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The description of corrected count increment on one hour and 24 hours after platelet apheresis transfusion in Sanglah General Hospital Denpasar

Anak Agung Ayu Lydia Prawita,[1*] Ni Kadek Mulyantari,[2] Sianny Herawati[2]

ABSTRACT

Introduction: Evaluating the response after platelet transfusion is vital to measure the success rate of the therapy and plan the subsequent management of patients. The evaluation can be done by calculating the corrected count increment (CCI) at 1 hour and 24 hours after transfusion. The purpose of this study was to determine the therapeutic response to apheresis platelet transfusion by measuring the CCI at 1 hour and 24 hours after transfusion.

Methods: This study was a cross-sectional descriptive study of patients who received apheresis platelet transfusions. In total, 35 samples were examined for platelet counts before and after transfusion. The CCI was measured at 1 hour and 24 hours after transfusion. Descriptive statistical analysis was performed to calculate the percentage and mean count.

Result: The mean count of transfused platelets was 2.7×10^{11} / unit. The mean platelet count before transfusion was 18.5×10^{3} / µL. The mean platelet increment at 1 hour was 25.4 10^{3} / µL and 24 hours was 22.6×10^{3} / µL. The mean CCI ± SD at 1 hour and 24 hours was 15,036.63 ± 13,709.73 and 13,625.60 ± 13,580 respectively. A total of 63% of samples reached the target CCI at the 1-hour measurement, while the remaining 37% did not. Meanwhile, 60% of the samples reached the CCI target at the 24-hour measurement, while 40% did not.

Conclusion: The response to apheresis platelet transfusion by measuring the CCI reached the target in 63% of patients at 1 hour after transfusion and 60% of patients at 24 hours after transfusion.

Keywords: apheresis platelet, corrected count increment

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[1]Resident of Clinical Pathology, Faculty of Medicine, Udayana University, Sanglah General Hospital
[2]Department of Clinical Pathology, Faculty of Medicine, Udayana University, Sanglah General Hospital

INTRODUCTION

Platelet transfusion is an effective and often supportive treatment to save the lives of patients with thrombocytopenia. Apheresis platelet is a platelet component obtained from the donation of apheresis, also called Single Donor Platelet (SDP).[1] At present, apheresis platelet transfusion is often done in several hospitals in Indonesia. In Bali, Sanglah General Hospital has been providing apheresis platelet transfusion since 2013.[2]

Evaluating the response to platelet transfusion is crucial to determine the success rate of therapy and plan the subsequent patient management. The response to apheresis platelet transfusion can be evaluated by calculating the correction count increment (CCI) after the transfusion. The CCI is a measure of response to platelet transfusion that "correct" the count increment for blood volume and number of platelets transfused. This study aimed to evaluate the therapeutic response to apheresis platelet transfusion by measuring the CCI at one hour and 24 hours after the transfusion.

METHOD

This study was a cross-sectional descriptive study of patients who received apheresis platelet transfusion from February to July 2018 at Sanglah General Hospital, Denpasar. A total of 35 samples were collected consecutively. The inclusion criteria were individuals aged ≥ 18 years, platelet counts on the transfused product (yield) > 2×10^{11} / mL,[3] and during the observation, the individual did not experience a fever (body temperature should be < 37.5°C). The exclusion criteria included individuals who refused to take part in the study, individuals who were dying, individuals experiencing grade 2 – 4 transfusion reactions or other circumstances that may cause failure of the apheresis platelet products to be completely transfused, and individuals who were forcibly discharged.

Apheresis platelets were obtained from the apheresis Fresenius Kabi COM.TEC machine. An examination of hematological parameters was performed using the Abbott CELL DYN Ruby device for both patients' blood samples and the apheresis platelet product samples. The patients' blood samples were examined before transfusion and at 1 hour and 24 hours after transfusion to calculate the increase in platelet count. The difference in platelet count before and after the transfusion is referred to as platelet increment.

