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Research Paper

The Relationship of PCLR Therapy on Hemoglobin Levels in Anemia Patients at BDRS MMC Jakarta (January-April 2022)

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Abstract

Anemia is generally characterized by a decrease in hemoglobin levels. In terms of function, a decrease in hemoglobin causes a reduction in the body's need for oxygen in sufficient quantities. PCLR (Packed Red Cell Leukoreduced) is a concentrated red blood cell product obtained through the process of reducing leukocytes, so PCLR transfusion is expected to increase Hb levels in anemia patients. This study aims to determine the relationship between PCLR administration and hemoglobin levels in anemia patients and to determine the increase in hemoglobin levels after PCLR transfusion at MMC Hospital Blood Bank (BDRS MMC) Jakarta. Quantitative (analytical) research methods. The sample in this study was 140 data from anemia patients who underwent PCLR transfusion (January-April 2022). Data analysis was carried out univariate and bivariate. The research was carried out at MMC Jakarta Hospital in July 2022. Research results: the majority of patients were elderly (56-<65 years) 67 people (47.9%), the majority gender was female 82 people (58.6%); there was an increase in Hb levels after PCLR transfusion, namely 1.89 gr/dL with an average use of 2 bags; and there is a relationship between PCLR administration and hemoglobin levels in anemia patients at BDRS MMC Jakarta. Suggestion: to achieve an increase in hemoglobin in anemia patients, PCLR can be used as a blood component of choice for transfusion at the right dose.

Keywords: *Hemoglobin, Anemia, PCLR*

INTRODUCTION

Anemia is a condition where the circulating erythrocyte mass and/or hemoglobin mass does not fulfill its function in providing oxygen to body tissues. Symptoms of anemia can generally be seen physically such as weakness, pale skin, and face, headaches, and sometimes shortness of breath. breathing and accompanied by chest pain (Amalia & Widuri, 2020). The results of laboratory examinations are described as a decrease in hemoglobin (Hb) levels below normal. The standard limit for Hb levels (WHO) is classified as mild anemia with an Hb level of 10 gr/dL. Hb levels <7 g/dL, especially in acute anemia, are indicated for packed red blood cell transfusion Packed Red Cell (PRC). The PRC component is the type of blood component that is most often transfused to increase the oxygen-carrying capacity of the blood in cases of bleeding or severe anemia (Zahroh & Istiroha, 2019).

PCLR (*PRC Leukoreduced*) is a blood product that contains red blood cells obtained from a modification process by reducing leukocytes (leukocyte reduction) pre-storage with a closed and automatic system. In one PCLR bag, there is 50-70% hematocrit and leukocyte count <$1.2x10^9$. The main aim of giving PRC blood transfusions to anemia patients is to increase the number of red blood cells and maintain Hb levels. In blood transfusion service standards (Minister of Health Regulation, 2015) unit is given *PRC Leukodepleted* in which there is Hb 43gr/dL to adult patients at least increase the Hb level by 1 g/dL with a hematocrit of around 3%. This is proven by research on the impact of Hb after PCLR transfusion in recipients with an average age of 66 years as many as 195 people with hematological diseases. There was an average increase of 0.6 gr/dL after PCLR transfusion per 1 unit (Karafin et al., 2019).

According to research results Damayanti (2021) reducing leukocytes can slow down the process of destroying red blood cells, the Hb concentration in PCLR supernatant is less than PRC

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nonleukoreduced, and the level of hemolysis in PCLR is lower than non-PCLR seen in 42 days. Similar research states that there is no significant difference in HB levels in PCLR seen from the shelf life from 0 days to day 42, the amount of HB on the first day was 52.42 gr/dL until the 42nd day, the amount of Hb was 53.03 gr/dL.

PCLR components are only produced by the DKI Jakarta Provincial Blood Donation Unit, and MMC Hospital Blood Bank (BDRS MMC) is one of the hospitals that orders the most PCLR. Since August 2020 until now BDRS MMC has consistently served requests for the PCLR blood group. The number of anemia patients with varying Hb levels, between <5gr/dL to <10gr/dL. There were 1282 patients requiring PCLR transfusions (August 2020 to March 2022), and the number of bags requested was different for each patient. There are 5-10 patients who undergo repeated PCLR transfusions every month, so a total of 2371 PCLR bags are needed to meet the need.

