ACADEMIC HOSPITAL JOURNAL

Volume 7, No. 2, September 2025

ISSN 2615-6253 (ONLINE)
ISSN 2615-6245 (PRINT)

Hemoglobin Levels in PRC Blood Products Before and After Shelf Life Period

***Orchelanesya Avrilia Ranika Puteri, Yoki Setyaji and Lilik Setyowatiningsih**

Politeknik Kesehatan Kementerian Kesehatan Semarang, Indonesia

*Corresponding Author: orchelanesyaavrilia16@gmail.com

Submitted: April 2025 **Reviewed: May 2025** **Published: September 2025**

Abstract

Background: PRC is a component found in living creatures, which plays an important role in transporting oxygen and metabolic products to body tissues. PRC transfusion is indicated at Hb levels < 7.0 g/dl, especially in patients with acute anemia. In the transfusion process, before there is a request for blood to be transfused, the blood will be stored in a blood bank. A good blood storage process is needed to maintain the quality of blood products so that they are safe for transfusion. During the storage process, hemoglobin levels in the blood can change. The longer blood is stored, the more red blood cells become fragile and lyse, thereby increasing the concentration of hemoglobin in the blood. This study aims to determine and describe the description of hemoglobin levels in pre- and post-PRC blood products during the shelf life at UDD PMI Rembang Regency.

Method: This type of research uses analytical descriptive research and a research design with purposive sampling techniques. The samples used in this study were 30 bags of PRC blood, which met the inclusion and exclusion criteria.

Result: The results of this study showed an increase in hemoglobin levels, with the average pre-storage hemoglobin level being 14.99 g/dl, while the average post-storage hemoglobin level was 17.5 g/dl.

Conclusion: In this study, there was an average increase in hemoglobin levels of 2.51 g/dl or 16.74%. This could be caused by temperature, storage time, and anticoagulants.

Keywords: hemoglobin, packed red cell, storage

1. INTRODUCTION

Blood products whose use is quite large are Packed Red Cell (PRC), Platelets Concentrate (TC), and Whole Blood (WB) (1). Packed Red Cell (PRC) is obtained from the separation of whole blood components by sedimentation during the storage process or by high-spin centrifugation. Packed Red cells are useful to increase the number of red blood cells in patients showing symptoms of anemia, which only requires red blood cells. PRC transfusion is indicated at Hb levels < 7.0 g/dl, especially in acute anemia patients. Transfusion can also be done at Hb levels of 7.0 – 10.0 g/dl if hypoxia or hypoxemia is found clinically or laboratoryly (2).

In PRC, transfusion hemoglobin will increase after 24 hours of administration of transfusion, so it is not yet known whether prolonged storage of PRC will affect hemoglobin levels or not. PRC is the main choice for chronic anemia because the volume is smaller compared to whole blood. Storage PRC should be stored in the refrigerator at a temperature of 2-6°C to maintain optimal erythrocyte life span. Each issued by PMI or BDRS, PRC must be started to be transfused within 30 minutes. Blood must be discarded if this requirement is not met, and the transfusion must be completed within 4 hours (3).

Storage of PRC blood products using CPDA anticoagulant (Citrate Phosphate Dextrose

COPYRIGHT ©2020 THE AUTHOR(S). This article is licensed under a Creative Commons Attribution ShareAlike 4.0 International License

Adenine) at a temperature of 2 – 6 ℃ with a storage period of 35 days. The number of requests for PRC blood by BDRS (Hospital Blood Bank) is based on Blood type cannot be predicted in advance, because BDRS requests are based on patient needs. This can cause PRC blood not to be removed from the blood bank until the expiry date approaches. UDD PMI Rembang Regency sets the period Expiration is 35 days or a maximum of 1 week before the blood expiration date. During the storage process, blood will experience changes in blood components, especially erythrocytes, which will undergo significant changes in shape along with long storage time. Storing blood will cause many erythrocytes to die immediately after transfusion due to a decrease in ATP levels. The longer the blood is stored, the more red blood cells are destroyed and the fewer the number of red blood cells that can survive (4).

