Profile of Nutritional Status, Hemoglobin, Leukocytes, Platelets, Hematocrit, Albumin Level and Serology Test in Children with Dengue Viral Infection in Dr. Soetomo General Hospital

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Abstract

Background: Dengue Viral Infection (DVI) that affects the host cause hemobiochemical and immunological changes. This research aims to study profile of nutritional status, hemoglobin, leukocytes, platelets, hematocrit, albumin level and serology test in children with DVI in Dr. Soetomo General Hospital 2015. **Methods:** This cross-sectional descriptive study has conducted by using data from medical records on patients that fulfilled the criteria. **Results:** There were 74 cases, consisting of patients with DF (33.78%), DHF I (27.03%), DHF II (4.05%), DHF III (25.68%), and DHF IV (9.46%), that dominated by 6-12 years of age (48.65%), boys (58.11%), and patients with normal nutritional status (50%). Girls and boys are mostly with normal nutritional status (32.26%, 62.79%) and dominated by DF (14.86%, 28.92%). Over-nutrition patients in DF, DHF without shock and DHF with shock are 12.5%, 33.33%, and 54.17%. DF and DHF IV are dominated by patients with <6 years old (17.57%, 8.11%). DHF I, DHF II, and DHF III are dominated by 6-12 years-old-child (14.86%, 2.70, 16.22%). It showed an increase in Hb levels from DF to DHF; 38 of 74 DVI patients had leukopenia; the lower Plt level the higher the DVI stage; Hct increase in DHF patients; albumins relatively low in DHF; Primary infection is more prevalent in DF, whereas secondary infection is more prevalent in DHF with shock; there is a difference between over-nutrition on the stages of DVI in patients in Dr. Soetomo General Hospital Surabaya 2015.

Keywords: Dengue Viral Infection; Nutritional Status; Hemoglobin; Leukocyte; Platelets; Hematocrit; Albumin; Serology test

INTRODUCTION

Dengue Virus Infection is commonly found in areas with tropical and subtropical climates, such as Indonesia (1). Data from World Health Organization (WHO) in 2009, there were 150,000 cases reported in 2007 (1). DVI has a high mortality rate in children due to hemobiochemical and immunological changes (1)(2). Immunity affected by nutritional status, including weight, height, and Body Mass Index (BMI), may also affect DVI due to increased antibody responses to bind antigens in children with over-nutrition (3).

MATERIALS AND METHODS

This is a cross-sectional descriptive study using medical records as the data. Samples were taken using total sampling. The samples were children (0-18 years) with DVI who have done Dengue serological test with positive results at Dr Soetomo Hospital Surabaya Indonesia during 2015, a complete medical record about age, sex, height, weight, laboratory result: albumin level (<3.5, 3.5-5.0, >5.0 g%), platelets (<50, 50-100, >100×10^3/mm^3), leukocytes (<5001, 5001-10000, >10000/ mm^3), hematocrit (<35, 35-45, >45%), hemoglobin (≤12, >12 g/dL), and Dengue serology test (+/-), such as NS1, IgM anti-Dengue, or IgG anti–Dengue. The diagnosis is taken from the patient's medical record at the time of admission (DF, DHF grade I, DHF grade II,

DHF grade III, DHF grade IV). Patients with the underlying blood disorder, pregnancy and smoking were excluded in this research.

RESULT

In January-December 2015, there are 371 DVI patients in Dr. Soetomo General Hospital. This research found 74 patients from 371 patients with Dengue serological test results and based on inclusion exclusion criteria. In table 1, it can be seen that its dominated by 6-12 years-old-child (48.65%). The youngest DVI patients is 5 months old while the oldest is 14 years and 10 months old. The research subject is dominated by men (58.11%).

Table 1. Distribution of DVI patients according to age and gender

Age (years old)	Female(s)	Male(s)
<6	15 (48.39%)	16 (37.21%)
6-12	14 (45.16%)	22 (51.16%)
>12	2 (6.45%)	5 (11.63%)

Table 2 shows the highest distribution of DVI patients with normal nutritional status is 50%, with details of 32.26% females and 62.79% males. The fewest distribution of DVI patients with patients with very poor nutritional status is 1.35%. The lowest BMI is 7,43kg/m^2 (Z-score=-6,55, 5 years and 6 months old), and the highest is 34,60kg/m^2 (Z-score= +7,50, 9 years and 11 months old).