When compared with a total of 1897 patients with a total use of 3390 bags of blood, the need for blood at BDRS MMC is dominated by patients with PCLR requests, namely 67.5% of the total patients. The size of the PCLR component is 70% of the total use of blood components. Looking at these data, the need for PCLR blood transfusions is very important for patients with low Hb. According to Roubinian et al. (2019) an increase in hemoglobin is used as a success in transfusion because hemoglobin levels are often the main parameter in clinical decisions in every PRC transfusion decision.

Research objectives: (a) To determine the characteristics of anemia sufferers based on age and gender; (b) Knowing the average Hb levels of anemia patients before and after PCLR blood transfusion as well as changes in Hb levels after PCLR transfusion; (c) Identifying the relationship between giving PCLR transfusions to the hemoglobin levels of anemia patients at BDRS MMC Jakarta (January-April 2022).

LITERATURE REVIEW

Blood transfusion services are a health effort in the context of curing disease and restoring health by utilizing human blood as a basic material for humanitarian purposes and not for commercial purposes (Minister of Health Regulation, 2015). There are 3 main purposes of blood transfusions, including: to treat anemia (decreased hemoglobin levels), to replace blood loss due to bleeding either due to surgery or accidents and to replace other blood components, for example, clotting factors (Aliviameita & Puspitasari, 2020).

Generally, the blood volume in a healthy body is 6-8% of an adult's body weight. In men, it is 7.5% and in women, it is 6.5% of body weight and amounts to around 5 liters. In general, the function of blood can be said to be a means of transport, a means of hemostasis, and a means of defense. Blood products come from any substance made from human blood. From blood products it is made into blood components, starting from whole blood (*whole blood*) which comes from a donor's blood collected in a container containing an anticoagulant. From whole blood, other blood components can be made, including PRC, plasma, platelets, and cryoprecipitate (Kesrianti, 2021).

In general, PRC is used for anemia patients who are not accompanied by a decrease in blood volume, for example, patients with hemolytic anemia, acute leukemia, chronic leukemia, malignancies, thalassemia, and chronic kidney failure (Saragih et al., 2019). PCLR processing procedures are considered more expensive in terms of costs when compared with processing *PRC* nonleukoreduced. The costs charged to patients are higher than ordinary PRC costs. From the perspective of using PCLR, it can reduce the risk of non-hemolytic febrile transfusion reactions *Human Leukocyte Antigen* (HLA) or *granulocyte alloimmunization,* minimize transmission *cytomegalovirus* (CMV) (Blaney et al., 2013). The results of research on the incidence of FNHTR (*Febrile Non-Hemolytic Transfusion Reaction*) in internal medicine patients at RSUP Dr. Sardjito. The incidence of FNHTR in the group of PCLR transfusion patients was 1 out of 76 subjects (1.3%) which

was lower compared to non-leukoreduction PRC, namely 7 out of 126 subjects (5.6%) (Eko et al., 2020).

Post-transfusion results show that the increase in Hb does not always correspond to the amount of PRC given, allegedly due to the recipient's immune reaction to the PRC components. From the results of research on the effectiveness of PCLR and WE (Washed Packed Red Cells) transfusions in 60 patients, an increase in Hb of 75% was found, and There was no difference between the groups transfused with PCLR and WE in terms of increasing Hb and the incidence of side effects after transfusion (Gatot & Mardia, 2021).

The Hb value limit reached as a reason for red blood cell transfusion with the 10/30 rule, transfusion when a patient has a Hb level of less than or equal to 10 gr/dL (100 g per L) and a hematocrit level of less than or equal to 30% regardless Based on the patient's clinical condition, this rule was used until 1980. The transfusion strategy was updated, recommending the use of red blood cells for transfusion with Hb levels of less than 7 gr/dL, and maintenance of Hb levels between 7 and 9 g per dL. Meanwhile, in children with critical illnesses, the Hb target is 8.5-9.5gr/dL (Sharma et al., 2011).

The decision to transfuse PRC is based not only on laboratory values but also on an objective evaluation of the patient's clinical condition and his ability to compensate for blood loss. Therefore, the patient's age, comorbidities, disease severity, and extent and amount of bleeding are taken into account before transfusion. Indications for blood transfusion are acute bleeding until hemoglobin < 8 g/dL or hematocrit < 30%, in major surgery where blood loss is > 20% of total volume, acute anemia patients with hematocrit < 21%, chronic anemia patients who cannot tolerate hemoglobin levels < 7 g/dL (Yaddanapudi & Yaddanapudi, 2014).

