

Original article:

The Correlation Between Blood Parameters as Early Detection on Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) in Children

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Abstract:

Background: Dengue Shock Syndrome (DSS) is a severe manifestation of Dengue Hemorrhagic Fever (DHF) and affects more children and young adults. The age of susceptibility to DSS is 5-15 years old, due to an imperfect immune system. DHF patients with manifestations of DSS have propensity that can affect the platelet and hematocrit values as an initial laboratory parameter. **Objective:** This study is intended to find out the most effective platelet and hematocrit blood parameters and to find the correlation between platelet values and hematocrit on the incidence of DHF in Wirosaban Hospital of Yogyakarta Municipality in the period of March 2015 to July 2016. The data used were secondary data from medical records of pediatric patients aged 5-15 years old. **Material and Methods:** The research method used was to determine the correlation between platelet values and hematocrit on the incidence of DHF and DSS in children. Data analysis used chi-square to determine the correlation between platelet values and hematocrit on the incidence of DHF and DSS in children. **Results and Discussion:** In this study, the number of samples that fulfilled the inclusion and exclusion criteria was 74 on platelet examination while in the hematocrit examination there were 77 that met the criteria. The results of chi-square test for platelet examination obtained p value > 0.05, which means there was no significant correlation between platelet counts and the incidence of DHF, DHF grade II, and DSS. The results of the chi-square test analysis on hematocrit examination obtained p < 0.05, which means that there was a significant correlation between hematocrit values and the incidence of DHF and DSS and it obtained r = 0.707. **Conclusions:** In this study the increase in hematocrit is one of the parameters to detect DHF with propensity to DSS.

Keywords: Platelet; hematocrit; DHF; DSS

Bangladesh Journal of Medical Science Vol. 19 No. 02 April'20. Page : 273-277
DOI: <https://doi.org/10.3329/bjms.v19i2.45007>

Background:

Dengue virus causes Dengue Hemorrhagic Fever (DHF), which belongs to the genus Flavivirus. This disease can attack all ages in both children and adults. Hemorrhagic Shock Syndrome (DSS) is a severe manifestation of dengue hemorrhagic fever (DHF)

and attacks more children and young adults¹. Dengue fever outbreaks are Indonesia's serious public health problems in tropical rain and equatorial areas where *Aedes aegypti* is prevalent in urban and rural areas. The growing number of dengue cases is closely linked to the increase in the mosquito population,

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especially when it rains a lot. High rainfall rates also cause mosquito population's growth⁷. In children, the immune response to dengue virus infection is not perfect so the end result of infection is a sudden increase in permeability of blood vessel walls due to the permeation of blood plasma and electrolytes through the endothelial wall of blood vessels and into the interstitial space, causing hypotension, hemoconcentration, hypoproteinemia and fluid effusion into the serous cavity which is believed to be one of the causes DSS in children patients. To predict which dengue hemorrhagic fever patients will develop into shock is not natural². DHF is an endemic disease over every year in the municipality of Yogyakarta. The number of dengue patients from 2004 to 2014 experienced the highest number of fluctuations in 2010. In 2013 in Yogyakarta Special Region there were 96 cases of DHF per 100,000 population with CFR 0.48%³. Through the results of the initial laboratory tests, which are platelets and hematocrit, it can be established that the diagnosis of DHF and DSS and immediate action can be taken to reduce the patient's morbidity and mortality. If the handling of this DSS case is not immediately addressed, it can lead to death in the patient. Laboratory confirmation is really needed to ensure the DHF with suspected DSS beside the symptoms especially if it is not very clear. For this reason, a parameter or laboratory marker of blood is needed so that DHF patients with manifestations of DSS can be early diagnosed^{2,3}.

Methods:

Study Design and Subjects

This research was an analytical retrospective study with cross-sectional design. The study was conducted in Wirosaban, City Hospital Yogyakarta and carried out in May 2017 - August 2017 by taking medical records of children patients diagnosed with DHF or DSS according to WHO 2014 criteria aged 5-15 years old from March 15, 2015, to July 14, 2016. This hypothesis test aims to determine the correlation between platelet values and hematocrit on the incidence of DHF and DSS in children. The first test is a normality test (Kruskal-Wallis test). Then, the analysis was continued by using the chi-square test.

