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The Effectiveness of Durante Hemodialysis Packed Red Cells (PRC) Transfusion on Hemoglobin Levels



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Abstract

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Renal Disease was a chronic disease that the most attacking people in Indonesia. Damage to this vital organ in the human body greatly affected a person's health condition, one of which was anemia. This study aimed to determine the effectiveness of Durante hemodialysis PRC transfusions on hemoglobin levels. The method used was Pre-experimental design, with the One group pre-post test design approach. With a sample of 49 patients who underwent regular hemodialysis at RSUD dr. Iskak Tulungagung. Data were obtained by direct observation. Processed by computerized methods with a statistical t-test, the significance level (α) was 0.05. The study results showed that the hemoglobin levels of the pre-Durante hemodialysis PRC transfusion patients were 4-5 mg/dl (53.06%), and the hemoglobin levels of the post-Durante hemodialysis PRC transfusion patients were 6.1-7 mg/dl (34.69%). The results of statistical tests showed that there was an increase in hemoglobin levels in patients who received Durante hemodialysis PRC transfusion by 1.22 mg/dl because $p\text{-value} = 0.000 < 0.05$ (α) means that there was an effect. It could be concluded that the delivery of Durante hemodialysis PRC transfusion could help increase hemoglobin levels. This finding was very helpful for chronic Renal Disease patients undergoing hemodialysis, who have been using erythropoietin preparations because PRC transfusions were cheaper and more effective when compared to using erythropoietin preparations.

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INTRODUCTION

All over the world, chronic non-communicable diseases (especially heart and blood vessel disease, hypertension, diabetes mellitus, and chronic renal disease) have become a major threat to public health and health budgets. In most countries, mortality from infectious diseases is expected to decline by 3% in the next decade. On the other hand, chronic disease, which currently accounts for 75% of the total burden of disease in people over the age of 30, will increase by 17%. The cost of treating this chronic disease has reached 80% of the world health budget (Yogiantoro, 2013).

Renal Disease is one of the most common diseases affecting people in Indonesia. Renal Disease is a condition in which the number of nephrons in human renals is slowly damaged and decreased. This disease can be caused by diet such as fast food and stamina-enhancing supplements. When the renals have decreased function, the body tries to compensate in an adaptive and maladaptive way, including various abnormal biochemical and physiological complexes. The existence of Renal Disease affects all organ systems, but the main complications are cardiovascular, neurology, hematology, musculoskeletal, and immunology, and all of them get worse as renal function decreases (Nurko, 2014).

The renal is one of the vital organs in the human body, whose main function is to regulate fluid, electrolytes, and body fluid composition, remove metabolic end products from the blood, produce hormones for the formation of red blood cells, and regulate blood pressure. This organ comes to one pair, and each renal weighs approximately 125 grams, which is located in the lateral position of the lower thoracic vertebrae, 3 cm to the right and left of the midline (Callaghan, *et al*, 2016).

The incidence rate of CRD is quite high. In the United States, it is estimated that in a year, there are 100-150 new cases of CRD for every million population, and in Japan with a population of about 127 million people, there are approximately 20,000 people with CRD who undergo regular hemodialysis as well as countries in Europe. In Asia, this number is thought to be slightly lower, presumably due to diet and lifestyle. In Indonesia, according to the Indonesian Nephrology Association (Perhimpunan Nefrologi Indonesia, PERNEFRI) in 2012, by researching four major cities, namely Jakarta, Jogjakarta, Surabaya, and Bali, there is a GJK rate

(degrees 1-5) between 2.6% and 7.5%, so that in Indonesia, there are around 60,000 people with CRD. This data shows a high incidence rate. The number of new CRD patients in Indonesia is estimated to be 5000 people each year, which of course not all can undergo regular hemodialysis (Suwitra, 2014).