American Society of Anesthesiologists states that the indication for blood transfusion is a Hb value <6 g/dL and rarely indicates a Hb >10 g/dL. For Hb values of 6-10 g/dL, indications depend on the risk of complications. Giving transfusions takes into account the body's physiology, if possible an autologous blood transfusion can be carried out (lower risk). In critical patients in the ICU, blood transfusion is considered at the time of Hb level ≤7 mg/dl with a target of 7-9 g/dL, unless there are specific morbidities or acute disease-related factors that modify clinical decision-making (Artha, 2017).

Increased Hb occurred in patients who received whole blood derivative transfusions compared with apheresis-derived units. Positive alloantibody factors influence the efficacy of PRC transfusion, where the incidence of erythrocyte alloimmunization increases and reduces the efficacy of PRC transfusion as seen from the difference in hemoglobin levels before and 24 hours after transfusion (Herawati & Santhi, 2018).

Post-transfusion Hb levels can be assessed 1 hour after a blood transfusion to see the impact of the transfusion on increasing Hb, but it is best to assess Hb 24 hours after the transfusion to obtain more stable results. At MMC Hospital, Hb levels after transfusion are checked 4 to 6 hours later or according to the instructions of the treating doctor.

RESEARCH METHOD

This research method is quantitative with a case study design, using secondary data in the form of medical records (data on anemic patients before and after PCLR transfusion and the number of blood bags used). The population is data on patients who underwent PCLR blood transfusions (January-April 2022), with a sample size of 140. The research was conducted at the MMC Hospital Blood Bank (BDRS) in H.R Rasuna Said Kav. 21 Karet Kuningan, Setiabudi, Central Jakarta in July 2022. Variables include patient characteristics (age and gender), and levels of Hb (before and after transfusion). Univariate data analysis to obtain information regarding the age and gender of the sample. Bivariate analysis to find out whether to test the hypothesis (to prove whether there is a

relationship between PCLR administration and the hemoglobin levels of anemia patients in the hospital. MMC between variables with chi-square test by SPSS24.

FINDINGS AND DISCUSSION

Results

Univariate

1. Patient characteristics (Age and Gender)

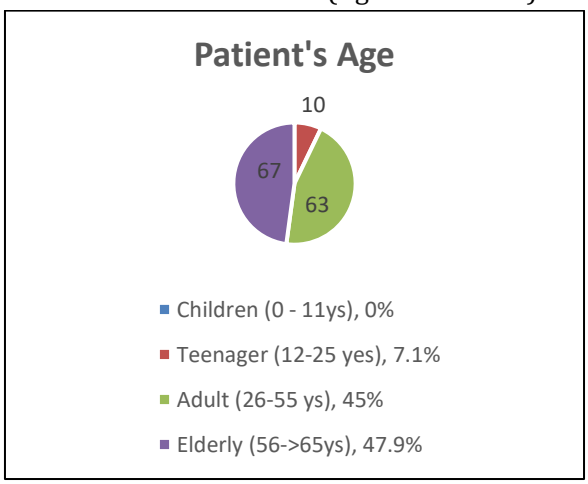

Figure 1. Patient's Age

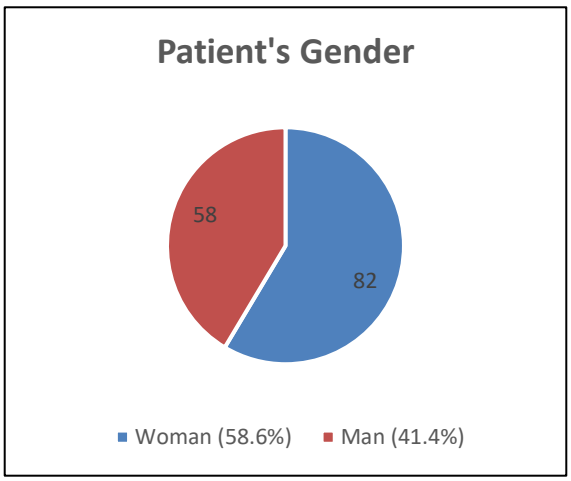

Figure 2. Patient's Gender

2. Hb levels of anemia patients before and after PCLR blood transfusion as well as changes in Hb levels after PCLR transfusion

Table 1. Hb levels of anemia patients before PCLR blood transfusion

PCLR Transfusion	Min	Max	SD	Mean
Before	4.2	9.9	1.03	8.2
After	6.4	12.8	1.13	10.1
difference	-1.2	5.7	0.09	1.89

Data Source: 2022 research

Table 2. Hb levels of anemia patients Use of PCLR Blood Bags

	Amount of Blood Bags (n=284)				Total
	1	2	3	4	
Sample	35	73	25	7	140
Percentage	25	52.1	17.9	5	100

Data Source: 2022 research

Bivariate

1. Normality Data Test

A normality data test was carried out. The normality test for this research data used the one-sample Kolmogorov-Smirnov test. The results of the data normality test are significant when the Sig value ($p > 0.05$) means the data is normally distributed.

