Calculating Blood Needs Using Prediction Models for Major Thalasemia Patients At Cut Meutia Hospital

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Abstract:Thalassemia major as a genetic disease suffered for life will bring many problems to the sufferer. Starting from blood disorder in the form of chronic anemia due to the process of hemolysis, to various body organs abnormalities either as a result of the disease itself or due to the treatment given. Until now, blood transfusions are still the main management to overcome anemia in thalassemia major. Some factors such as age, weight and hemoglobin levels before transfusion are factors that must be taken into account when calculating blood transfusion needs for patients with thalassemia major. The research was using cross sectional design on 50 patients at Cut Meutia Hospital with convenient sampling technique. Multiple linear regression analysis was used to create predictive models. The results showed that 23.5% of the blood needs for thalassemia major can explained by age, weight, and hemoglobin level while 76.5% were explained by other causes. The prediction formula states that every decrement of one year in age, the need for blood will increase by 11 milliliters, every increment of one kilogram of body weight will increase by 7 milliliters of blood and if the hemoglobin level decreased 1 g/dL then the need for blood will increase by 32 milliliters.

Index terms: blood need, predictive models, thalassemia major

I. BACKGROUND

Thalassemia is a disorder of hemoglobin synthesis due to a decrease in the production of one or more globin chains and is a hereditary disease derived autosomal recessive(1). Thalassemia major is still a problem in the field of hematology because of the high incidence and various consequences of this disease. The genes carrying thalassemia major properties in the Mediterranean countries such as Italy, Greece, Malta, Sardinia and Cyprus ranged from 10-16%. Whereas in Asia such as China, Malaysia and Indonesia ranged from 3-10% (2). In the world population, an estimated 3% (150 million people) carry the β thalassemia gene(3).

In Indonesia, the number of thalassemia-β carriers is 3% - 5%, even in certain regions reaching 10%. Based on the results of the study, with the calculation of the birth rate and population in Indonesia it is estimated that newborn thalassemia patients are quite high, reaching 2500 babies per year. The number of patients enrolled in Thalassemia Center, Department of Child Health Sciences, FKUI-RSCM, up to August 2009 reached 1,494 patients with the highest age range between 11-14 years. The number of new patients continues to increase every year reaching 100 people / year (4).

Until now thalassemia has not been cured. The main treatment is blood transfusions that are carried out every month of his life. Supportive costs incurred such as transfusion and chelation therapy can reach 200-300 million / child / year, not including costs if complications occur (4). Continuous blood transfusion will cause iron buildup in the liver parenchyma tissue and is accompanied by high serum iron levels. Side effects of transfusion are increased iron accumulation in the body(5). Research conducted by Anggororini, Fadlyana, and Idjradinata (2009) on children aged 10-18 years in Dr. Hasan Sadikin Bandung found as many as 25 (83%) children in the group with thalassemia experienced delays in growth and sexual maturity. The cause of this problem is the difference in the administration of iron chelation so that the amount of iron in the body will vary (6).

The results of previous studies stated that patients with thalassemia began transfusion with an average age of 3.78 years, and transfusion frequency was mostly 1 month 1 time (87.5%). One of the management is to provide the amount of blood needed by the provider of blood for transfusion so that the blood needs of thalassemia sufferers can be fulfilled every time they do transfusion so thalassemia patients can maintain their life well (7)

II. METHODS

The type of research was cross sectional design, where the measured variables are observed at one time. The research has been conducted at Cut Meutia General Hospital. The population in this study were all thalassemia major patients who had transfusions at Cut Meutia General Hospital. The sample of this study were all thalassemia major patients who had transfusions at and met the inclusion criteria and exclusion criteria. Inclusion criteria was patients who carried out blood transfusions routinely at

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least once a month during 2018. The criteria were exclusion of complete data available from the variables to be studied. This research used total sampling method which amounts to 50 patients with thalassemia major. This research used convenient sampling. The variables in this study were age, weight, hemoglobin level and blood needs. Data analysis performed using statistical analysis to obtain a prediction model for blood needs by multiple linear regression. Multiple linear regression analysis is a linear relationship between two or more independent variables (X_1, XX_2, ...$_n$) with the dependent variable (Y).

