Majalah Kedokteran Sriwijaya,
Th. 52 Nomor 2, April 2020

CORRELATION OF MEAN PLATELET VOLUME AND SOFA SCORE ON SEPSIS PATIENTS IN INTENSIVE CARE UNIT

Irma Yunita Puspayani[1], Rose Malfiana[1], Rizal Zainal[1], Iche Andriyani Liberty[2]

[1]Department of Anesthesia and Intensive Therapy, RSUP DR. Mohammad Hoesin, Faculty of Medicine, Sriwijaya University, Palembang
[2]Department of Public Health and Community Medicine, Faculty of Medicine, Sriwijaya University, Palembang

email: bundayudirta@gmail.com

ABSTRACT

Delay in diagnosis and treatment of sepsis can result in a rapid deterioration in the direction of failed circulation, damage to various organs until death. The rating system that is often used to assess the extent of organ damage and the likelihood of death is the SOFA score. Mean platelet volume (MPV) is a measurement of average platelet volume (MPV) that has been routinely, but its correlation with SOFA scores in sepsis is not widely understood. The purpose of this study was to determine the correlation of mean platelet volume (MPV) and SOFA scores in septic patients in the ICU. This research is a descriptive observational study using cross sectional design. The sample size obtained from this study was 87 people. The sample in this study were all patients aged ≥18 years who were treated in the intensive care unit of RSUP Dr. Mohammad Hoesin Palembang, both heavenly and medical, fulfilled the criteria for diagnosis of sepsis. The results of correlation analysis using the Pearson test showed that statistically SOFA and MPV scores were positively correlated positively with moderate strength (0.5732). This shows that the increase in MPV is directly proportional to the increase in sofa scores in predicting death in sepsis patients.

Keywords: Mean Platelet Volume (MPV), SOFA Score, Sepsis

1. INTRODUCTION

Sepsis is a major cause of morbidity and mortality in the world, this is caused by dysregulation of the body's immune system in response to infection. Although various sepsis management strategies based on pathophysiology have been implemented, mortality rates remain high, around 300 deaths per 100,000 people. Incidence increased from 1,060,052 cases in 2003 to 1,129,816 in 2013 with an annual growth rate of 0.66%. [1,2]

Death in sepsis is related to multiple organ failure (multiple organ dysfunction or MODS) caused by microvascular thrombosis and endothelial dysfunction, resulting in tissue hypoxia. The degree of organ damage can be assessed by several assessment systems based on clinical examination, laboratory data, and therapeutic interventions. The grading system that is often used is The Sequential Organ Failure Assessment (SOFA). A high SOFA score is associated with an increased chance of death. SOFA scores require several clinical examination variables and laboratory data such as PaO2, platelet count, creatinine levels, and bilirubin levels.

Unfortunately, not all hospitals in the area can do this examination. Several previous studies have shown that mean platelet volume (MPV) can be used to estimate the prognosis and mortality rate in sepsis patients.[3-5]

Mean platelet volume (MPV) is a parameter to see an inflammatory process that can be seen from a complete blood test. Inflammatory conditions can change the size of platelets which will affect platelet reactivity. Previous studies have shown that this MPV value increases in a serious condition. A prospective study in neonates concluded that neonatal sepsis had a higher MPV value than non-sepsis. [6,7]

Sepsis is associated with endothelial dysfunction involving platelet activation and platelet consumption. Some protrombus and proinflammation conditions involve a considerable number of inflammatory cytokines and thrombopoietin, along with genetic factors that regulate the thrombopoiesis process. Increased thrombopoesis will cause the release of many young platelet cells with larger granules. This is illustrated by an increase in mean platelet volume (MPV).[8]

Mean platelet volume (MPV) is a measurement of average platelet volume (MPV) that has been routinely available since the 1970s, but its correlation with SOFA scores in sepsis is not widely understood. [9,10] The purpose of this study was to determine the correlation of mean platelet volume (MPV) and SOFA scores in septic patients in the ICU.

2. METHODS

This research was conducted from November until December 2019. The data taken is data from the patient's medical record which is stored in the medical record installation of Dr. RSUP. Mohammad Hoesin Palembang. This research is a descriptive observational study using cross sectional design. All patients with a diagnosis of sepsis who met the inclusion criteria were taken by consecutive sampling method. Total samples obtained 87 patients. with power studies using different formulas for hypothesis proportion Kelsey (1996) 99.4% Data was collected from the status of the study, then entered in the data entry format STATA version 15 (College Station, Texas 77845 USA) and MedCalc 12.7

The population in this study were all sepsis patients who were treated in the intensive care unit of RSUP Dr. Mohammad Hoesin Palembang from the period January 2018 to December 2018. The inclusion criteria, (1) All patients treated in the intensive care unit of RSUP Dr. Mohammad Hoesin Palembang, both heavenly and medical, fulfilled the criteria for diagnosis of sepsis. (2) Age ≥18 years. The exclusion criteria are (1) Referral patients from other hospital ICUs (2) Patients with active bleeding, malignancy, acute coronary syndrome, or have a history of platelet neglect such as ITP. (3) Data incomplete.

