). There was no correlation between NLR, MLR and PLR values with procalcitonin levels in septic patients. There is a significant correlation between the MPV / PC ratio value and the procalcitonin level in septic patients. In patients with sepsis the MPV / PC ratio value can be used as an alternative as a substitute for procalcitonin testing which is considered expensive and difficult to do in limited areas.

Keywords: Neutrophil-to-Lymphocyte Ratio, Monocyte-to-Lymphocyte Ratio, Platelet-to-Lymphocyte Ratio, and, Mean Platelet Volume-to-Platelet Count Ratio, Procalcitonin, Sepsis

INTRODUCTION

Sepsis is a life-threatening organ dysfunction resulting from an excessive host response to an

infection. Sepsis and the resulting inflammatory response can lead to multiple organ dysfunction syndromes and death (Singer et al., 2016). Sepsis is difficult to determine globally, although recent scientific publications estimate that in 2017 there were 48.9 million cases and 11 million sepsis-related deaths worldwide, accounting for nearly 20% of all global deaths (Rudd et al., 2020).

The standard diagnosis of sepsis is a blood culture examination which takes a relatively long time and a positive result is only 26.6% of all diagnosed sepsis patients (Bates et al., 1997). One of the tools to diagnose sepsis quickly is Q-SOFA which can be used to diagnose sepsis. In addition to the blood biomarkers, one of which is procalcitonin. Increased PCT levels correlate with the severity of sepsis, so procalcitonin is a diagnostic tool with higher accuracy than other laboratory parameters (Bloos & Reinhart, 2014). A number of simple parameters, derived from a complete blood count, have been investigated for their use as biological markers, including the neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR). Mean Platelet Volume - Platelet count (MPV / PC) However, the results were variable and there is no consensus so far regarding the accuracy and clinical usefulness of these parameters (Djordjevic et al., 2018).

This study will look at the suitability of the neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR). Mean Platelet Volume - Platelet count (MPV / PC) with procalcitonin levels in patients diagnosed with sepsis at Wahidin Sudirohusodo Hospital.

METHODS

The research was conducted at Wahidin Sudirohusodo Hospital Makassar. The research was conducted starting in December 2020 until the number of samples was met. The research design used was observational with cross sectional design. The study population was all inpatients with a diagnosis of sepsis at Dr. Wahidin Sudirohusodo in Makassar who was seen from Medical Record data and was diagnosed with sepsis according to the inclusion criteria, namely age > 18 years, and had data on routine blood laboratory results and procalcitonin. with the exclusion criteria criteria: a) Patients with a diagnosis of malignancy b). Patients with a diagnosis of autoimmune disease c). Chronic liver disease.

The research material is the result of complete blood count which is stated in the patient's medical record report. Complete blood count was performed using the Sysmex XP-300TM Automated Hematology Analyzer (Sysmex Corporation, Kobe, Japan) using the flowcytometry method. Procalcitonin examination was carried out using the VIDAS B-R-A-H-M-S PCT with the ELISA method (enzyme linked immunosorbent assay).

Approval and declared to meet the ethical requirements of research is issued by the Biomedical Research Commission on Humans, Hasanuddin University Medical Faculty Number: 716 / UN4.6.4.5.31 / PP36 / 2020. Data were processed with the help of SPSS version 22.0 for Windows, the statistical test used was the Chi-Square test and significant test if $p < 0.05$.

RESULTS

The study was conducted at Wahidin Sudirohusodo hospital from June 2019 - July 2020. The sample of this study was inpatients at Wahidin Sudirohusodo Hospital diagnosed with sepsis, involving 48 research subjects who met the inclusion criteria. In table 1 below is a description of the distribution of research respondents based on the characteristics of the research subject, gender and age, and the differential count.

Table 1. Description of the characteristics of the research subject

Characteristic	Result
Age (Year)	46,8 ± 13,2
gender (%Male/%Female)	56,3/45,8
<i>Diff. Count</i>	
Leukocytes (10 ³ /ul)	15,3± 9,01
Neutrophils (10 ³ /ul)	12,482 ± 7,39
Lymphocytes (10 ³ /ul)	1.3898 ± 1,15
Monocytes (10 ³ /ul)	1.1806 ± 2,23
Platelets (10 ³ /ul)	244,979± 139,02
MPV	9.9479 ± 1,37

Based on a study of 48 sepsis patients aged 20-81 years, the mean age was (47.7 ± 12.7). The number of respondents consisted of 26 men (54.2%) and 22 women (45.8%). Overview of routine blood results with leukocyte values (mean 15.3 ± SD 9.01), with a differential count, namely: neutrophil values (mean 12.482 ± SD7.39), lymphocyte values (mean 1.3898 ± SD 1 , 15), monocyte values (mean 1.1806 ± SD 2.23). Then the platelet values we found were (mean 244.979 ± SD 139.02), and the mean platelet volume values (mean 9.9479 ± SD 1.37).

Based on blood tests carried out on research subjects, it can be seen the characteristics of the results of several simple blood count ratio profiles in the table below:

Table 2. Statistically Descriptive Research Variables (n=48)

Variables	Minimum	Maximum	Mean	Std. Deviation
NLR	0,318	20,356	10,745	5,341
MLR	0,028	6,365	0,858	0,987
PLR	39,431	807,598	242,904	175,887
MPV/PC	0,884	14,286	5,544	3,296
Procalcitonin	0,11	200,00	26,849	51,145

Based on the data table above shows that the NLR variable has a minimum value of 0.318, a maximum value of 20.356 with an average value of 10.834. The MLR variable has a minimum value of 0.028, a maximum value of 6.365 with an average value of 0.798. The PLR variable has a minimum value of 2.716, a maximum value of 165.814 with an average value of 35.884. The MPV / PC variable has a minimum value of 0.009, a maximum value of 0.134 with an average value of 0.053. The procalcitonin variable has a minimum value of 0.11, a maximum value of 200.00 with an average value of 23.060.