The CCI measurement at 1 hour and 24 hours are calculated using the formula: [4]

*Correspondence to:
Anak Agung Ayu Lydia Prawita;
Resident of Clinical Pathology,
Faculty of Medicine, Udayana University, Sanglah General Hospital
gunglydia18@gmail.com

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$$CCI = \frac{\text{Body Surface Area } (m^2) \times \text{Platelet Count Increment} \times 10^{11}}{\text{Number of Platelets Transfused}}$$

Body Surface Area was calculated using the Mosteller formula.[2]

$$\text{Surface Area } (m^2) = \sqrt{\text{height (cm)} \times \text{weight (kg)}/3600}$$

The number of transfused platelets (yield) was calculated by multiplying the product platelet count by the mean product volume of 300 mL in 10^{11} platelets. The transfusion of apheresis platelet reached the target if the CCI result at 1 hour was more than 7,500 and at 24 hours was more than 4,500.[4] The SPSS version 2.0 software was used to analyze the data descriptively.

RESULT

Thirty-five patients met the inclusion criteria. As shown in Table 1, the highest number of patients were in the age group of 18 – 44, with a total of 15 people (42.9%). Based on their sex, 60% of patients were women (21 people), and the remaining 40% (14 people) were men. This study included 17 patients with blood type B (49%), 12 patients with blood type O (34%), 4 patients with blood type A (11%) and 2 patients with blood type AB (6%). The majority of patients were diagnosed with aplastic anemia (25%), which was followed by acute myeloid leukemia (23%). All patients have had previous transfusions.

Table 1 Characteristics of patients by age, gender, blood type, and diagnosis

Variable	Patient Distribution	Number	
		n	(%)
Age	18 – 44 years	15	42.9
	45 – 59 years	14	40.0
	60 – 74 years	4	11.4
	> 75 years	2	5.7
Sex	Men	14	40.0
	Women	21	60.0
Blood Group	A	4	11.4
	B	17	48.6
	AB	2	5.7
	O	12	34.3
Diagnosis	Acute myeloid leukemia	8	22.9
	Acute lymphoid leukemia	1	2.9
	Aplastic anemia	9	25.7
	Non-hodgkin lymphoma	1	2.9
	Myelodysplastic syndrome	6	17.1
	Idiopathic thrombocytopenic purpura	4	11.4
	Observation of thrombocytopenia	5	14.3
	Ovarian cyst	1	2.9

The mean age of patients was 46 years old, the mean body weight was 58 kg, and the mean height was 161 cm. The mean body surface area (BSA) of patients was 1.60 m^2. All apheresis platelet products have a number of platelets transfused (yield) > 2×10^{11}, with 6 samples (17.14%) > 3×10^{11} and 29 samples (82.86%) < 3×10^{11}. The mean number of platelet transfused was 2.7×10^{11} / unit.

The mean platelet count in patients before transfusion was 18.5×10^3 / µL, with the lowest platelet count being 0.00×10^3 / µL and the highest being 91.5×10^3 / µL. The mean platelet count at 1 hour after transfusion was 43.8×10^3 / µL and at 24 hours after transfusion was 41.1×10^3 / µL. The mean platelet increment at 1 hour was 25.4 10^3 / µL and at 24 hours was 22.6×10^3 / µL. The results of the analysis for the mean and standard deviation can be seen in Table 2.

As shown in Table 3, 22 patients (63%) reached the CCI target at 1-hour, while the remaining 13 patients (37%) did not. The result of the CCI measurement at 24 hours showed that 60% of the samples reached the target. There was one patient who showed CCI results achieved at 1 hour, which was not achieved at 24 hours after apheresis platelet transfusion. The patient was a 48-year-old woman with a diagnosis of acute myeloid leukemia. There were also two patients who did not reach the CCI target at 1 hour but reached the CCI target at 24 hours after transfusion. These two patients were aged 87 years and 46 years with a diagnosis of observation of thrombocytopenia.