Hemoglobin (Hb) is a protein molecule in erythrocytes that functions as a medium to transport oxygen throughout the body and carbon dioxide from body tissues to the lungs. According to WHO (2011), everyone has different Hb levels. Hb reference value in adult men is 13 – 17 g/dL, in adult women it is 12 – 15 g/dL, and in children it is 11.5 – 15.5 g/dL. Check hemoglobin levels before donating to find out whether the hemoglobin level is normal or not at that time.
Research conducted by Sitanggang, N.M. (2018) shows an increase in hemoglobin levels when stored at a temperature of 2 – 6 ℃ for one week (5). Apart from that, research conducted by Zuherni, V. (2019) on levels of fresh blood hemoglobin with blood stored for 14 days also showed an increase in hemoglobin levels (6). A significant increase in hemoglobin levels has several clinical significances, including the potential for misleading Hb values during transfusion evaluation, such as due to dehydration factors. Based on this description, the storage of blood products is too long can affect hemoglobin levels. Side effects in blood storage create Many erythrocytes die after blood is transfused, because there is a decrease in ATP levels (Adenosine Tri Phosphate). Research by Maharani and Noviar (2018) Blood storage for several days will experience shifts oxygen dissociation curve to the left (7). Oxygen is tightly bound to hemoglobin, and there is too little of it given to the network (8). Because there are still limited local studies in Indonesia that evaluate changes in PRC hemoglobin levels at the end of the shelf life, this study aims to determine the pre- and post-shelf life hemoglobin levels of PRC blood products.

2. MATERIALS AND METHODS

This research uses descriptive analytics with a purposive sampling technique. Purposive sampling technique is a data collection technique by determining the samples that have been considered (9). The population in this study involved blood donors in the Rembang Regency PMI building, and their blood products were in the form of Packed Red Cell (PRC) components, which had previously passed the test filter IMLTD. The number of samples used in this study was 30 bags of PRC blood stored up to day 25, which had met the inclusion and exclusion criteria. The data in this research were obtained from secondary data obtained from the SIMDONDAR database and primary data obtained through direct examination using an Hb examination tool, namely the Hb meter for 6 plus. The Fora 6 Plus Hb level measuring device uses the Point of Care Testing (POCT) method, not the cyanmethemoglobin method. The POCT method allows for quick and easy Hb level measurements in various locations, unlike the cyanmethemoglobin method, which is generally carried out in laboratories. The working principle of this device uses a test strip that reacts with a blood sample, then produces Hb level results that can be read on the device monitor. Calibration on the Hb for the 6 plus device is carried out twice a year. Next, the data processing will be presented in table form, frequency distribution, and described.

3. Result

Results of examination of hemoglobin levels pre- and post-shelf life. Based on the results of research conducted on 30 donor blood samples before and after being stored at the PMI Blood Donation Unit, Rembang Regency.

Table 1. Table 1. Results of examination of HB levels pre- and post-shelf life

Number	Blood Bag Number	Blood type	Hb *pre* shelf life (g/dl)	Hb *post* shelf life (g/dl)	Hb Change Value (g/dl)
1.	Y4632606A	A	15.1 g/dl	16.5 g/dl	1,4 ↑
2.	Y4632927A	A	14.5 g/dl	16.3 g/dl	1,8 ↑
3.	Y5632331A	A	15.5 g/dl	16.6 g/dl	1,1 ↑
4.	Y3632187A	A	15.5 g/dl	17.3 g/dl	1,8 ↑
5.	C4562218A	A	15.8 g/dl	18.3 g/dl	2,5 ↑
6.	C1453127A	A	15.5 g/dl	17.1 g/dl	1,6 ↑
7.	Y2389102A	A	14.4 g/dl	17.8 g/dl	3,4 ↑
8.	Y1423103A	B	15.0 g/dl	18.7 g/dl	3,7 ↑
9.	Y2331221A	B	13.8 g/dl	16.1 g/dl	2,3 ↑
10	Y2328148A	B	14.9 g/dl	18.7 g/dl	3,8 ↑
11.	Y3226512A	B	14.4 g/dl	18.3 g/dl	3,9 ↑
12.	Y5634399A	B	14.5 g/dl	17.3 g/dl	2,8 ↑
13.	Y3632586A	B	14.4 g/dl	17.5 g/dl	3,1 ↑
14.	C5652028A	B	16.2 g/dl	17.1 g/dl	0,9 ↑
15.	Y3617708A	B	14.6 g/dl	15.0 g/dl	0,4 ↑
16.	Y5632599A	O	15.3 g/dl	16.7 g/dl	1,4 ↑
17.	Y5632598A	O	15.2 g/dl	17.6 g/dl	2,4 ↑
18.	Y1634450A	O	14.8 g/dl	16.9 g/dl	2,1 ↑
19.	Y2340998A	O	15.0 g/dl	17.2 g/dl	2,2 ↑
20.	Y1349151A	O	15.2 g/dl	18.7 g/dl	3,5 ↑
21.	Y2349245A	O	14.7 g/dl	17.4 g/dl	2,7 ↑
22.	Y4549106A	O	15.0 g/dl	18.2 g/dl	3.2 ↑
23.	Y2350623A	O	13.9 g/dl	17.4 g/dl	3,5 ↑
24.	Y2642563A	O	16.0 g/dl	19.3 g/dl	3,3 ↑
25.	Y0013479A	O	15.5 g/dl	17.6 g/dl	2,1 ↑
26.	Y2349152A	AB	15.8 g/dl	18.3 g/dl	2,5 ↑
27.	Y2349046A	AB	16.0 g/dl	19.0 g/dl	3 ↑
28.	Y4349003A	AB	14.8 g/dl	16.4 g/dl	1,6 ↑
29.	Y2349142A	AB	14.2 g/dl	19.0 g/dl	4,8 ↑
30.	C5651875A	AB	14.4 g/dl	16.7 g/dl	2,3 ↑
	Average value of Hb levels		**14.99 g/dl**	**17.5 g/dl**	**2.51/dl**