Based on data from RSUD Dr. Iskak Tulungagung, in June 2019, 56 Renal Disease patients were undergoing regular hemodialysis therapy. 31 of them needed PRC transfusion because they had anemia, with hemoglobin levels < 7 g/dL. Of the 31 patients who received PRC transfusions, there were 20 people whose hemoglobin levels increased significantly, and the others did not. This incident can be influenced by several other factors, for example, the patient's diet, inadequate hemodialysis process, frequency of reuse of the dialyzer (Re-use Dialyzer) (Suwitra, 2014).

The kidney has a very vital function, so it can adversely affect the body's physiological processes. The most common kidney disorder is Chronic Renal Disease. CRD is caused by a decrease in the Erythropoietin hormone which plays a role in the formation of red blood cells. As a result of the decrease in the Erythropoietin hormone in CRD, there is a decrease in hemoglobin levels (Brunner, *et al.*, 2014).

Hemoglobin is one of the blood components contained in red blood cells (Erythrocytes). It serves as a carrier of oxygen (O₂) and carbon dioxide (CO₂) in the body. Adult's normal Hb levels are 11.5-15.5 g/dL for women, and 13.5-17.5 g/dL for men. If the hemoglobin level in the blood decreases, it will affect the perfusion to the tissues and organs throughout the body. This is commonly referred to as anemia (Mehta, *et al.*, 2016).

The causes of CRD are numerous and vary from region to region. Among these causes, the most are Diabetes Mellitus, high blood pressure (hypertension), obesity, high cholesterol, kidney and urinary tract infections, kidney stones, obstruction of the urinary tract, high uric acid, congenital disorders, and tumor (Suwitra, 2014).

The existence of this disorder causes a decrease in kidney function to perform filtration, reabsorption, secretion, and excretion, so that the ability of the kidney to remove metabolic waste substances is reduced, which in turn causes a buildup of toxins from metabolic waste in the body of CRD

patients. The impact of the accumulation of metabolic waste substances is the emergence of symptoms such as back pain, bloody or frothy urine, urinating a lot especially at night, swelling (edema) in the face, weakness, pale, dizziness/headache, nausea/decreased appetite, shortness of breath, swelling in the legs, high blood pressure, and anemia (decreased Hemoglobin levels) due to impaired production of the Erythropoietin hormone. Therefore, most of the patients undergoing hemodialysis will experience a decrease in their hemoglobin levels and require PRC (Packed Red Cells) transfusions. If these metabolic waste substances are allowed to accumulate in the body, it will be fatal to the patient's health since they can cause poisoning in the blood and cause death.

Treatment options to replace kidney function include regular hemodialysis. Currently, the most widely used is hemodialysis, but hemodialysis will usually cause a reduction in hemoglobin levels in patients due to a small portion of blood left on the bloodline or dialyzer (Agustina, 2019). However, this can be minimized by delivering PRC transfusions during (Durante) the hemodialysis process, or by delivering erythropoietin preparation therapy (EPO).

This EPO preparation therapy is rarely used because of its very expensive price, so the medical team often recommends doing PRC transfusions. The choice of PRC transfusion therapy has several drawbacks and potential disadvantages including post-transfusion reactions, the risk of transmission of infectious diseases (Hepatitis, HIV, malaria), and can increase fluid overload which is limited to patients with renal disease, and PRC transfusion can only be given in certain circumstances. Hemoglobin level for patients with chronic renal disease is one of the factors that affect prognosis and has a significant relationship with the patient's quality of life (Ardhilles, 2019). Therefore, it is necessary to do further research on the effectiveness of Durante hemodialysis PRC transfusion in increasing hemoglobin levels in patients with chronic renal disease, considering that this PRC transfusion is an alternative solution for patients with chronic renal disease to maintain hemoglobin levels within normal limits.