Table 3. Normality Test Result

Hb Value	One sample Kolmogorov-Smirnov test		Monte Carlo Sig. (2-tailed)
	Mean	**Statistic**	**Asymp.Sig**
Before transfusion	8.2	0.100	0.112
After transfusion	10.1	0.046	0.910

Data Source: 2022 research

2. Relationship Between giving PCLR transfusions to the hemoglobin levels of anemia patients

Table 4. Relationship Between giving PCLR transfusions to the hemoglobin levels of anemia patients

	Value
Chi-square	13.524
df	2
Asymp. Sig	0.001

Data Source: 2022 research

DISCUSSION

Based on the results of the data on the age characteristics of anemia patients, the highest number of elderly patients was 67(47.8%). The results of research on the prevalence of anemia in the elderly are 6-30% in men and 10-22% in women. At the age of 75 years the prevalence can increase significantly, anemia in elderly people over 85 years is associated with increasing mortality. The increase in Hb levels in transfusion patients is influenced by iron and depends on age. Adolescents and adults when transfused increase Hb levels more quickly compared to the elderly. The increase in HB levels is also influenced by the amount of fluid entering the patient's body and can also be caused by the patient's illness (Pratama, 2020).

From the data on gender characteristics, the highest number of female patients was 82 patients and 58 male patients. According to research (Nidianti et al., 2019), the incidence of anemia in women is 40% greater than in men, 6%. The highest number of cases of anemia occur at ages > 60 years with a percentage of 36% compared to other age groups.

The results of the test of the relationship between giving PCLR and hemoglobin levels using chi-square showed that there was a relationship between giving PCLR and increasing hemoglobin levels with a significance value of 0.001 where $p<0.05$. From the results of the research conducted, based on Table 4.8, the average increase in Hb levels after PCLR transfusion was obtained with an average value of 1.89 gr/dL. This is by research conducted by (Karafin et al., 2019), where there was an average increase of 0.6 gr/dL after PCLR transfusion per 1 unit.

Researchers assume that, based on calculations of the total bags transfused divided by the amount of increase in Hb after transfusion, a value of 1,017 gr/dL is obtained, which means that each PCLR bag can increase Hb by 1 gr/dL. This is by Minister of Health Regulation 91 of 2015 (Minister of Health Regulation, 2015) giving 1 unit of Leukodepleted PRC can at least increase Hb levels by 1 g/dL. The purpose of giving blood or blood transfusion is a treatment method that plays an important role in determining the patient's treatment. Treating the underlying disease is the main therapeutic approach for anemia in chronic diseases, however, if the underlying disease has not been resolved then alternative strategies such as transfusion may be needed.

CONCLUSIONS

The conclusions of this study are (a) Characteristics of anemia patients based on age and gender, dominated by elderly patients (56-65 years) 47.9% and female patients 58%; (b) The average hemoglobin level in anemia patients before PCLR transfusion was 8.2 gr/dL and the hemoglobin level after transfusion was 10.1 gr/dL; (c) The average increase in Hb levels after giving a PCLR transfusion was 1.89 gr/dL and judging from its effectiveness, giving 1 bag of PCLR can increase Hb by 1.017 gr/dL; (d) There is a relationship between PCLR administration and increased hemoglobin levels in anemia patients.

LIMITATION & FURTHER RESEARCH

Research limitations (a) The research uses secondary data and is not experimental research; (b) The Hb value after PCLR transfusion is also influenced by the patient's diagnosis, patient bleeding, transfusion or reproductive history, hemolytic transfusion reactions due to the presence of alloantibodies and varying post-transfusion Hb examination times. (c) There is no complete patient clinical history data, such as previous transfusion history, pregnancy history, transfusion reactions, and the patient's use of medications.

REFERENCES

Aliviameita, A. & Puspitasari. (2020). *Buku Ajar Mata Kuliah*, *Umsida Press Sidoarjo Universitas*. Sidoarjo.

Amalia, Y. & Widuri, S. (2020). *Manajemen Mutu Pelayanan Darah bagi Teknisi dan Mahasiswa Teknologi Bank Darah*. Surabaya: Scopindo Media Pustaka.