3. RESULTS

Subject's general characteristics were categorized into age, gender, number of comorbidities, wards, infection sources, and diagnoses (Table 1).

Table 1. Distribution of subject's general characteristics (*n* = 87)

Characteristics	*n*	Percentage (%)
Age		
- 18-65 years	69	79.3%
- > 65 years	18	20.7%
Mean 52 ± 15,46 years		
Min-max (18 – 82 years)		

Gender		
- Male	55	63.2%
- Female	32	36.8%
Comorbidities scores		
- Score 0	20	23%
- Score 1-2	67	77%
Ward		
- GICU	44	50.6%
- ER ICU	35	40.2%
- P1	8	9.2%
Source of infection		
- Respiratory tract	34	39.1%
- Gastrointestinal tract	37	42.5%
- Others	16	18.4%
Case type		
- Medical	38	43.7%
- Surgical	49	56.3%
SOFA score	8,08 $\pm$ 3,16 (2.0 -14.0)	

Distribution based on the type of disease in this study found that the highest source of infection was gastrointestinal infection of 37 people (42.5%) and respiratory tract of 24 people (39.1%). While the distribution based on the type of cases found some surgical cases, namely 49 people (56.3%) and medical cases amounted to 43.7%.

Correlation analysis using Pearson test showed that SOFA score and MPV positively correlated with moderate significance (0.5732).

Table 2. Correlation of SOFA Score and MPV

		MPV
SOFA score	Correlation coefficient (r)	0.573
	p	0.000

Correlation power, from correlation coefficient: 0 (no correlation); 0.00-0.199 (very weak); 0.20-0.39 (weak); 0.40-0.59 (medium); 0.60-0.79 (strong); 0.80-1.0 (very strong)

4. DISCUSSION

Sepsis is the main cause of ICU morbidity and mortality. High mortality rate of sepsis in part is caused from late diagnosis and therapies. In recent decades, many studies have been conducted to address this condition, with the main aim of creating correct therapeutic management, preventing possible complications, and reducing mortality rate.[11] In our study, general and clinical characteristics of subjects, including age, gender, and wards did not show significant differences ($p > 0.05$) and not to be compared.

From our analysis, 69 (79.3%) subjects were aged 18-65 years old and 18 (20.7%) subjects were aged 65 years old (mean: 52 ± 15.46 years; min-max 18-82 years). Based on gender distribution, 56 (64.4%) of our patients were male and 31 (35.6%) of our patients were female. Theoretically, male gender has higher incidence and mortality rate from sepsis. A study showed that hormonal conditions played part in immune system, where androgen hormones play suppressive role in immune response, while female hormones play protective role. Meanwhile, Anthony *et al.* showed that mortality rate was higher in female than male. Nevertheless, in this study, gender did not play direct role in septicemia.[12,13]

This study used Pearson test to analytically associate SOFA score and MPV. Our Pearson test showed positive correlation with medium power (r = 0.5732). Our result was in line with the study conducted by Vardon Bounes *et al.* (2019) that utilized multidimensional analysis with 301 subjects, that showed significant correlation between MPV and SOFA score (r = 0.486; $p < 0.0001$). Lee *et al.* (2015) showed that MPV and SOFA were positively correlated (r = 0.018; $p = 0.746$). Death from septicemia is strongly correlated with multiple organ failures. The degree of organ disfunction in sepsis has prognostic value, and translated clinically into SOFA (Sequential Organ Failure Assessment) that is recommended by Surviving Sepsis Campaign (SSC). Multiple organ failures caused in part from microvascular thromboses and endothelial dysfunctions, involving thrombocytes. Thrombocytopenia has been known to correlate with sepsis since more than 40 years ago. Thrombocytopenia (< 50,000 / µL) is known to be prognostically negative in sepsis; this negative prognosis is acknowledged to arise from thrombocyte activation and usage. Markers of thrombocyte functions, such as mean platelet volume (MPV), platelet distribution width (PDW), and other thrombocyte indices all shows positive correlation with degree of septicemia. [3,4,14]