Materials and Methods

The design of this study is a pre-experiment with the One Group Pre-Post Test design approach. Respondents were patients with chronic renal

disease who underwent regular hemodialysis at RSUD dr. Iskak Tulungagung in June 2019 totaling 49 people. The selection of respondents used the Purposive Sampling technique, with the inclusion criteria of patients who underwent regular hemodialysis, patients who underwent laboratory tests to find out their hemoglobin levels before transfusion, patients who had anemia with $Hb \leq 7$, and $Hb \leq 8$ for patients with impaired heart function, patients who received Durante hemodialysis PRC transfusion advice, and patients with GCS 456. Exclusion criteria were patients with decreased consciousness, intoxicated patients, and patients who underwent cito hemodialysis. The independent variable in this study was Durante hemodialysis PRC transfusion, and the dependent variable was the hemoglobin level. The data collection process was carried out with a complete blood laboratory examination of the respondent before hemodialysis was carried out as pre-intervention hemoglobin level data, the respondent was given PRC transfusion of 350 ml (1 single blood bag) during the hemodialysis process. After undergoing the process of hemodialysis and PRC transfusion, respondents were given time to rest for 30 minutes then blood samples were taken for post-intervention hemoglobin level examination. The research data were documented in the observation sheet.

The statistical analysis used in this research is the Paired T-test, with the ratio data scale to determine the effect of the independent variable on the dependent variable.

Study Results

The research results are presented in the following Table 1.

Based on the data in Table 1, it was found that most of the respondents who were female were 31 respondents (63.2%); most of the respondents who aged between 61-70 years were 27 respondents (55%); most of the respondents who underwent hemodialysis 2x/week were 37 respondents (75.5%); most of the respondents who had undergone hemodialysis for > 2 years were 29 respondents (59.2%), and almost all respondents who had a non-vegetarian diet were 41 respondents (83.7%).

Table 1 Frequency Distribution of Respondents based on General Data

Variable		N	%
Gender	Male	18	36.7
	Female	31	63.2
Age	40-50 years old	8	16.2
	51-60 years old	13	26.4
	61-70 years old	27	55
	71-80 years old	1	2.4
HD Interval	1x/week	5	10.2
	2x/week	37	75.5
	5 days once	7	14.3
HD Duration	< 6 months	5	10.2
	6-12 months	15	30.6
	> 2 years	29	59.2
Diet	Vegetarian	8	16.3
	Non Vegetarian	41	83.7

Table 2 Frequency Distribution of respondents' hemoglobin levels before and after receiving Durante hemodialysis PRC transfusions

Variable	N	%
Hb Level before intervention		
4-5	26	53.06
5.1-6	15	30.62
6.1-7	8	16.32
7.1-8	0	0
Hb Level after intervention		
4-5	6	12.25
5.1-6	14	28.57
6.1-7	17	34.69
7.1-8	12	24.49

Based on the data in Table 2, it was found that most of the respondents had Pre-PRC transfusion Hb levels of 4-5 mg/dl (53.06%), and most of respondents had Hb levels of 6.1-7 mg/dl (34.69%).

Based on the data in Table 3, it can be concluded that there is a difference between the pre-PRC transfusion Hb levels and post-PRC transfusion Hb levels in respondents by 1.22 mg/dl.

Table 3 Cross tabulation of Pre-transfusion and Post-transfusion Hb levels

Hb Level	Frequency	Mean	SD
Pre-transfusion	49	5.18	0.70066
Post-transfusion	49	6.4	1.05308

Table 4 Statistical analysis result

	N	Coefficient	p-value
Pre- and Post-transfusion Hb Level	49	0.694	0.000

Based on Table 4 of the statistical analysis result above, we can get a p-value of 0.000 with a correlation coefficient of 0.694. So we can conclude that the p-value < α (0.000 < 0.05) then H_0 is rejected, which means that there is an effect of Durante hemodialysis PRC transfusion on the hemoglobin levels in patients undergoing regular hemodialysis.