Artha, I. G. P. W. (2017). *Transfusi Darah Pasca Bedah*. Denpasar.

Blaney, Kathy, D. & Howard, Paula, R. (2013). *Basic & Applied Concepts of Blood Banking and Transfusion Practices - Elsevier eBook on Vital Source, 3rd Edition*. 3rd ed. Mosby.

Damayanti, E. (2021). *Pengaruh Masa Simpan PCLR Terhadap Kadar Hemoglobin di UDD PMI DKI Jakarta*. DKI Jakarta, Indonesia.

Eko, A., Johan, K. dan Hardianti, M. S. (2020). *Pengaruh Leukoreduksi Pada Kejadian Febrile Non Hemolytic Transfusion Reaction (Fnhtr) Resipien Transfusi Packed Red Cell*. Universitas Gadjah Mada.

Gatot, D. & Mardia, A. I. (2021). Effectiveness Of Leukoreduction And Washed Packed Red Blood Cells on Hemoglobin Increment And Side Effects In Post Transfusion Anemia Patients. *Buletin Farmatera*, *6*(3). 177–180. http://dx.doi.org/10.30596%2Fbf.v6i3.

Herawati, S. dan Santhi, D. G. D. D. (2018) "Korelasi Efikasi Transfusi Packed Red Cell (PRC) dengan Kejadian Aloimunisasi Eritrosit pada Pasien Anemia Kronik," *Fakultas Kedokteran Universitas Udayana*, hal. 10.

Karafin, M. S., Bruhn, R., Roubinian, N. H., Chowdhury, D., Qu, L., Snyder, E. L., ... & Malkin, K. B. (2019). The impact of recipient factors on the lower-than-expected hemoglobin increment in transfused outpatients with hematologic diseases. *Transfusion*, *59*(8), 2544-2550. http://doi.org/10.1111/trf.15439.

Kesrianti, A. M. (2021). *Kadar Hemoglobin (Hb) pada Perokok*. Yogyakarta: Penerbit KBM Indonesia.

Minister of Health Regulation. (2015). *Peraturan Menteri Kesehatan Nomor 91 Tahun 2015 tentang Standar Pelayanan Transfusi Darah*. Jakarta.

Nidianti, E., Nugraha, G., Aulia, I. A. N., Syadzila, S. K., Suciati, S. S., & Utami, N. D. (2019). Pemeriksaan Kadar Hemoglobin dengan Metode POCT (Point of Care Testing) sebagai Deteksi Dini Penyakit Anemia Bagi Masyarakat Desa Sumbersono, Mojokerto. *Jurnal Surya Masyarakat*, *2*(1), 29-34. http://doi.org/10.26714/jsm.2.1.2019.29-34.

Pratama, A. S. D. (2020). Perbedaan Kadar Hemoglobin Penderita Anemia Sebelum dan Sesudah

Transfusi Darah. *Karya Tulis Ilmiah*, hal. 1–53.

Roubinian, N. H., Westlake, M., St. Lezin, E. M., Edgren, G., Brambilla, D. J., Lee, C., ... & NHLBI Recipient Epidemiology and Donor Evaluation Study-III (REDS-III). (2019). Association of donor age, body mass index, hemoglobin, and smoking status with in-hospital mortality and length of stay among red blood cell–transfused recipients. *Transfusion*, *59*(11), 3362-3370. https://doi.org/10.1111/trf.15541.

Saragih, P., Adhayanti, I., Lubis, Z., & Hariman, H. (2019). Pengaruh waktu simpan Packed Red Cells (PRC) terhadap perubahan kadar hemoglobin, hematokrit, dan glukosa plasma di RSUP H. Adam Malik, Medan, Indonesia. *Intisari Sains Medis*, *10*(2). https://doi.org/10.15562/ism.v10i2.415.

Sharma, S., Sharma, P. & Tyler, L. N. (2011). Transfusion of blood and blood products: Indications and complications. *American Family Physician*, *83*(6), hal. 719–724.

Yaddanapudi, S. & Yaddanapudi, L. (2014). Indications for blood and blood product transfusion. *Indian journal of anaesthesia*, *58*(5), hal. 538–542. https://doi.org/10.4103/0019-5049.144648.

Zahroh, R. & Istiroha. (2019). *Asuhan Keperawatan pada Kasus Hematologi*. Surabaya: CV. Jakad Publishing Surabaya.