

High Platelet to Lymphocyte Ratio (PLR) Associated with High Q-Sofa in Multi-Trauma Patients at RSUP Prof Dr I.G.N.G Ngoerah Hospital Denpasar

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ABSTRACT

Background: Trauma is one of the world's major health problems; in 2013, 56.2 million patients were hospitalized, and globally, 8 million people died from trauma. Traumatic injury can cause changes in immune function, which can lead to the activation of proinflammatory cytokines known as SIRS. In addition to the immune response in addition to SIRS, platelets also play an important role in trauma; platelets play a key role in hemostasis. A simple clinical screening tool that performs very well in identifying adult patients with suspected infection is called qSOFA. Apart from that, a new score, namely PLR, was also found to be able to predict the severity of trauma more quickly. Therefore, PLR is thought to be able to predict the severity of a trauma that results in SIRS using qSOFA. **Objective:** To determine if the high PLR value is significantly related to the improvement of the qSOFA score in multi-trauma cases. **Method:** This type of study is a cross-sectional study. The subjects of this study totaled 45, which were divided based on the data of PLR value variables, namely ≤ 200 and > 200 , and qSOFA score variables, namely ≥ 2 and < 2 . **Results:** The Spearman test conducted in the study obtained a value of $p = 0.001$. In addition, the correlation value between PLR and qSOFA variables was found to be 0.444 in the contingency coefficient test and 0.469 in the Spearman test. **Conclusion:** Both variables show a significant relationship between PLR and qSOFA, so they can be used to assess each variable. However, the correlation shown by these two variables is quite low, so further research can be done to confirm this condition.

Keywords: multi-trauma; SIRS; qSOFA; PLR; sepsis.

INTRODUCTION

Trauma is one of the world's major health problems (Global Burden of Disease Study, 2013). In 2013, 973 million people were estimated to have experienced trauma, of which 56.2 million patients were hospitalized due to trauma, and globally, 8 million people died from trauma (Haagsma *et al.*, 2016). Traumatic injury can cause changes in immune function, which can lead to the activation of proinflammatory cytokines known as systemic inflammation response syndrome (SIRS) followed by anti-inflammatory reactions and immunosuppression mechanisms known as compensatory anti-inflammatory response syndrome (CARS) (Politi, Frieri, and Boutin, 2017).

In addition to the immune response in SIRS, CARS, and MARS, platelets also play an important role in trauma. Platelets play a key role in hemostasis (Yun

et al., 2016); these cells rapidly bind to damaged blood vessels and aggregate to form a thrombus to prevent excessive bleeding (Kornblith *et al.*, 2014). In addition, platelets play an important role in the development of sepsis (Wang *et al.*, 2018).

A simple clinical screening tool has now been developed that performs very well in identifying adult patients with suspected infections who are likely to have poor outcomes, called 'rapid SOFA' or quick sequential organ failure assessment (qSOFA). The qSOFA measures three clinical parameters (Evans, 2018).

Several studies have proposed a direct relationship between low platelet count and MODS in trauma patients. Thrombocytopenia occurring immediately post-injury is also an independent risk factor for multiple organ failure, death, and other complications

(Nydam, Kashuk and Moore, 2011). PLR is significantly associated with an increased risk of in-hospital mortality in adult patients admitted as a result of traffic accidents (Dewar *et al.*, 2013).

Currently, however, researchers are interested in identifying more prognostic factors that can be used in trauma patients. One of them is platelet to lymphocyte ratio (PLR). Until now, there is not much literature that discusses PLR, multiple trauma, and its relationship with sepsis. PLR has several advantages, namely that the examination is very simple and easy to calculate. In addition, PLR can be used in almost all emergency departments (EDs) worldwide, including in developing countries, because complete blood count tests are widely used and very cheap. Thus, PLR can be obtained in the early phase when patients enter the emergency room or are experiencing acute conditions such as trauma. Therefore, several studies have been conducted to determine the predictive performance of PLR in various acute diseases (Jo *et al.*, 2020).