Ethical clearance: This research study has received clearance from ethics committee of Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia.

Result:

The research sample was taken from medical record

data of patients diagnosed with Dengue Hemorrhagic Fever (DHF) grade I, DHF grade II and Dengue Shock Syndrome (DSS) in Wirosaban, Hospital of Yogyakarta Municipality during March 15, 2015 until July 14, 2016. The number of samples that met the inclusion and exclusion criteria was 74 on platelet examination while at hematocrit examination 77 patients met the criteria.

Table 1. Frequency Distribution Result of DHF 1, DHF 2 dan DSS on children aged 5-15 years old in Wirosaban Hospital of Yogyakarta Municipality

Patient Criteria	Percentage
DHF 1	67.53 %
DHF 2	6.49 %
DSS	22.07 %
Total	100 %

In this study based on the observation of the sample, the researchers classified platelet levels into two criteria, namely low platelet levels 51 (68.9%) and normal platelet levels 23 (31.1%). The results of the chi-square test obtained p value > 0.05, which means there is no significant correlation between platelet counts and the incidence of DHF, DHF grade II, and DSS.

Table 2. Results of Chi-Square Tests in children patients with a diagnosis of DHF and DSS in Wirosaban City Hospital, Yogyakarta

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.009 ^a	2	.082
Likelihood Ratio	6.586	2	.037
Linear-by-Linear Association	3.291	1	0.070
N of Valid Cases	74		

Analyzed from the data, it shows that the hematocrit value increased by 23 (29.9%) patients in DHF grade I, 38 (49.4%) patients in DHF grade II, and 8 (10.4%) patients in DHF grade III. To find out whether the data are significant or not, the researcher used the chi-square test. The results of the chi-square test analysis show p-value < 0.05, which means that there is a significant correlation between hematocrit values and the incidence of DHF and DSS and obtained a value

of $r = 0.707$ which means it has strong correlation. So, it can be concluded that hematocrit values have a significant and strong correlation between the incidence of DHF and DSS.

Discussion:

The increase in dengue cases is influenced by climatic factors such as temperature, humidity, number of rainy days and rainfall. The high rainfall, rainy days, and temperature of Yogyakarta municipality are directly proportional to the increase in dengue cases where mosquito larvae develop during the incubation period in the temperature range of 15°C to 30°C ⁴. In addition, an increase in dengue cases is influenced by behavioral factors and community participation that are still lacking in terms of mosquito nest eradication activity. The population and the increased population mobility and transportation facilities make the dengue

fever virus easier and broader to spread. Ministry of Health of Indonesia make it, (2016)⁵. All of these factors can affect the higher cases of DHF. DHF is a severe form of DF (dengue fever) with clinical symptoms such as a fever that lasts 2-7 days with a biphasic pattern or commonly called a horse saddle pattern, bleeding as evidenced by tests, hematemesis (melena), thrombocytopenia (100,000 cells / mm³ or less), and there is a plasma leak that will cause an increase in hematocrit levels^{6,8}. In children, the risk of getting DHF is very high with secondary infection of 10 times more than primary infection. Children are more affected by dengue and it even continues to DSS because immunity in children is not as strong as adults and also environmental factors greatly affect this incident where children play in places that are humid, dark, and smelly and where there are mosquito nests.

Table 3. Hematocrit Value Result in Children Patient with DHF and DSS Diagnosis in Wirosaban Hospital of Yogyakarta Municipality

			Diagnosis				Total
			Normal	DHF Grade I	DHF Grade II	DHF Grade III	
Hematocrit Value	Increase	Count	0	23	38	8	69
		% of Total	0.0 %	29.9 %	49.4 %	10.4 %	89.6 %
	Normal	Count	5	0	0	0	5
		% of Total	6.5 %	0.0 %	0.0 %	0.0 %	6.5 %
	Decrease	Count	3	0	0	0	3
		% of Total	3.9 %	0.0 %	0.0 %	0.0 %	3.9 %
Total	Count	8	23	38	8	77	
	% of Total	10.4 %	29.9 %	49.4 %	10.4 %	100.0 %	
Total	Count	8	23	38	8	77	
	% of Total	10.4 %	29.9 %	49.4 %	10.4 %	100.0 %	