The results of the CCI measurement based on patient characteristics (Table 4) showed that the majority of samples that reached the 1-hour CCI target was aged 18 to 59 years, with a total of 18 samples (82%). In the age range of 18-44 years and 45-59 years, 9 samples (43%) and 7 samples (33%) respectively reached the CCI target at 24 hours. The percentage of female patients reaching the CCI target at 1 hour and 24 hours was higher than men (55% and 52% respectively). Patients with blood type B had the highest percentage of CCI reaching the target at both 1 hour (45%) and 24 hours (43%). The majority of patients that reached the CCI target at both 1 hour and 24 hours after apheresis platelet transfusion were patients diagnosed with aplastic anemia (32% and 33% respectively).

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Table 2 Mean and standard deviation

Parameter	Mean	Standard deviation	Unit
Age	45.57	16.64	years
Body weight	57.50	9.13	Kg
Height	160.94	6.67	Cm
Body surface area	1.60	0.15	m^2
Platelet count before transfusion	18.50	20.99	$\times 10^3/\mu L$
Platelet count 1 hour after transfusion	43.81	29.90	$\times 10^3/\mu L$
Platelet count 24 hours after transfusion	41.10	35.16	$\times 10^3/\mu L$
Platelet increment 1 hour	25.35	22.20	$\times 10^3/\mu L$
Platelet increment 24 hours	22.63	23.83	$\times 10^3/\mu L$
Number of platelets transfused	2.70	0.30	$\times 10^{11}$
CCI 1 hour	15,036.63	13,709.73	
CCI 24 hours	13,265.60	13,580.29	

Table 3 CCI measurement results

		Number	
CCI	Result	n	(%)
1 hour after transfusion	Reached	22	63
	Not reached	13	37
	Total	35	100
24 hour after transfusion	Reached	21	60
	Not reached	14	40
	Total	35	100

Table 4 Characteristics of patients on the achievement of the CCI assessment calculated at 1 hour and 24 hours

		CCI 1 hour				CCI 24 hour			
		Reached		Not Reached		Reached		Not Reached	
Characteristics	Distribution	n	%	n	%	n	%	n	%
Age	18 – 44 years	9	41	6	46	9	43	6	43
	45 – 59 years	9	41	5	38	7	33	7	50
	60 – 74 years	3	14	1	8	3	14	1	7
	75- 90 years	1	4	1	8	2	10	0	0
	Total	**22**	**100**	**13**	**100**	**21**	**100**	**14**	**100**
Sex	Men	10	45	4	31	10	48	4	29
	Women	12	55	9	69	11	52	10	71
	Total	**22**	**100**	**13**	**100**	**21**	**100**	**14**	**100**
Blood Group	A	2	9	2	15	2	10	2	14
	B	10	45	7	54	9	43	8	57
	AB	2	9	0	0	1	4	1	7
	O	8	37	4	31	9	43	3	22
	Total	**22**	**100**	**13**	**100**	**21**	**100**	**14**	**100**

Table 4 ***Continue***

Characteristics	Distribution	CCI 1 hour				CCI 24 hour			
		Reached		Not Reached		Reached		Not Reached	
		n	%	n	%	n	%	n	%
Diagnosis	Acute myeloid leukemia	5	24	3	23.5	4	19	4	29
	Acute lymphoid leukemia	1	4	0	0	1	5	0	0
	Aplastic anemia	7	32	2	15	7	33	2	14
	Non-hodgkin lymphoma	1	4	0	0	1	5	0	0
	Myelodysplastic syndrome	4	18	2	15	4	19	2	14
	Idiopathic trombocytopenic purpura	1	4	3	23.5	1	5	3	22
	Observation of thrombocytopenia	3	14	2	15	3	14	2	14
	Ovarium cyst	0	0	1	8	0	0	1	7
	Total	**22**	**100**	**13**	**100**	**21**	**100**	**14**	**100**