Platelet is a dynamic particle; although its main purpose is in blood coagulation (together with coagulation factors), platelet is known to contribute in inflammation, host defense against microbes, wound healing, angiogenesis, and remodeling. Platelet is also known to mediate leukocyte extravasation and to synthesize reactive oxygen species; oxidative stress that occurs in inflammation is also known to activate thrombocytes. Platelet ability to influence other cells shows that platelet is able to play many significant roles in pathologic processes. Platelet indices is a group of platelet derivate parameters that comes from automatic blood count. Evidences showed that platelet indices may have diagnostic and prognostic values in some conditions. Therefore, simultaneous measurement of platelet indices (MPV, PDW, P-LCR, PCT, and PC) will produce valid instrument to measure disease severity. Platelet indices come from automatic blood count; without additional costs.[15,16]

5. CONCLUSION

There is a correlation between mean platelet volume (MPV) and SOFA score in predicting 28-day mortality in sepsis patients, which is positive with a moderate correlation (r = 0.5732). This shows that the increase in MPV is directly proportional to the increase in sofa scores in predicting death in sepsis patients.

REFERENCES

[1]. Shen Y, Huang X, Zhang W. Platelet-to-lymphocyte ratio as a prognostic predictor of mortality for sepsis: Interaction effect with disease severity - A retrospective study. BMJ Open. 2019;9(1):1–7.

[2]. Dellinger RP, Levy MM, Rhodes A, Bs MB, Annane D, Gerlach H, et al.

Surviving sepsis campaign : international guidelines for management of severe sepsis and septic shock. Intensive Care Med. 2013;39(2): 165-228

[3]. Singer M, Deutchman C, Seymour CW, Hari M, Annane D, Bauer M et al. The third intenational consensus definitions for sepsis and septic shock (sepsis-3). JAMA. 2016;315(8):801–10.

[4]. Vardon BF, Gratacap MP, Groyer S, Ruiz S, Georges B, Seguin T, et al. Kinetics of mean platelet volume predicts mortality in patients with septic shock. PLoS One. 2019;14(10):1–15.

[5]. Kim CH, Kim SJ, Lee MJ, Kwon YE, Kim YL, Park KS, et al. An increase in mean platelet volume from baseline is associated with mortality in patients with severe sepsis or septic shock. PLoS One. 2015;10(3):1–13.

[6]. Biyikli E, Kayipmaz AE, Kavalci C. American Journal of Emergency Medicine Effect of platelet – lymphocyte ratio and lactate levels obtained on mortality with sepsis and septic shock. Am J Emerg Med. 2017;10–3.

[7]. Zampieri FG, Ranzani OT, Sabatoski V, de Souza HP, Barbeiro H, da Neto LMC, et al. An increase in mean platelet volume after admission is associated with higher mortality in critically ill patients. Ann Intensive Care. 2014;4(1):1–8

[8]. Montero-Chacón LB, Padilla-Cuadra JI, Chiou SH, Torrealba-Acosta G. High density lipoprotein, mean platelet Volume, and Uric Acid as Biomarkers for Outcomes in Patients With Sepsis: An Observational Study. J Intensive Care Med. 2018;20(10):1-7

[9]. Oh GH, Chung SP, Park YS, Hong JH, Lee HS, Chung HS, et al. Mean platelet volume to platelet count ratio as a promising predictor of early mortality in severe sepsis. Shock. 2017;47(3):323–30.

[10]. Ginting AR, Sembiring E, Rahimi A. Hubungan nilai mean platelet volume (MPV) dengan derajat sepsis. Majalah kedokteran nusantara; 2016 : 77–8.

[11]. Rudd KE, Kissoon N, Limmathurotsakul D, Bory S, Mutahunga B, Seymour CW, et al. The global burden of sepsis : barriers and potential solutions. 2018;2016:1–11.

[12]. Yang Y, Xie J, Guo F, Longhini F, Gao Z, Huang Y, et al. Combination of C-reactive protein, procalcitonin and sepsis-related organ failure score for the diagnosis of sepsis in critical patients. Ann Intensive Care. 2016;6(1) : 1-16

[13]. Angele MK, Pratschke S, Hubbard WJ, Chaudry IH. Cardiovascular and immunological aspects.Virulance. 2014;5(1):12–9.

[14]. Greco E, Lupia E, Bosco O, Vizio B, Montrucchio G. Platelets and multi-organ failure in sepsis. Int J Mol Sci. 2017;18(10):1–10.

[15]. Pradesh M, Author C, Pradesh M. Platelet Indices as Prognostic Markers in Sepsis Patients. 2019;07(04):31–5.

[16]. Path PRMD, Path GSMD, Padmavathidevi CMD, Mounika DCPTDN. A Comparative Study of Platelet Indices , in Cases of Fever , Sepsis Leading To Multiorgan Dysfunction And Control Group , At A Tertiary Care Hospital Using An Automated Hematology Analyzer Sysmex Xn _ 1000. 2017;16(12):27–33.