Platelet count ($<100,000$) is one of the laboratory parameters issued by WHO to diagnose DHF caused by thrombopoiesis and platelets which experience increased blood destruction and platelet function disorders⁹. The discovery of immune complexes on the platelet surface is thought to be the cause of platelet aggregation which will then be destroyed by the reticuloendothelial system, when the platelet count is $<100,000\text{ mm}^3$, in which platelet function in hemostasis is impaired so that vascular integrity decreases and causes vascular damage¹⁰. In this study, the health worker takes blood sample on the first day of admission on the average day 3 to day 6 of fever. On that day the number of platelets decreased¹¹. The results of the study based on the chi-square test showed no significant correlation

between platelet count values in patients infected with dengue in Wirosaban Hospital of Yogyakarta Municipality ($p > 0.05$). So, based on this study, the decrease in platelet count cannot describe the severity of dengue virus infection in patients with DHF. Similar research was conducted by Nyi Nyoman (2016)¹² in Denpasar which gave similar results. In his research, all platelet patients with thrombocyte levels were below the normal range, but the level of platelet decreased varied in various clinical degrees of DHF¹². Someone who has DHF has clinical symptoms with high permeability of blood vessel walls, decreased plasma volume, hypotension, thrombocytopenia and hemorrhagic diabetes. The decrease in plasma volume in patients with DHF can be caused by weak blood vessels that cause the

plasma to seep out of the blood vessels. If the plasma continues to seep out of the blood vessels, it will cause an increase in hematocrit levels. If the elevated hematocrit level is not treated immediately, it will cause DSS where the hematocrit level is $> 20\%$ from normal levels. If the hematocrit level $> 60\%$, it can cause death¹³.

One of the parameters used in the treatment of DHF is hematocrit levels. Increased hematocrit levels are very dangerous because this can be an indication that the body is in an unstable state. Hemoconcentration occurs due to increased blood cell levels and due to plasma leakage which will cause the body to dehydrate because the plasma component is 90% water¹⁴. The researchers choose to take the highest hematocrit levels in patients with DHF and DSS during treatment. From these data, there is value of $p < 0.05$, which means that hematocrit levels have a significant correlation with the incidence of DHF and DSS, this is strengthened by the value of $r = 0.707$, which means that they have a strong correlation. Hematocrit levels on children and adults are different. Children have hematocrit levels greater than adults. Hematocrit levels in women are also lower than in men. The fever can cause the body to become dehydrated. If dehydration is severe, it will cause hematocrit levels to rise. If the hematocrit level $> 60\%$ will cause spontaneous blood clots that will cause death¹⁵. The results of this study compared with research of Nurhayati¹⁶. The study finds that the peak levels of hematocrit has a significantly correlation with the incidence of DHF. The results of this study different from Utami⁹. The results show that hematocrit levels do not have a significant correlation with the incidence of DHF. In the results of Syumarta¹⁷⁻¹⁸ study of the correlation of initial

hematocrit levels to the incidence of DHF, there are no significant results between hematocrit levels and incidence of DHF. According to the three previous researches, it shows that shows that hematocrit levels are not related to the degree of DHF infection, but the hematocrit peak level has a significant correlation with the incidence of DHF. Hematocrit levels can be a determinant of a body condition and determinant in the therapy is given so that the healing process can be maximized.

Conclusion:

Platelet values do not have a significant correlation with the incidence of DHF and DSS but hematocrit values have a significant correlation to the incidence of DHF and DSS.

Acknowledgements:

This research study was funded by Ministry of Technology Research and Higher Education of Indonesia 2017. We would like to express our gratitude to all the subjects and director of Wirosaban Hospital of Yogyakarta Municipality for giving us assistance and permission for the location of this research.

Conflict of Interest : None

Authors's contribution:

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