DISCUSSION

This study aimed to find out the response to apheresis platelet transfusion at Sanglah General Hospital Denpasar. The CCI measurement is one of the standard measurements to measure the response to platelet transfusion therapy.[4] The findings of this study showed that the majority of patients that reached the CCI target were in the age ranges of 18-44 and 45-59 years. A study conducted by Slichter et al. in 2005 reported that age was associated with an increase in platelet increment, especially in the 1-hour CCI.[5]

In this study, more women (55%) than men (45%) reached the 1-hour CCI target. Likewise, the percentage of women (52%) reaching the CCI target at 24 hours was also higher than men (48%). The reason for this may be because most of the research samples were women. This finding is in agreement with the findings of a study by Holbro et al. in 2013, which reported that male patients had a lower CCI response than women.[6] Similarly, a study conducted by Jaime-Perez et al. in 2018 also reported that men had a lower response than women.[7]

Providing apheresis platelet that is ABO-compatible has been found to result in a better response.[4] All patients (100%) in this study were given ABO-compatible apheresis platelet transfusion. Platelet transfusion is performed to prevent or treat bleeding in patients who experience abnormalities in platelet counts or functions. Indications for TC transfusion are divided into two, namely for prophylactic and therapeutic purposes. In most patients, the platelet count used by the standard limit for TC transfusion prophylaxis is ≤ 10,000 / µL. However, patients with active bleeding or with platelet dysfunction (platelet counts < 50,000 / µL) and those with brain injury or major surgery platelet transfusion can be considered at platelet counts < 100,000 / µL.[8,9] In this study, the mean platelet count before transfusion was 18.5×10^3 / µL, with a range of 0.00×10^3 / µL - 91.5×10^3 / µL.

Although the measurement of CCI is usually used to assess the success of apheresis platelet transfusion, the calculation may be a little difficult to perform, especially when smaller platelet doses are given. The platelet transfusion dose is generally 3×10^{11}, which is equivalent to the content of one unit of platelet apheresis or six platelet units from whole blood donors.[1] According to AABB requirements, 75% of the apheresis platelet products prepared must contain ≥ 3×10^{11} platelets per unit.[4] Europe recommends platelet content ≥ 2×10^{11} / unit. Twenty nine samples (82.86%) in this study received transfused platelet content > 2×10^{11} / unit, with a mean of 2.7×10^{11} / unit. Similarly, Geetha et al. also provided transfused platelet content with a mean of 2.7×10^{11} / unit.[10]

In this study, a total of 22 samples (63%) reached the CCI target at 1 hour after apheresis platelet transfusion, while the remaining 13 samples (37%) did not reach the target. At 24 hours after transfusion, 21 samples (60%) reached the target, while the remaining 14 (40%) did not. The results of this study are in line with the results of a study by Jaime-Perez et al. in 2018, which reported that 67% of samples reached the CCI target at 24 hours.[7] A study by Slichter et al. in 2005 also reported that 72% of samples reached the target.[5]

Likewise, the mean ± SD of CCI at 1 hour and 24 hours were 15,036.63 ± 13,709.73 and 13,265.60 ± 13,580.29 respectively. In accordance

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with this, Dijkstra-Teikstra et al. also found that the mean ± SD of CCI at 1 hour (13,600 ± 6,500) was quite different from the mean at 24 hours (6,300 ± 5,300).[11] The ability of patients to achieve the CCI target was determined by two factors, namely internal factors of the patient's condition and external factors of the platelet products transfused. Some internal factors, such as fever, sepsis, bleeding, splenomegaly, DIC, and some drugs, have been found to contribute to the failure to achieve therapeutic targets. In a study conducted by Jaime-Perez et al. in 2018, splenomegaly and fever were found to be significantly associated with CCI.[7] However, a study by Shastry and Chaudhary in 2012 found that fever, the administration of drugs such as steroids, chemotherapy, antibiotics, intravenous immunoglobulin, factors of infection, bleeding, DIC, and splenomegaly did not significantly affect the success of the therapy.[1]

A study conducted by Dijkstra-Teikstra et al. in 2013 found that the administration of immunosuppressive drugs could increase the CCI at 1 hour but not at 24 hours.[11] The results of this study showed one patient whose CCI score reached the target at 1 hour but did not reach the target at 24 hours. This patient had a history of receiving chemotherapy, so it is possible that chemotherapy is one of the reasons why this patient did not reach the CCI target at 24 hours after transfusion.