By considering the advantages of PLR, which is easily available in all hospital emergency rooms in Indonesia, its affordable price, its potential to predict sepsis through Sequential Organ Failure Assessment (SOFA) score, and the lack of research linking PLR with multi-trauma, researchers are interested in proving whether PLR can be used as a predictor of sepsis based on SOFA score in multi-trauma. This is certainly expected to help doctors determine more appropriate therapy and treatment.

METHODS

The research design used a cross-sectional study to determine the relationship between PLR and qSOFA values, which are used as predictors of sepsis in multi-trauma cases. Data was taken from the patient's medical record.

The population of this study were all patients with trauma cases who came to the Emergency Department (IGD) of Prof. Dr. IGNG Ngoerah Hospital who underwent surgery and conservative measures from January 2019 to December 2022. The sample of this study was selected using sampling techniques, namely non-probability sampling/ consecutive sampling, with a total sample size of 45 people who met the inclusion criteria.

The inclusion criteria in this study are: 1) Patients aged ≥ 18 years. 2) Patients with ISS score ≥ 17 . 3) Patients with complete medical record status. The exclusion criteria in this study are: 1) Female patients in pregnancy. 2) Patients with physical disabilities. 3) Patients with a length of stay < 4 days. 4) Patients with incomplete medical record data. 5) Patients who only received conservative therapy (without surgery). 6) Patients with previous comorbid diabetes mellitus, hypertension, heart disease, stroke, and platelet function disorder.

Data analysis was performed using SPSS for Windows version 21.0 software. The statistical analysis included univariate analysis, bivariate analysis, and multivariate analysis.

RESULTS

Characteristics of the study

As a result, 45 patient medical records were obtained that met the inclusion criteria. Respondent characteristics were described based on age, gender, nutritional status, length of ICU treatment, comorbidities, PLR value, and qSOFA Score. Data with an abnormal distribution were displayed with the median (min-max) value. The complete characteristics of the study subjects are listed in Table 1 and Table 2

TABLE 1: Basic Characteristics of Research Subjects.

Variable	Description (N=45)
Age	30(18-47)*
Length of treatment	5(4-7)*
GCS	14(3-15)*
Systolic Blood Pressure	100(68-148)*
Diastolic Blood Pressure	63(32-72)*
Respiratory Rate	20(12-34)*
ISS score	29(21-57)*
PLR	123(32-1229)*
qSOFA	1,51(1-3)*

*Presentation: Median (Minimum-Maximum).

TABLE 2: Distribution of Basic Characteristics of Research Subjects.

Variable	Description (N=45)
Gender	
Male	37 (82,2%)
Female	8 (17,8%)
GCS score	
<15	24 (53,3%)
15	21 (46,7%)
Systolic Blood Pressure	
≤100 mmHg	34 (75,6%)
100 mmHg	11 (24,4%)
Respiratory Rate	
≥22 times/minute	40 (88,9%)
22 times/minute	5 (11,1%)
ISS score	
≥17	45 (100%)
17	0 (0%)
Nutritional Status	
Skinny	0 (0%)
Normal	45 (100%)
Fat	0 (0%)
Obese	0 (0%)
PLR	
≤200	31 (68,9%)
>200	14 (31,1%)
qSOFA Score	
≥2	22 (48,9%)
<2	23 (51,1%)

Of the 45 subjects, 82.2% were male, and 17.8% were female. The median age of the subjects was 30 years old, with the youngest age being 18 and the oldest 74 years old. The age range of male subjects ranged from 18-74 years, while female subjects were between 27-72 years. The median PLR value in the subjects was 123, with a value range of 32-1229. The proportion of subjects with high PLR (>200) and low PLR (≤200) were 31.1% and 68.9%, respectively. The subject's qSOFA score obtained a median of 1.51 with a range of 1 to 3, divided into the qSOFA Score ≥2 group with a proportion of 48.9% and the qSOFA score <2 category of 51.1%.