Table 2. Distribution of nutritional status in DVI patients

Nutritional status	Female(s)	Male(s)
Very thin	0 (0%)	1 (2,33%)
Thin	8 (25,81%)	4 (9,30%)
Normal	10 (32,26%)	27 (62,79%)
Fat	6 (19,35%)	7 (16,28%)
Obesity	7 (22,58%)	4 (9,30%)

Table 3 shows females and males are dominated by DF (14.86%, 28.92%).

Table 3. Distribution of gender in DVI patients

Severity of DVI	Female(s)	Males(s)	N (%)
DF	11 (44%)	14 (56%)	25 (100%)
DHF grade I	7 (35%)	13 (65%)	20 (100%)
DHF grade II	1 (33,33%)	2 (66,67%)	3 (100%)
DHF grade III	8 (42,11%)	11 (57,89%)	19 (100%)
DHF grade IV	4 (57,14%)	3 (42,86%)	7 (100%)

Table 4 shows that most of DF, DHF grade I, III, and IV patients are in normal nutritional status (15/25, 12/20, 19/7, 3/7). DHF grade II is dominated by patients with obesity (2/3).DHD grade IV is also dominated by fat patient. Over-nutrition patients in DF, DHF without shock and DHF with shock are 12.5%, 33.33%, and 54.17%.

Table 4. Distribution of nutritional status in DVI patients according to severity of DVI

Nutritional status	DF	DHF I	DHF II	DHF III	DHF IV
Very thin	0 (0%)	0 (0%)	0 (0%)	1 (5,26%)	0 (0%)
Thin	7 (28%)	3 (15%)	0 (0%)	2(10,53%)	0 (0%)
Normal	15 (60%)	12 (60%)	0 (0%)	7(36,84%)	3(42,86%)
Fat	3 (12%)	2 (10%)	1(33,33%)	4(21,05%)	3(42,86%)
Obesity	0 (0%)	3 (15%)	2(66,67%)	5(26,32%)	1(14,28%)

In table 5, it can be seen that DF and DHF IV subjects are mostly <6 years old (17.57%, 8.11%)), while 6-12 years-old-children are dominating in DHF I, DHF II, DHF III (14.86%, 2.70, 16.22%).

Table 5. Distribution of age in DVI patients according to severity of DVI

Severity of DVI	<6 y.o	6-12 y.o	>12 y.o	N (%)
DF	13 (52%)	10 (40%)	2(8%)	25 (100%)
DHF grade I	5 (25%)	11(55%)	4(20%)	20 (100%)
DHF grade II	1 (33,33%)	2 (66,67%)	0(0%)	3 (100%)
DHF grade III	6(31,58%)	12(63,16%)	1(5,26%)	19 (100%)
DHF grade IV	6 (85,71%)	1 (14,29%)	0 (0%)	7 (100%)

From the table 6 it can be concluded that DVI is dominated by patients with levels of hemoglobin (Hb) >12g/dL (74.32%). All of patients with DHF I to IV have Hb >12g / dL (20, 3, 19 and 7 children) with average Hb in DF and DHF I to IV as follows: 11,004 g/dL, 13.645 g/dL, 13.433 g/dL, 15 g/dL, and 14,571 g/dL. DVI is dominated by albumin (Alb) 3,5-5,0g% (24,32%), and 42 of 74 children have no data (56,76%). The average of albumin levels in DF and DHF I to IV were 3.852g%; 3.8322g%; 2.875g%; 3.36g%; and 3.394g%. Most of DVI patients have platelet (Plt) $>100\times10^3/mm^3$(36.49%). The platelet in DF, DHF I to IV were $120.4\times10^3/mm^3$, $96.25\times10^3/mm^3$, $72,667\times10^3/mm^3$, $56,979\times10^3/mm^3$ and $50,429\times10^3/mm^3$. Most of patients with DVI have leukocytes levels (Leu) $<5001/mm^3$(51.35%). The mean of leukocytes levels as follows were $5670/mm^3$, $4230.5/mm^3$, $7016,7/mm^3$, $7440/mm^3$ and $5872.9/mm^3$. While Hct levels were 32.58%; 40,72%; 39.7%; 44.863%; and 45.186%. Most of patients with DVI have hematocrit levels (Hct) 35-45% (59.46%).

