Correlation between thrombocyte, erythrocyte, and ratio thrombocyte leucocyte in patient with cardiovascular disease

Indranila Kustarini Samsuria[1*], Judiono[2], Theophilus Wilhelmus Watuguly[3]

ABSTRACT

Background: Cardiovascular disease (CVD) has caused at least 1.1 million deaths per year globally. Heart and blood vessel disease are silent killer which can cause disability or death if left untreated. Stress on the walls of the blood vessels leads to hypertrophy and hyperplasia of the vascular smooth muscle causing endothelial damage and facilitating atherosclerosis. Endothelial dysfunction indirectly affects platelet (thrombocyte) function which has an important role in the formation of primary blockage. The formation of the primary blockage is influenced by the number and function of the thrombocyte and can be checked by biomarkers of thrombocyte, erythrocytes, and the ratio of thrombocyte -to-leukocytes. The purpose of this study was to analyze the relationship between erythrocytes, thrombocyte, and the ratio of thrombocyte-to- leukocyte (RTL).

Materials & Methods: Descriptive analytic design with a cross sectional approach was applied. Sixty CVD patients were examined for thrombocyte, erythrocytes, and ratio thrombocyte-to-leukocyte (RTL) based on routine hematological examinations. Data were tested for normality and checked with Pearson Correlation test. The research was conducted at the Dr. Kariadi Hospital for the period January-April 2020.

Results: Based on the statistical analysis test, the Pearson correlation test showed a moderate positive correlation between thrombocyte and RTL (p=<0.001; r=0.569), while the correlation between thrombocyte and erythrocytes were not significantly correlated (p=0.687; r=-0.046) in CVD patients.

Conclusion: There is a relationship between thrombocyte, and RTL values in CVD disease, so that thrombocyte biomarkers and RTL are suggested to be biomarkers in the management of CVD.

Keywords: CVD, thrombocyte, erythrocyte, RTL, automation, ontogenic.
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[1]Department Clinical Pathology, Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia.
[2]Department Nutrition Bandung Health Polytechnic, MOH RI, Bandung, Indonesia.
[3]Department Biology Medical Faculty, Universitas Pattimura, Ambon, Indonesia.

*Corresponding author:
Indranila Kustarini Samsuria;
Department Clinical Pathology, Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia;
nila_fkundip@yahoo.com

INTRODUCTION

Cardiovascular disease (CVD) has caused at least 1.1 million deaths per year in the world. Cardiovascular disease (CVD) is one of the main problems that can increase hospital admissions and mortality rates. According to the American Heart Association, in 2017, cardiovascular disease was one of the diseases causing death in the United States. A total of 801,000 Americans died because of the coronary heart disease. The average coronary heart disease in America reached 47.7% male and 46.0% female. According to Indonesian Basic Health Research (2013), the prevalence of coronary heart disease at age ≥ 15 years is found in the provinces of South Sulawesi (2.9%), Central Sulawesi (3.8%), East Nusa Tenggara (4.4%), and Aceh, at the 6th level with prevalence (2.3%).[1]

The hematological examination consists of hemoglobin, hematocrit, erythrocyte, leukocytes, thrombocytes, mean corpuscular hemoglobin concentration (MCHC), Mean corpuscular hemoglobin (MCH), Mean corpuscular volume (MCV).[2] Leukocytes can be used as a parameter and predictor for Acute Coronary Syndrome because the increased leukocytes are one component of inflammation.[2,3] Complete hematological examination has been used to help make diagnosis, help diagnose the pathogenesis of the disease, assess the severity of the pain, and determine prognosis.

The oncogenicity of human hematopoietic cells is a constant area of research and is of great interest. Three elements of hematopoietic blood are red blood cells (RBC), white blood cells (WBC), and thrombocytes which come from one hematopoietic stem cell (HSC).[4] Erythrocytes (red blood cell/RBC) and thrombocytes have a close history of development; therefore, attention has been focused on their relationship. Erythrocytes and thrombocytes exhibit similar physiological rhythms and are simultaneously involved in various pathological conditions.[5] Platelet-to-white blood cell ratio (PWR) is a ratio of thrombocyte-to-leukocyte (RTL) is used as a prognostic predictor in ischemic stroke patient by intravenous thrombolysis.[6] Leucocyte is the marker of systemic inflammation associated with increased risk of cardiovascular and increasing thrombocyte activity. However, further studies are compulsory to explore the association of these mechanisms.[7] As the ratio of thrombocyte-to-leucocyte (RTL)

is an independent predictor to prognoses the outcomes of some disease, it is useful as an adjunct test for other standardized tests used for diagnostic and screening.[8,9]

The critical limitation of this study is related to the use of automatic analyzers. The precision or reproducibility is much lower for thrombocytes than for erythrocytes (red blood cells). Inflammatory markers such as C-reactive protein and interleukin-6 were not analyzed although evaluation of these markers helps clarify the findings.