III. RESULTS

Table below shows the results in calculating blood requirements for thalassemia major patients using multiple linear regression analysis in Cut Meutia Hospital in 2018.

Table 1. Multivariate Analysis using Multiple Linear Regression

Independent Variables	p value	Dependent Variable
Age	0.18	Blood needs of thalassemia patients
Weight	0.04	
hemoglobin level	0.002	

Based on the results of the table above, all variables meet the requirements to be included in the multivariate analysis, namely if the p value is under 0.25. The following is a table that shows the results of the regression equation model

Table 2. Regression Equations Model

R	R Square	Adjusted R square	SSE
0.484	0.235	0.185	88.49

Equation 1. Regression Equation Blood Needs

Blood Needs = 443.28-10.90 age + 6.85 body weight - 32.31 hb levels

The results showed that 23.5% of the blood demand for thalassemia major was explained by the variables of age, weight, and hemoglobin level while 76.5% were explained by other causes. The prediction formula states that every reduction of 1 year of age will increase 11 milliliters of blood and every increase of 1 kilogram of body weight will increase 7 milliliters of blood and if the hemoglobin level decreases by 1 g / dL, the need for blood will increase.

IV. DISCUSSION

The prediction formula states that every reduction in age 1 year will increase blood needs by 11 milliliters. Age variable affects the blood need for transfusion of thalassemia patients. These results are consistent with previous studies, there is a linear relationship between the age of thalassemia major patients and the number of blood transfusions received. As we get older, the frequency of blood transfusions received every month also increases because of increasing age, the condition of the disease worsens so that the need for blood transfusion increases (8). Blood requirements needed for each subsequent transfusion in thalassemia major patients will gradually increase. The amount of blood given to each transfusion increases with increasing age and with child growth. If the sufferer has a large spleen that can process blood pressure too quickly, they need more blood, but if the spleen has been removed, their blood needs are reduced slightly (9). Most patients aged 0-5 years receive a blood transfusion once a month while patients aged 11-20 years mostly receive blood transfusions twice a month. In patients with thalassemia major, a regular blood transfusion program will better ensure growth and development in childhood (10).

The results show that every increase of 1 kilogram of body weight will increase 7 milliliters of blood and decrease hemoglobin levels 1g/dL, the need for blood will increase by 32 milliliters. In thalassemia patients, the Hb level will decrease by about 7% (or 1 g / dL) every week. If, a sufferer of thalassemia major is transfused every four weeks, the hemoglobin level drops by around 28% (4 g / dL), blood is needed which can increase Hb by around 28%. So, to increase the Hb level by 28% (4 g / dL) it takes 12 milliliters of red blood cells or 20 milliliters of donor blood per kilogram of body weight. For example, if the body weight of a thalassemia major patient is 20 kilograms, it takes 240 milliliters of red blood cells (400 milliliters of donor blood or about 2 bags of 220 milliliters) to increase the hemoglobin level by 4 g / dL (9). According to Rejeki, et al (2014) The prediction model produced shows that for thalassemia sufferers, age factors need to be considered even though the influence given is not as large as the weight factor and hemoglobin level. The prediction model states that the rate of transfusion of blood demand increases for patients who have fixed weight and Hb levels before transfusion is the same as the previous period, increasing the need for transfusion by around 0.816 mL / year. The level of Hb in patients with thalassemia major should be measured before and after transfusion so that it can calculate the implementation of the next transfusion. Hb before transfusion should not be lower than 70% (10 g / dL) and never below 60% (8.6 g / dL), so it is very important to measure Hb levels regularly (11).

V. CONCLUSION

Research shows that calculating blood requirements with predictive models in thalassemia patients showed 23.5% of blood demand for thalassemia major is explained by the variables of age, weight, and hemoglobin levels

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while 76.5% is explained by the causes other. The prediction formula states that every reduction in age of 1 year will increase blood needs by 11 milliliters and every increase of 1 kilogram of body weight will need 7 milliliters of blood and if the hemoglobin level decreases by 1 g / dL then the need for blood will increase by 32 milliliters.

SUGGESTION

There are many factors that must be taken into account when calculating blood transfusion requirements for patients with thalassemia major, namely age, weight and Hb levels before transfusion.

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