Note ↑ : Hemoglobin levels have increased

a. Describe changes in hemoglobin levels during shelf life

Based on Table 1, the average pre-storage hemoglobin level value was 14.99 g/dl, with the lowest Hb level being 13.8 g/dl and the highest Hb level being 16.2 g/dl. The hemoglobin level after the 25-day shelf life was obtained on average at 17.5 g/dl, with the lowest Hb level being 15.0 g/dl and the highest Hb level being 19.3 g/dl. During the blood storage process, there was an average increase in hemoglobin levels of 2.51 g/dl.

b. Describe the average hemoglobin level value based on blood type

The average increase in the hemoglobin level value for blood group A was 1.94 g/dl, the average increase in the hemoglobin level value for blood group B was 2.61 g/dl, the average increase in the hemoglobin level value for blood group O was 2.64 g/dl, and the average increase in hemoglobin levels for blood group AB was 2.92 g/dl.

4. DISCUSSION

Based on research conducted at the PMI UDD, Rembang Regency, and blood samples from 30 donors were examined, with the blood product examined being PRC. It was found that the average hemoglobin level in the blood before

storage was 14.99 g/dl, which is a normal number. After the blood was stored for 25 days, the average hemoglobin level increased to 17.5 g/dl. This means that the hemoglobin level in the blood increased after being stored for several days, as shown in Table 1. Increasing Hb levels only increases the Hb value and does not always result in an improvement in the quality of the transfused blood.

The results of the hemoglobin level examination in this study are in line with the research conducted by Nia Martha Adiratna Sitanggang in 2018 entitled "The Effect of Blood Storage on Hemoglobin Levels in Whole Blood Components of Donor Blood Before and After Being Stored for One Week at PMI Medan City" with research results showing that the amount of hemoglobin in the blood increased after being stored for one week. This was also found in a study by Elvi Zahara entitled "The Effect of Blood Storage Duration on Hemoglobin Levels Before and After Being Stored for 3 Days at PMI Medan in 2016." In the results, it was found that the amount of a substance called hemoglobin in the blood increased after being stored for 3 days.

Freshly drawn blood from a person and used immediately, the blood still has all the important parts needed to clot and carry oxygen throughout the body. Fresh blood has everything needed to clot and stop bleeding, such as factor V and factor VIII (10). However, when blood is stored for a while, these clotting factors begin to run out. If the remaining clotting factors are not enough, the blood may not clot properly. Oxygen transport by erythrocytes will also decrease because it is caused by the high affinity of hemoglobin for oxygen, so that oxygen is difficult to release to the tissues (11).

The longer the blood is stored, the more red blood cells die, and fewer can survive. This certainly makes red blood cells weak, so that some red blood cells begin to rupture and then experience lysis. This can increase the amount of hemoglobin in the blood.

In this study, there was an increase in hemoglobin levels in PRC blood components after being stored in the blood bank until the 25th day, where there was an average increase in hemoglobin levels of 2.51 g/dl. PRC is obtained from the processing of whole blood components, where whole blood itself is still in the form of complete blood (its content contains erythrocytes, leukocytes, and plasma), while if it has been processed into PRC, the most abundant or dominant component is erythrocytes (70-80%) (12). If this PRC is stored for a long time, in this case during a 25-day storage period, the blood will become thicker, and if examined, the hemoglobin value will be high, or in other words, it shows an increase in hemoglobin levels (13). The longer the blood is stored in the blood bank, the erythrocytes will swell due to the loss of erythrocyte cell vitality. The loss of the erythrocyte cell lipid membrane cannot be avoided, causing plasma to become trapped and causing hemoglobin levels to increase during storage (14). The use of PRC with high Hb levels due to hemolysis has the potential for serious clinical consequences, such as thrombosis (formation of blood clots). High hemoglobin levels can cause the blood to become thicker and potentially form clots. These clots can block blood flow, triggering various problems such as stroke, heart attack, and even the risk of infection (15).