MATERIALS AND METHODS

The descriptive-analytic design was used in this study in conjunction with a cross sectional approach. Sixty CVD patients were examined for thrombocyte, erythrocyte, and ratio thrombocyte-to-leukocyte (RTL) based on routine hematologic examinations. Data were tested for normality and checked with Pearson Correlation test. The research was conducted at the Dr. Kariadi Hospital Semarang in the period January-April 2020. Data of the patients were kept confidential according to ethical standards and only relevant data were recorded in proforma throughout the study.

In this study, automatic multichannel hematology analyzer, Sysmex XT 1000 was used. All information including age, sex, and indication, was sent for a complete hemogram. In order to avoid bias, generate homogeneity, and apply correct random sampling, clinical and demographic details were excluded. Random selection on daily sample was chosen to get a fixed number of samples. Erythrocyte, thrombocyte, and leucocyte parameters were recorded. Sysmex auto analyzer was used to generate validated hematological parameters; meanwhile, hematology laboratory regularly and externally underwent quality control following national quality control programmed. Data were analyzed using Pearson test with SPSS 20.0 for Windows. Statistically significant was determined by p-value at <0.05.

RESULTS

Table 1, illustrates the patient characteristics this research and the result of hematology examination.

Table 1. Patient characteristics

Variable	n=60
Gender	
• Male	37
• Female	23
Age (years)	57.30 ± 11.05
Baseline	
• Hb (g/dl)	13.56 ± 1.58
• Ht %	40.27 ± 4.30
• Erythrocyte (10^6/ul)	4.59 ± 0.59
• MCH (pg)	29.65 ± 2.04
• MCV (fl)	88.36 ± 4.48
• MCHC (g/dl)	33.64 ± 1.07
• Leucocyte (10^3/ul)	9.91 ± 3.72
• Thrombocyte (10^3/ul)	292.55 ± 70.23
• RDW (%)	13.06 ± 0.97
• MPV (fl)	10.03 ± 0.78

Table 2. Correlation between thrombocyte and ratio thrombocyte-to-leucocyte (RTL)

Variable		Thrombocyte
RTL	r	0.569
	p	0.000

Table 3. Correlation between thrombocyte and erythrocyte

Variable		Thrombocyte
Erythrocytes	r	-0.046
	p	0.687

Based on statistical analysis test using Pearson correlation test, the results showed that there was a moderate positive correlation between thrombocyte and RTL (p = <0.001; r = 0.569), as shown in table 2.

The effect of thrombocyte on erythrocytes was not significantly correlated (p = 0.687; r = -0.046) in Cardio Vascular Disease (CVD) patients (Table 3).

DISCUSSION

The objective of this study was to determine the relationship between erythrocyte, thrombocyte, and ratio thrombocyte-to-leukocyte (RTL) for cardiovascular disease. One of the subsequent progenitors, the common myeloid progenitor, cleaved into megakaryocyte/erythroid progenitor (MEP) and granulocyte/monocyte progenitor (GMP). Later, MEP is separated to commit to forming precursors that create a rise to erythrocyte and thrombocytes. Erythrocytes and thrombocytes exhibit a similar physiological rhythm and are simultaneously engaged in a variety of pathological conditions.[10]

The results of a hematology examination would be beneficial if certain laboratory parameters could predict cardio vascular disease so that it could give more attention to these cases. This hematology examination could be carried out in various laboratories, even at Community Health Center (*Puskesmas*), by assessing the clinic's various degrees from the results of the erythrocyte, thrombocyte, and ratio thrombocyte-to-leukocyte. It was expected that these findings might help medical personnel estimate the diagnosis of CVD so that treatment could be maximized with accurate blood tests.

The relationship between thrombocyte and Ratio Thrombocyte-to-leukocyte (RTL) was moderate positive correlation (p<0.001; r=0.569) in CVD patients. The thrombocyte and leukocyte count could be converted into ratio thrombocyte-to-leucocyte (RTL). This ratio was formed by comparing the number of cells of

thrombocyte and leucocyte; higher RTL will provide better clinical outcomes. The thrombocyte role is important in forming thrombus after activated in certain conditions, including atherosclerosis, inflammation, and hemorheological changes. Having been activated, the thrombocytes will accumulate damaging cells of endothelial and take part in improvement of atherosclerotic lesions. The increased number of leucocyte cells, particularly neutrophils in peripheral blood, is related and tends to have worsened clinical outcomes. These effector cells regulate the activation and attachment of cell structure one to another and with endothelial cells, release cytokines synthesize and other factors that reinforce atherosclerosis development and acute thromboembolism formation.[11]