DISCUSSION

From the results of the study, it is found that most of the respondents who have not received PRC transfusions had hemoglobin levels of 4-5 mg/dl, as many as 26 respondents (53.06%). This indicates that the most of patients undergoing regular hemodialysis have low hemoglobin levels and require transfusions. This is due to damage in the kidney, which affects the four kidney functions, namely filtration, reabsorption, excretion, and secretion.

The kidneys have the function of secreting the erythropoietin hormone, which functions to increase the production of red blood cells in the bone marrow (Callaghan, 2016). Therefore, if there is damage or disturbance to the kidneys, it will also result in kidney function, especially the function of decreasing erythropoietin hormone secretion which results in a decrease in hemoglobin levels in patients with chronic renal failure, and eventually, anemia occurs. This condition is following the statement contained in the book by Mansjoer Arif, et al, (2013), that one of the symptoms of chronic renal disease in the hematological system is anemia, immune deficiency, and easy bleeding. The presence of bleeding causes anemia in patients with renal failure caused by the deficiency of the erythropoietin hormone (Mansjoer, et al, 2013).

This anemia condition is also exacerbated by other symptoms of renal disease such as bleeding too easily in renal disease patients, so the risk of anemia in renal disease patients is also getting bigger. Therefore, in patients with renal disease, there is a decrease in hemoglobin levels (Suwitra, 2014).

Based on the results of the study, most of the respondents who had received Packed Red Cells (PRC) transfusions experienced an increase in hemoglobin levels to 6.1-7 mg/dl by 17 respondents (34.69%), and a small proportion of their hemoglobin levels were still low, ranging from 4-5 mg/dl by 6 respondents (12.25%). This situation indicates that most of the regular hemodialysis patients who had received Packed Red Cells (PRC) transfusions experienced a significant increase in hemoglobin levels. The increase in hemoglobin levels is due to the transfusion given is a concentrated red blood cell concentrate. So that it is expected to increase hemoglobin levels in renal disease patients who have anemia.

These concentrated red blood cells are used to increase the number of red blood cells showing symptoms of anemia, and only require additional red blood cell mass, such as in patients with renal disease or malignancy (cancer). The advantage is improved oxygenation and increased levels of erythrocytes (red blood cells) without an increase in volume load, so it is safe if given to renal disease patients who have complications of heart failure. However, deficiency can cause hypervolemia if given in large quantities and for a short time. Every 1 unit of concentrated red blood cells (PRC) can increase hemoglobin levels by around 1 mg/dl or hematocrit by 3-4% (Haroen, 2012).

According to Haroen (2012), PRC transfusion is more widely used to increase hemoglobin levels in renal disease patients who have anemia, due to its minimal side effects, and an affordable price compared to the use of erythropoietin (EPO) preparations which are quite expensive and side effects that can aggravate the work of the heart. It is expected that by delivering Durante hemodialysis PRC transfusions, the hemoglobin levels of patients with renal disease who have anemia can increase, with side effects that can be minimized. So that it will be more effective and efficient, as well as great benefits for the development of patients' health with renal disease.

From the results of data analysis using the T paired t-test statistical test, the value of P value = 0.000 is obtained. This shows that the P value = $0.000 < \alpha = 0.05$ which indicates that H_0 is failed to be rejected. And the coefficient is positive, this shows that the independent variable and the dependent variable are directly proportional. Patients who receive Packed Red Cells (PRC) transfusions during the hemodialysis process will experience an

increase in hemoglobin levels. So it can be concluded that there is an effect of PRC transfusion on hemoglobin levels in patients undergoing regular hemodialysis. This proves that the delivery of Durante hemodialysis PRC transfusions can help increase hemoglobin levels in hemodialysis patients who are in anemia. Because PRC contains concentrated red blood cells with a high enough concentration.

Pre-PRC transfusion hemoglobin levels in most renal disease patients undergoing regular hemodialysis have decreased. This is due to decreased function of the erythropoietin hormone secretion by the kidneys, as a result of impaired kidney function. This function cannot be replaced by the hemodialysis process, since the dialyzer function is only limited to filtration (Price, 2016).