5. CONCLUSION

Based on the research results, it can be concluded that hemoglobin levels pre-storage day 0 have an average hemoglobin level of 14.99 g/dl, with the lowest Hb level being 13.8 g/dl and the highest Hb level being 16.2 g/dl. Hemoglobin levels post shelf life on day 25 had an average of 17.5 g/dl, with the lowest Hb level being 15.0 g/dl and the highest Hb level being 19.3 g/dl. During the shelf life, there was an average increase in hemoglobin levels of 2.51 g/dl or 16.74%. Routine evaluation of Hb levels in PRC approaching the end of its shelf life is required, as well as clinical considerations in its use.

REFERENCES

1. Rahmah, W. N., & Chairunnissa, A. (2021). Pengaruh Lama Penyimpanan Kantong Darah Terhadap Kadar Hemoglobin Pada Komponen Darah di PMI Kota Palangka Raya. The Effect of Storage Of Blood Bags on Hemoglobin Levels In The Unit Donor Darah PMI Palangka

Raya. Borneo Journal of Medical Laboratory Technology, 4(1), 242–248.
2. Rosyidah, R. A., Mustapa, A. N., & Sumoko, E. (2020). Perbedaan Kadar Hemoglobin Pada Komponen Darah Donor Packed Red. Retrieved from Jurnal Ilmu Kesehatan Bhakti Setya Medika, 5, 34-41.
3. Fitri, J., Linda, W.A., Rotty, & Agnes L. Panda. (2015), "Gambaran Kadar Hematokrit Dan Hemoglobin Pada Kejadian Infark Miokard Akut (Ima) Di Rsup Prof. Dr. R. D. Kandou Manado Periode Januari - Agustus 2014", E-Clinic, 3.1 (2015), pp. 282–88, doi:10.35790/ecl.3.1.2015.6831.
4. Yuniyati, S., Fridayenti., Hartini. (2019). Pengaruh Lama Penyimpanan Terhadap Kadar Hemoglobin Kantong Darah Donor di Bank Darah Rumah Sakit Santa Maria Pekanbaru. Jurnal Sains dan Teknologi Laboratorium Medik. ISSN 2621-2208 (Media Online).
5. Sitanggang, N. M. (2018). Karya Tulis Ilmiah Pengaruh Penyimpanan Darah Terhadap Kadar Hemoglobin Pada Komponen Whole Blood Darah Donor Sebelum dan Sesudah Disimpan Selama Satu Minggu di PMI Kota Medan. Politeknik Kesehatan Kemenkes RI Medan.
6. Zuherni, V. (2019) "Gambaran Kadar Hemoglobin Darah Segar Dengan Darah Simpan 14 Hari Pada Darah Donor Di Unit Donor Darah PMI Kota Padang", (Doctoral issertation, Stikes Perintis Padang), 2019. Karya Tulis Ilmiah oleh Vella Zuherni.
7. Maharani, E. A. dan Noviar, G., (2018). Imunohematologi dan Bank Darah. Jakarta: Departemen Kesehatan RI.
8. Notoatmodjo, S., (2010). Metodologi Penelitian Kesehatan RI Jakarta : Rineka Cipta. 57 – 60.
9. Sugiyono. (2010). Metode Penelitian Pendidikan Pendekatan Kuantitatif, kualitatif, dan R&D. Bandung: Alfabeta.
10. Artha, D. and Dwipayana, I.K. (2022). Gambaran Hasil Peningkatan Kadar Hemoglobin Pada Pasien Anemia Yang Ditransfusi Dengan Packed Red Cell Dan Whole Blood Di Rsud Kabupaten Polewali Mandar. Jurnal Media Laboran. 10, 2 (Feb. 2022), 22-27.
11. Suryani, N. (2018). Perbedaan Hasil Pemeriksaan Kadar Hemoglobin Dengan Menggunakan Stik (Hb Meter) dan Hematology Analyzer. Karya Tulis Ilmiah Program Diploma III Universitas Muhamadiyah Semarang.
12. A.V Hoffbrand, J. E. Petit & P.A.H Moss, Kapita Selekta Hematologi Edisi 4. Penerbit Buku Kedokteran EGC, Jakarta 2005.
13. Saragih, P., Adhayanti, I., Lubis Z, and Hariman, H. 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, 2019 10(2): 501-5.
14. WHO. 2011. Haemoglobin Concentration for the Diagnosis of Anaemia and Assessment of Severity. World Health Organization.
15. Permenkes, (2015). Peraturan Menteri Kesehatan Nomor 91 Tahun 2015 tentang Standar Pelayanan Transfusi Darah. Standar Pelayanan Transfusi Darah.