Table 6. Distribution of Hb, Alb, Plt, Leukocyte, and Hct in DVI patients according to severity of DVI

Hemoglobin (g/dL)	DF	DHF I	DHF II	DHF III	DHF IV	N
≤12	19	0	0	0	0	19
	(100%)	(0%)	(0%)	(0%)	(0%)	(100%)
>12	6	20	3	19	7	55
	(10,91%)	(36,36%)	(5,45%)	(34,55%)	(12,73%)	(100%)
Albumin (g%)						
<3.5	1	2	2	6	3	14
	(7,14%)	(14,29%)	(14,29%)	(42,85%)	(21,43%)	(100%)
3.5-5.0	4	7	0	5	2	18
	(22,22%)	(38,89%)	(0%)	(27,78%)	(11,11%)	(100%)
No data	20	11	1	8	2	42
	(47,62%)	(26,19%)	(2,38%)	(19,05%)	(4,76%)	(100%)
Platelet ($\times 10^3/mm^3$)						
<50	3	6	2	9	4	24
	(12,5%)	(25%)	(8,33%)	(37,5%)	(16,67%)	(100%)
50-100	8	4	0	8	3	23
	(34,78%)	(17,39%)	(0%)	(34,78%)	(13,05%)	(100%)
>100	14	10	1	2	0	27
	(51,85%)	(37,04%)	(3,70%)	(7,41%)	(0%)	(100%)
Leukocyte($/mm^3$)						
<5001	14	13	0	8	3	38
	(36,84%)	(34,21%)	(0%)	(21,05%)	(7,89%)	(100%)
5001-10000	9	7	3	7	3	29
	(31,04%)	(24,14%)	(10,34%)	(24,14%)	(10,34%)	(100%)
>10000	2	0	0	4	1	7
	(28,57%)	(0%)	(0%)	(57,14%)	(14,29%)	(100%)
Hematocrit(%)						
<35	15	0	0	0	0	15
	(100%)	(0%)	(0%)	(0%)	(0%)	(100%)
35-45	10	19	3	8	4	44
	(22,73%)	(43,18%)	(6,82%)	(18,18%)	(9,09%)	(100%)
>45	0	1	0	11	3	15
	(0%)	(6,67%)	(0%)	(73,33%)	(20%)	(100%)

Table 7 shows 71 of 74 patients with DVI have IgM Dengue +.

Table 7. Distribution of serological test result of DVI patient according to severity of DVI

Serology test	DF	DHF I	DHF II	DHF III	DHF IV	N
IgM Dengue +	24	19	2	19	7	**71**
	(33,80%)	(26,76%)	(2,82%)	(26,76%)	(9,86%)	**(100%)**
IgG Dengue +	6	9	0	12	3	**30**
	(20%)	(30%)	(0%)	(40%)	(10%)	**(100%)**
NS1 +	2	1	1	0	0	**4**
	(50%)	(25%)	(25%)	(0%)	(0%)	**(100%)**

From the table 7 it can be concluded that in DF is dominated by primary infections, whereas in dengue shock syndrome is dominated by secondary infections.

DISCUSSION

Dengue viral infection (DVI) can attact all ages and can be suffered by both boys and girls. In this research can be seen that subjects distribution are frequent at the age of 6-12 years old. This is according to Raharjanti, et al. In Sekadau General Hospital Kalimantan Barat period April 2014 to March 2015 who declared that age range >5-18 years old (63%) is the most common age group infected with Dengue virus compared to other age groups (4). Capeding et al., in Philippines, period 2009-2010 also showed that the age range 6-10 years old (36.7%) is the most common age group experiencing DVI (5). The reason is immunity to Dengue increases with age (5). The second reason is the tendency of children to play outdoors during the day when Aedes aegypti mosquitoesactively bite (4).

DVI is more frequent in males than females. This is according to Raharjanti, et al, who showed that males DVI patients (51%) are dominated than females (49%) (4). There are other studies by Yulianto et al in Yogyakarta showed males (51,60%), and Mishra et al. in India showed males (77,3%) (6)(7). It is because boys are more often do activities outdoors than girls (4). Another reason males are dominated because females tend to use closed clothing (7).