Relationship between each variable to qSOFA

Each variable was tested on the dependent variable in the form of qSOFA score, which was categorized into qSOFA Score ≥2 and <2 groups. The analysis results on age, gender, and length of treatment showed no significant differences in each variable with qSOFA scores with p values of 0.102, 0.324, and 0.768, respectively. However, the relationship between PLR value and qSOFA score showed a significant difference with a p-value of 0.002. This is shown in Table 3.

TABLE 3: Subject Characteristics based on qSOFA Score.

Characteristics	qSOFA score		p-value
	≥2 (n=22)	<2 (n=23)	
Age	39(18-74)	31(19-59)	0,072*
Gender			
Male	17 (37,78%)	20 (44,4%)	0,324**
Female	5 (11,11%)	3 (6,67%)	
Length of Treatment	5(4-7)	5(4-6)	0,768*
GCS	14 (3-15)	15(14-15)	0,310*
Systolic Blood Pressure	100(68-148)	100(90-115)	0,793*
Diastolic Blood Pressure	60(32-72)	65(55-75)	0,161*
Respiratory Rate	20(12-30)	20(18-34)	0,759*
ISS score	30(22-57)	28(21-45)	0,206*
PLR	219(32-1229)	108(34-108)	0,002*

*= Mann-Whitney test; **= Fisher test

Bivariate Analysis Results

Bivariate analysis was performed to find the correlation between variables and to see the relationship between PLR and qSOFA Score as predictors of sepsis.

Hypothesis testing was conducted based on the contingency coefficient test. In the test, the PLR value

variable was divided into 2 categories, namely the PLR value of ≤ 200 and the PLR value of >200 . The qSOFA score variable is also divided into 2 categories, namely the ≥ 2 score group and the <2 score group. Table 4 shows the test results between the PLR and qSOFA category variables grouped into scores ≥ 2 and <2 .

TABLE 4: Contingency Coefficient Test Results.

		qSOFA score		Correlation Coefficient (r)	P value*
		≥ 2	<2		
PLR value	≤ 200	10 (32,3%)	21 (67,7%)	0,444	0,001
	>200	12 (85,7%)	2 (14,3%)		
Total		22 (48,9%)	23 (51,1%)		

*=Contingency Coefficient Test

Based on the contingency coefficient test calculation results, the p-value calculated between the PLR score category variable and the qSOFA score is 0.001. The correlation coefficient obtained is 0.444. This indicates that statistically, there is a significant relationship between PLR scores and qSOFA scores. However, the correlation coefficient is below 0.5 as a reference, indicating a positive correlation between

the two variables, but it has a clinically weak strength.

In addition, correlative analytic testing was conducted, as listed in Table 5. The test was conducted using the Spearman test because the research data had characteristics that were not normally distributed.

TABLE 5: Spearman Correlation Test Results between PLR and qSOFA Score.

Spearman Correlation Test	qSOFA Score (n=45)	
	r	P value
PLR value (n=45)	0,469	0,001

The results of the correlative analytic analysis between the PLR value and the qSOFA score showed significant results ($p < 0.05$) with a correlation strength of 0.469, which means that the PRL value and qSOFA Score have a sufficient correlation.

In addition, correlative analytic testing was conducted between PLR and each component of qSOFA Score (GCS, blood pressure, respiratory rate) as listed in Table 6. The test was conducted using the Spearman test because the research data had characteristics that were not normally distributed.

TABLE 6: Spearman Correlation Test Results between PLR and each component of qSOFA Score.

Spearman Correlation Test	GCS (n=45)		BP Systole (n=45)		BP Diastole (n=45)		Respiratory rate (n=45)	
	r	P value	r	P value	r	P value	r	P value
PLR value (n=45)	0,170	0,264	0,242	0,109	-0,006	0,971	-0,170	0,264

The multivariate analysis with the four components of the qSOFA Score could not be carried out because it did not meet the required requirements, which in each bivariate test required a p-value < 0.25 , while based on Table 6, the p-value that met the requirements was only 1 variable (BP systole) out of 4 variables.