PRC transfusion is an appropriate therapy given to patients with renal disease due to its effectiveness, and there are no side effects that can aggravate the works of the heart and kidney so it is safe to use. Besides, the cost is also affordable, when compared to the erythropoietin (EPO) preparation which is quite expensive (Supandiman, 2016).

The hemoglobin level of patients with renal disease is also influenced by many factors, including age, the interval of hemodialysis therapy, length of time undergoing hemodialysis therapy, and patient's diet. Age is a factor that can affect hemoglobin level in patients with renal disease, due to degenerative processes that can result in the decreased systemic function of the body, coupled with interference with kidney function, so that it can exacerbate anemia symptoms that occur in patients with renal disease. The next factor is the interval of the hemodialysis therapy, the determination of this interval depends on the general condition of the patient with renal disease. If the general condition is good, then the patient will be advised to undergo hemodialysis once a week, and if the general condition is weak, the patient will undergo hemodialysis twice a week. This can affect the patients' hemoglobin levels, because the more often the patients undergo hemodialysis, the more risk of anemia will be if it is not balanced with the things recommended by the medical team. This situation is caused by the hemodialysis process which uses acid and bicarbonate as the dialysate. This fluid has an effect that can damage red blood cells so that it will affect the hemoglobin levels of patients undergoing hemodialysis in the long term. Therefore, the length

of time undergoing hemodialysis therapy also becomes the factor that affects the hemoglobin levels in renal disease patients (PPGII Jatim, 2011). The last factor is the patient's diet. A small percentage of hemodialysis patients have a vegetarian diet because on average, they also have hypertension and heart disease. Lack of consumption of meat and iron is what ultimately triggers anemia in kidney disease patients. However, it is not absolute that diet affects hemoglobin levels in patients undergoing regular hemodialysis. Therefore, regular hemodialysis patients who experience complications in the form of hypertension or heart disease are recommended not to adopt an absolute vegetarian diet, so that the patients' hemoglobin levels do not tend to fall (PERNEFRI, 2012).

From the discussion above, it can be concluded that the PRC transfusion is better, more effective, and more efficient to increase hemoglobin levels in patients with renal disease who have anemia. With various advantages, such as hemoglobin levels can increase significantly, prices are likely to be affordable if compared with other therapies for anemia, side effects that are not harmful to the heart, and there is no risk of hypervolemia if delivered in the correct dosage and manner (Pinheiro, 2018).

CONCLUSION

Based on the results of the study and discussion, we can conclude that most renal disease patients who underwent regular hemodialysis (53.06%), had low hemoglobin levels (4-5 mg/dl) before being given Packed Red Cells (PRC) transfusions. Most of the renal disease patients who underwent regular hemodialysis (34.69%), had hemoglobin levels of 6.1-7 mg/dl after receiving Durante hemodialysis Packed Red Cell (PRC) transfusions. There is an effect of giving Durante hemodialysis Packed Red Cells (PRC) transfusions on hemoglobin levels in renal disease patients undergoing regular hemodialysis.

SUGGESTION

For renal disease patients undergoing regular hemodialysis with symptoms of anemia, it is necessary to consider getting transfusions according to the doctor's advice so as not to worsen the anemia experienced by the patients. Besides, maintaining a diet so that it can help the formation of new red blood cells, so it is expected that anemia

does not occur. The medical team should recommend giving Packed Red Cells (PRC) transfusions to patients with renal disease who have anemia because of its proven effectiveness to increase hemoglobin levels, and there are no side effects that can aggravate the kidney and heart. Also, the cost is relatively cheap when compared with the delivery of erythropoietin preparations. For other researchers who want to continue this research, confounding variables in this study should be removed, and respondents can be made more homogeneous by adding inclusion criteria so that the research results become more valid.

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