Refractory platelet is a condition in which patients fail to reach the CCI target two times. This condition is often experienced by patients who receive recurrent platelet transfusions.[4] In this study, all patients had previously received transfusions, so this may be the reason why they failed to reach the CCI target. Similarly, Slichter et al. also reported that the frequency of transfusions could decrease platelet increments.

CONCLUSION

The response to the administration of apheresis platelet transfusion at Sanglah General Hospital Denpasar can be seen from the achievement of the CCI target at 1 hour and 24 hours after transfusion. At 1 hour, 63% of samples reached the target, with a mean ± SD CCI of 15,036.63 ± 13,709.73, whereas 60% of samples reached the target at 24 hours, with a mean ± SD CCI of 13,265.60 ± 13,580.29. It appears that various factors can affect the ability of an individual to reach the CCI target, so further research is needed to explore the causal factors.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ETHICAL CONSIDERATION

This article was approved by the Ethics Committee of Udayana University.

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REFERENCES:

1. Shastry S, Chaudhary R. Clinical factor influencing corrected Increment. Transfusion and Apheresis Science. 2012;47(3):327-330.
2. Triyono T, Dan Vrielink H. Therapeutic Apheresis in Asia: An Indonesia Single Center Experience. J Clin Apher. 2015;30(3):139-40
3. Republik Indonesia. Peraturan Menteri Kesehatan Republik Indonesia Nomor 91 tahun 2015 tentang Standar Pelayanan Transfusi Darah; 2015.
4. Nester T, Aubuchon JP. Hemotherapy Decisions and Their Outcomes. Technical Manual 17th AABB. United States: American Association of Blood Bank; 2011.
5. Slichter SJ, Davis K, Enright H, Braine H, Gernsheimer T, Kuo-Jang et al. Factors affecting posttransfusion platelet increments, platelet refractoriness, and platelet transfusion interval in thrombocytopenic patients. Blood. 2005; 105(10):4106-4114.
6. Holbro A, Infanti L, Sigle J, Buser A. Platelet transfusion: basic aspects. Swiss Medical Weekly. 2013;143:w13885.
7. Jaime-Perez JC, Vasquez-Hernandez KE, Jimenez-Castillo RA et al. Platelet Survival in hematology Patients Assessed by the Corrected Count Increment and Other Formula. Am J Clin Pathol. 2018;150(3):267-272.
8. National Health and Medical Research Council (NHMRC)/ Australian Society of Blood Transfusion (ASBT). Clinical Practice Guidelines on the Use of Blood Components (red blood cells, platelets,fresh frozen plasma and cryoprecipitate). Australia; 2001.
9. Estcourt LJ, Birchall J, Allard S, Bassey SJ, Hersey P, Kerr JP et al. Guidelines for the use of platelet transfusion. Br J Haematol. 2017;176(3):365-394
10. Geetha C, Pavani M, Korti P, Jayashankar E, Deshpande AK. Factors affecting platelet yield in single donor plateletpheresis: A single institution experience. Indian Journal of Pathology and Oncology. 2017;4(1):23-26.
11. Dijkstra-Tiekstra MJ, Rondeel JMM, Slomp J, Smid WM, de Wildt-eggen J. A positive effect of immune supression on corrected count increment after platelet transfusion at 1 but not 24h. Transfus Apher Sci. 2013;49(2):189-92