DISCUSSION

Characteristics of Research Subjects

The results showed that the incidence of sepsis characterized by qSOFA Score ≥ 2 was less than qSOFA Score < 2 with 22 (48.9%) and 23 (51.1%) subjects, respectively. The data from this study are also supported by research conducted by Wafaisade et al. (2011), which found that the proportion of

multi-trauma patients who experienced sepsis were less than those who did not experience sepsis. The mean age of sepsis patients was 42 years old, and non-sepsis patients were 31 years old. The gender in this study was dominated by men compared to women, with a proportion of 82.2% of them being men, while 17.8% were women.

Capability of PLR as a Predictor of High qSOFA in Multi-trauma Patients

In this study, the Coefficient of Contingency C test was conducted to see the relationship between PLR values and qSOFA scores categorized into score ≥ 2 and score < 2 groups. The results showed a statistically significant correlation, with a p-value < 0.05 (0.001). However, this correlation has a weak clinical strength with a value of $r=0.444$. This is in line with research conducted by Hou et al. (2021), which states that PLR shows a significant relationship with the incidence of sepsis. However, in this study, no information was obtained regarding the strength of the correlation, so it could only describe a significant relationship. In a meta-analysis conducted by Wang et al. (2022), non-sepsis survivors had a higher PLR value than sepsis survivors. This indicates a positive correlation between the two.

Application of PLR as a Predictor Tool of High qSOFA in Multi-trauma Patients

In this study, the results showed a significant relationship between PLR values and the incidence of sepsis in trauma patients ($p=0.002$), which is also in line with the research conducted by Jo et al. (2020) and Hou et al. (2021). In addition, the value used as the prediction limit (>200) is in a range close to that of Hou et al. (2021) of >210 . Therefore, this shows that PLR is one of the predictors that can be used in the incidence of sepsis both in general and in trauma conditions. Several other studies have linked the PLR value as a prognosis assessment to predict sepsis outcomes in several conditions, such as mortality. This was discussed in a study conducted by Shen et al. (2019), which showed that the prognosis of survival would be worse in sepsis patients with high PLR. However, there was a difference in results when vasopressor use became insignificant, and the mechanism is unknown.

This study also found that there was no significant relationship between PLR and each component of the qSOFA score (GCS, BP systole, BP diastole, respiratory rate) ($p>0.005$). This is in accordance with several studies, one of which was by Zhang et al. (2018), who found that an increase in PLR value was not associated with a decrease in GCS value in emergency cases, but a high PLR value correlated with a decrease in GCS value so that it could be used as a prognostic indicator in identifying patients admitted to the ICU and at high risk of neurological deficits.

Strengths and Limitations of the Research

The strength of this study is that it is the first to examine the correlation between qSOFA score and PLR in multi-trauma patients in Indonesia. The

results obtained from this study can be applied to daily clinical practice, where an increase in PLR values in multi-trauma patients ($ISS\geq 17$) can raise suspicion of sepsis.

The limitation of this study is that the data is sourced from the emergency room medical record status of Prof. Dr. IGNG Ngoerah Hospital, so the validation of measurement results cannot be done. In addition, conducting blood culture tests as a gold standard diagnostic in sepsis is not possible in all research samples because it is not the main thing that is generally done in emergency treatment in multi-trauma patients. The sepsis predictor method using qSOFA Score has the disadvantage of mixed results.

CONCLUSIONS

There is a significant relationship between PLR value and categorical group qSOFA score in multi-trauma patients at Prof. Dr. IGNG Ngoerah Hospital, where the results obtained are $r = 0.444$ and $p = 0.001$. Then, an analysis was carried out between the PLR value and qSOFA score without grouping, and $r = 0.469$ and $p = 0.001$ were obtained, showing a sufficient correlation strength. Therefore, it can be concluded that a high PLR value can predict an increase in qSOFA score (≥ 2) in multi-trauma patients. The results of the correlation test between PLR and each component of the qSOFA score (GCS, BP systole, BP diastole, respiratory rate) showed an insignificant correlation ($p>0.05$).

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