The relationship between thrombocytes and erythrocytes was not significantly correlated ($p = 0.687$; $r = -0.046$) in CVD patients. The erythrocytes and thrombocytes which were analyzed using hydrodynamic focusing, yielded parallel like parameters. The relationship of ontogenic between erythrocytes and megakaryocytes is manifested in the stage of maturation.[12] The erythropoiesis and thrombopoiesis are derived from general bipotent hematopoietic stem cells-Colony Forming Units - Erythrocyte megakaryocytes (CFU-EMc). These cells divide into different trails and lead to specific cell lines - red blood cells and platelets. Throughout the erythrocyte maturation stage, normoblasts use up their nucleus, enter the peripheral circulation to form immature red blood cells, and known as reticulocytes and eventually develop into mature red blood cells. The nucleated form of erythrocyte, called normoblast, is realized only in the bone marrow and is found only in the peripheral circulation in disease conditions, such as damaged bone marrow, stress, and other underlying disorders that are potentially serious. Thrombocyte is a derivation of nucleic cytoplasmic fragments from megakaryocytes - nucleated cells. The thrombocyte such as erythrocytes exhibits an immature stage in the circulation,

called reticulated thrombocyte. The freshly released thrombocyte are referred to as reticulated thrombocyte or reticulated platelets which preserve the remaining RNA, analogous to erythrocyte/red blood cell reticulocytes.[12]

CONCLUSION AND SUGGESTION

Changes in the hematologic profile can be used as a baseline diagnosis for future patients in CVD. A growing number of research show that routine hematological parameters and disease conditions are significantly associated. While many studies on erythrocyte, thrombocyte and RTL as parameters have become the objective of this study. This study demonstrates an inherent ontogenic relationship that plays a role in this correlation; however, further in-depth evaluation is needed.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

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AUTHOR CONTRIBUTION

IKS and J designed the study and drafted the manuscript. IKS and TWW did the acquisition and statistical analysis. IKS did the study supervision.

ETHICAL CONSIDERATION

Ethical approval for the study was obtained from the ethics committee of Health Research Ethics Committee of Faculty of Medicine Diponegoro University as registered no. No. 84/EC/KEPK/FK-UNDIP/V/2020. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee, in accordance to 7 (seven) WHO 2011 Standards referring to the 2016 CIOMS Guidelines.

REFERENCES

1. Kumar D, Kasukurti P, and Murthy S. erythrocytes and platelets : a critical analysis of their ontogenic relatiohship through automated parameters. J Clin Diagn Res. 2017;11(5):EC05-BC08.

2. Rosdiana I, Tjeng WS, Sudarso S. The relationship between the results of the examination of leukocytes, platelets and hematocrit and the clinical degree of dengue fever in pediatric patients at Abdul Wahab Sjahranie Hospital, Samarinda. Sari Pediatri. 2017;19(1):41-45.

3. Hoffbrand P, Pettit K, Moss M. Essential Haematology. Wiley Blackwell. 2005; p.26.

4. Septiana M, Halimuddin. Hematologi Pada Pasien Acute Coronary Syndrome Haematological In Acute Coronary Syndrome Patients.Journal ilmiah mahasiswa fakultas keperawatan Unsyiah 2017:2(3):1-7.

5. Chen Z, Huang Y, Li s, Lin J, Liu W, Ding Z, Li X. Chen Y, Pang W, Yang D, Su Z, Li J, Weng Y, Zhang X. Platelet-to White Blood Cell Ratio : A prognostic predictor for 90-Day Outcomes in Ischeic Stroke patients with intravenous thrombolysis. J. Stroke Cerebrovasc Dis. 2016;25(10):2430-2438.

6. Lathouras K, Panagakis G, Bowden SJ, Saliaris K, Saso S, Haidopouloos D, and Fotopoulou C. Diagnostic value of post-operative platelet-to white blood cell ratio after splenectomy in patients with advanced ovarian cancer. Int J of Gynecological cancer .2019;29(8):1292-1297.

7. Krishnamoorty P, Naranjo M, Koshkelashvili N, Gopalakrishnan A, Tuluca A, Rangaswarni J, Figueredo V, Anderson M, and Morris D. White blood cell count to platelet ratio: A novel biomarker of outcomes in patients with circulatory support on left ventricular impella assist devices. JACC. 2017;69(11 supplement):1252-1259.

8. Jie Y, Gong J, Xiao C, Zhu S, Zhou W, Luo J, Chong Y, and Hub. Low platelet to white blood cell ratio indicates poor prognosis for acute-on-chronic liver failure. Biomed research international 2018; article ID 7394904:1-8.

9. Akram W, Muaeed D. The significance of (platelet/white blood cell) counts ratio in screening for high risk for preeclampsia and its related complications. Mutansiriya Med J. 2019;18(1):36-42.

10. Zhang J, Qiu Y, He X, Mao W, and Han Z. platelet -to-white blood cell ratio: A novel and promising prognostic marker for HBV-associated decompensated cirrhosis. Journal Of Clinical Laboratory Analysis. 2020;34(12):1-6.

11. Amalia L, Dalimonthe NZ. Clinical significance of Platelet-to-white blood cell ratio (PWR) and National Institute of health stroke scale (NIHSS) in acute ischemic stroke. Heliyon 2020;6(10):1-4.

12. Zhou P, Meng Z. The associations between leukocyte, erytrhrocyte or platelet, and metabolic syndrome in different genders of Chinese. Medicine (Baltimore). 2016;95(44):1-7.