Most of the subjects of this study have normal nutritional status (50%) compared to other nutritional status (fat (17.57%), thin (16.22%), obese (14.86%), and very thin (1.35%)). These results are the same as Yulianto et al.s' research in Yogyakarta that DVI is dominated by patients with normal nutritional status (69%) and the lowest is patient with malnutrition (2%) (6).

Subjects of this study are 33.78% DF and 66.22% DHF (27.03% I, 4.05% II, 25.68% III, and 9.46% IV). These results are similar to Capeding, et al. in Philippines that most of the DVI patients are DHF (82.7%) (5). Clinical manifestationsof DF that are often mild and cured spontaneously with home care (4).

There were 3 (12.5%) over-nutrition children with DF, 8 (33.33%) over-nutrition children with DHF I and II, and 13 (54.17%) over-nutrition children with DHF III and IV. Tedesco, et al.'s research in 2016 states that the prevalence of fat and obesity is relatively high in cases of Dengue (0.7% poor nutrition and 18.1% over-nutrition) (8). According to Rajapakse, although malnutrition is a predisposition to many infectious diseases, it does not appear to increase the severity of DVI (9). The reason of the patient with DVI is more suffered by the children with normal nutritional status is the nutritional status affect the degree of severity of DVI through the immune response in the form of increased antibody response in terms of binding to antigen in children with good nutrition (3).

The results of this study indicate that there is higher Hb levels in DHF than DF. Like Mayetti's research in Padang which states that Hb levels rise following the increase of Hct in patients and patients who have just been infected with Dengue virus will have normal or low Hb levels (10). In contrast, the results of Ramandeep's research, et al. in India showed that Dengue patients had low Hb levels, ranging from 5.4 to 12.7 g / dL with mean of 8.79g / dL due to bleeding (11).

The results of this study indicate 38 of 74 DVI patients has leukopenia. This result is similar with Raihan's research, et al. in Banda Aceh that there were 76.8% of DVI patients with leukocytes <5000/mm^3 (12). This study is similar to Raditha's research, et al. that in DF found the levels of leukocytes lower than DHF (13). Leukocytes are relatively elevated in Dengue cases can be caused by leakage of plasma (13). Leukocytosis may also be caused by another bacterial infection (14).

The lower the platelet, the higher severity of DVI. Another study in Samarinda also stated that the platelet count increased according to the degree of the infection (mean of Plt levels in DHF I to IV were 105,160.7/mm^3, 81,653.8/mm^3, 59,000/mm^3 and 35,200/mm^3) (15). Hartoyo also said that platelets in DSS were lower than DF and DHF without shock (16). Decreased platelet levels occur due to bone marrow depression (13). In addition to platelet counts, platelet quality is also decreased in DVI (12).

We found elevated Hct in Dengue. Increased of Hct and Hb levels occur due to increased vascular permeability leading to leakage of plasma causing extravascular spaces to be filled with fluids (17). Such as Mayetti study which shows that one of the risk factors of shock is hematocrit levels ≥42% (10). Rosdiana, et al., in Samarinda said that Hct increased in DHF without shock to DHF with shock (mean of Hct levels in DHF I, II, III and IV were 36.60%, 38.45%, 40.62%, 38.20%) (15). The results of this study showed there were 32 of 74 patients who checked the albumin level and only 14 of 32 patients with hypoalbuminemia. Dharma, et al. in Jakarta show that endothelial dysfunction was not associated with albumin levels in DHF (18). In addition to being seen from low albumin levels, plasma leakage in DHF can also be seen from clinical features of pleural effusion, ascites, and / or Hct ≥20% (2).

Based on existing data, the primary infection is more prevalent in DF, whereas secondary infection in DHF with shock. The results of this study can show the type of secondary infection can indicate the trend of high stage of dengue virus infection. This result also similar with Hartoyo's research in Banjarmasin that primary infection is found in most of DF case (95.3%) and secondary infections are found in most of DSS (86%) (16).

CONCLUSION

Mostly, children with DVI in Dr. Soetomo General Hospital Surabaya 2015 had normal nutitional status and leukopenia. Hb and Hct are higher in DHF, while albumin and Plt are relatively lower. We must aware of clinical symptoms caused by secondary infections because they tend to show more severe manifestations. Further research is needed to be done by adding other variables such as day fever rate, SGOT, SGPT, PT, aPTT, food intake, electrolyte, and clinical incidence of plasma leakage.

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