Below shows the correspondence between the NLR, MLR, PLR, and MPV / PC values with the procalcitonin levels diagnosed with sepsis. (Table 3, Figure 1).

Table 3. Correlation of NLR, MLR, PLR, MPV/PC with Procalcitonin

Variabel	Statistik	Procalcitonin
<i>NLR</i>	R	-0,078
	p	0,599
	n	48
<i>MLR</i>	R	-0,052
	p	0,726
	n	48
<i>PLR</i>	R	-0,179
	p	0,223
	n	48
<i>MPV/PC</i>	R	0,317
	p	0,028
	n	48

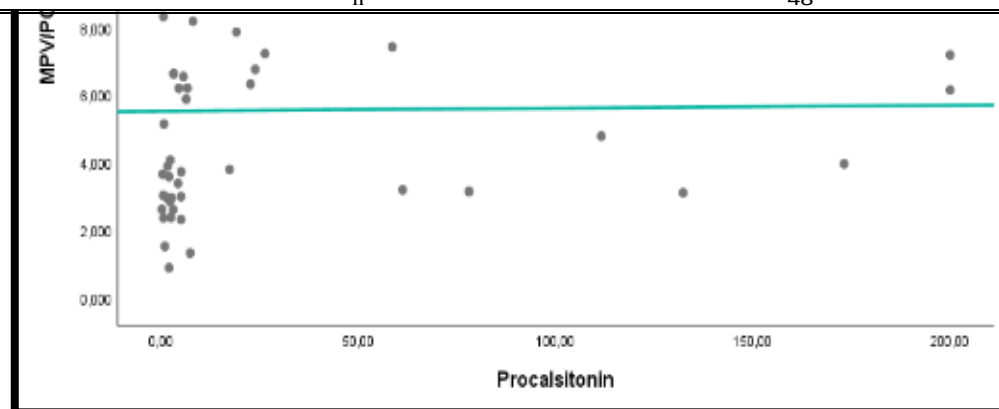


Figure 1. Correlation of *MPV/PC* with Procalcitonin

Based on the results of the analysis of the table above, it can be concluded that there is no compatibility between NLR and Procalcitonin ($r = -0.078$ $p > 0.05$), MLR with Procalcitonin ($r = -0.052$ $p > 0.05$), and other results that there is no agreement. between PLR and Procalcitonin ($r = -0.179$ $p > 0.05$). And the final result is that there is a significant positive agreement between MPV / PC and Procalcitonin, where the higher the MPV / PC, the higher Procalcitonin ($r = 0.317$ $p < 0.001$).

DISCUSSION

This study included 48 patients diagnosed with sepsis, aged between 20-81 years, 26 people (54.2%) and 22 women (45.8%). In this study, the results showed that there was no match or correlation between NLR and procalcitonin levels with insignificant results ($r = -0.078$; $p > 0.05$). This is similar to Jonathan et al. (2019) who conducted a similar study with the result that there was no correlation between NLR and procalcitonin levels in septic patients ($r = 0.122$; $p > 0.05$). A different study obtained by Nurdani et al. (2019) in Surabaya stated that there was a strong and significant correlation between NLR and procalcitonin levels ($r = 0.68$; $P < 0.01$) in septic patients (Jonathan et al., 2019; Nurdani et al., 019).

The difference in the results of the study could be due to differences in sampling time which cannot be ascertained properly so that the results of the measurement of neutrophils, lymphocytes and procalcitonin from blood samples. Neutrophils will increase in circulation and infected tissue several hours (7-10 hours) after endotoxin is released by microbes and last several days in circulation. Procalcitonin levels increase within 2 hours after bacterial stimulation which peaks within 12-48 hours and decreases thereafter (Arif et al., 2017).

In this study, the results showed that there was no match or correlation between MLR and procalcitonin levels with insignificant results ($r = -0.052$; $p > 0.05$). The results of Djordjevic's study reported that MLR values were increased in patients with bacterial infection. However, there was no

significant difference in MLR values between living and dead patients in the sub-analysis of this study further. While we know that in other studies increased procalcitonin levels were found to be elevated in all patients with sepsis (Djordjevic et al., 2018; Wang et al., 2019). So we think in accordance with our results that the increase in MLR value with procalcitonin levels is not compatible.

In this study there was a result that there was no match or correlation between the PLR value and the procalcitonin level ($r = -0.179$; $p > 0.05$). The research conducted to link the PLR value to the procalcitonin level does not yet exist. Research on PLR on sepsis cases by Karina as a diagnostic test and suggests that the PLR value can be used to determine sepsis in adult patients with a sensitivity: 85.7% and a specificity of 86.7% (Nilasari & Iskandar, 2021).

This study also obtained a result of a significant conformity or correlation between MPV / PC and Procalcitonin, where the higher the MPV / PC the higher Procalcitonin ($r = 0.317$; $p < 0.001$). In the study, Jooyoung Found that MPV / PC results were increased in pneumonia patients with increased levels of procalcitonin (Cho et al., 2020).

In this study there are still deficiencies in which the study sample we took is common in all cases of sepsis, where we did not differentiate the severity of inflammation that occurs in sepsis, especially in patients with septic shock. We also did not differentiate this suitability by culture from individual patients.

CONCLUSION

There was no correlation between NLR, MLR and PLR values with procalcitonin levels in septic patients. There is a significant correlation between the MPV / PC ratio value and the procalcitonin level in septic patients. In septic patients the MPV / PC ratio value can be used as an alternative as a substitute for procalcitonin testing which is considered expensive and difficult to do in limited areas.

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