

THE RELATIONSHIP OF PRE-DONATION CBC PARAMETERS ON PLATELET YIELD BY SINGLE DONOR PLATELETPHERESIS

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Abstract

Objectives: To determine the correlation of different Complete Blood Count (CBC) parameters with platelet yield by single donor (SD) plateletpheresis

Methods: A cross-sectional study was conducted at the Blood Bank of Pathology Department, Mayo Hospital, Lahore, from 3rd August 2024 to 2nd November 2024 (3-month duration), comprising 154 patients. After obtaining informed consent with IRB approval(768/RC/KEMU), Blood counts for each donor were determined using a calibrated automated analyzer (Beckman Coulter). Plateletpheresis was subsequently conducted using a continuous flow cell separator apheresis machine with closed-system kits in accordance with standard operating procedures. The platelet yield was documented following procedure completion. Statistical analysis was performed using SPSS v.26.0, where Pearson correlation coefficients were calculated and results with $p \leq 0.05$ were considered statistically significant.

Results: Platelet yield was seen strongly correlated to age, weight, hemoglobin levels and most importantly pre-donation platelet counts of donors. Blood group, Rh factor, total leukocyte count and procedure time however did not affect platelet yield significantly.

Conclusions: Donor's pre-donation platelet counts, age and weight of donor and other CBC parameters like hemoglobin had positive correlation with platelet yield. These factors can contribute to selection of donors to enhance platelet yield.

INTRODUCTION

Platelet transfusion serves as a standard clinical procedure for managing and preventing bleeding in thrombocytopenic patients. Annual usage is significant, with approximately 230,000 platelet component transfusions administered in Spain and nearly two million in the United States. Over half of all platelet transfusions are allocated to individuals diagnosed with onco-hematological diseases or those who are undergoing transplantation procedures and major surgeries.¹ This intervention is also frequently used for hospitalized patients with conditions that

involve platelet consumption or destruction. Clinical guidelines commonly advise a prophylactic transfusion threshold of $50 \times 10^9/L$ to reduce bleeding risk before invasive interventions, though the specific recommended level can vary based on the procedure's nature.²

A persistent challenge in this field is the sole reliance on human donors for blood and blood products. Consequently, securing a sufficient number of voluntary donors for platelet-specific donations remains a significant difficulty for healthcare

systems.³ In United States, 90% of platelets are obtained by single donor (SD) plateletpheresis which is method of choice because recipient is exposed to only one donor thus lowering the risk of recipient's platelet refractoriness and minimizing transmission of infectious diseases.⁴ SD plateletpheresis results in the collection of a platelet unit with an adult therapeutic dose (equivalent to 6-8 random donor platelet units).⁵

Platelet yield, which is the measure of the quality of SD plateletpheresis, determines therapeutic benefit to the patients. It is the number of platelets in the platelet-rich plasma sample as a percentage of the number of platelets in the blood from which the platelet-rich plasma was prepared. It is calculated as follows.⁴

Actual Platelet Yield = Volume of the Platelet Concentrate × Platelet Count of the Platelet Concentrate. Optimizing platelet yield is an increasingly important objective, as identifying key factors can aid in the selection of donors capable of producing higher yields in a reduced time frame, consequently improving patient outcomes. Standards set by the American Association of Blood Banks (AABB) mandate that a minimum of 3×10^{11} platelets must be present in at least 90% of tested apheresis platelet components. Research into these yield factors has identified a strong, statistically significant positive correlation between pre-donation complete blood count (CBC) parameters—particularly the pre-donation platelet count and its indices—and the final platelet yield, as demonstrated in a recent study from Bangladesh.⁶ These findings are supported by another study, which also reported a strong positive correlation and statistical significance between pre-donation platelet counts and the mean platelet yield.⁷

So, the present study aims to investigate the impact of different pre-donation CBC parameters, like platelet count, hemoglobin, and total leukocyte count of eligible donors through apheresis, and to review their association with platelet yield. In this way, this study will be a good help in the field of Blood Banking and Hematology in Pakistan to enhance platelet yield from suitable donors.

MATERIAL AND METHODS:

After obtaining approval (768/RC/KEMU) from the hospital's ethical review committee, a Cross-sectional study was performed on 154 patients at the Blood Bank of the Pathology Department, Mayo Hospital, Lahore, from 3rd August 2024 to 2nd November 2024 (3-month duration). A sample size of 154 was calculated by keeping α error as 5% and β error as 10% and expected correlation of TLC with platelet yield as 0.258.⁸ Patients were selected through non-probability consecutive sampling. Written informed consent was obtained from every participant, and the data were collected in the pre-designed Performa. Inclusion Criteria included pre-screened non-smoker male donors with an age range of 18-50 years, donors with a body weight of 60-80 kg, and donors with blood count ranges according to American Association of Blood Banks (AABB) standards.

Donors taking aspirin or any product containing aspirin for 48 hours of donation, and those meeting deferral criteria of AABB standards, were excluded from the study. Blood samples from each donor were analyzed using a calibrated automated hematology analyzer (Beckman Coulter) to obtain complete blood count (CBC) data. The plateletpheresis procedures were subsequently conducted utilizing a Fresenius Kabi COM.TEC apheresis instrument, a continuous flow cell separator. All procedures adhered to standard operating protocols, employing closed-system apheresis kits. Acid-Citrate-Dextrose (ACD) was used as the anticoagulant at a fixed ratio of 1:8, with a maintained blood flow rate of 50-60 mL/min.

Upon completion of each procedure, the final platelet yield was documented. To ensure accurate representation of the entire product, a 1-2 mL sample was aseptically drawn into an integrated satellite pouch attached to the platelet bag. This sample was then used for the precise calculation of the platelet yield via the automated analyzer.

For data management, all information was initially recorded in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and subsequently imported for statistical analysis into the SPSS Statistics software package, version 26.0. Quantitative variables, including hemoglobin, total leukocyte count (TLC), platelet count, and platelet yield, are expressed as mean \pm standard deviation (SD). A Pearson correlation analysis was employed to

evaluate the relationship between pre-donation CBC parameters—with a specific focus on platelet counts—and the resulting platelet yield from single-donor (SD) plateletpheresis. The data were further stratified based on donor age and weight. Following stratification, Pearson correlation coefficients were recalculated, with a p-value of ≤ 0.05 considered statistically significant.

The total number of participants was 154, all of whom were male (100%). This was mainly due to more willingness of males to donate, better physical conditions, and easy access. Mean weight of patients was 69.8 kg (range 52 to 90 kg).

Average age of patients was 28.5 years (range 18 to 47 years). Most patients belonged to the age group 21 to 30 years. (Table 1)

RESULTS:

Table 1: Age Distribution of Platelet Donors

Age (years)	No. of Donors (n)	Percentage (%)
18 - 20	10	6.49
21 - 30	75	48.70
31 - 40	50	32.48
41 - 47	19	12.33
Total	154	100%

Average pre-donation platelet count was $2.82 \times 10^5/\mu\text{L}$ (range 2.0 to $3.9 \times 10^5/\mu\text{L}$). 120 (77.92%) donors had more than $2.5 \times 10^5/\mu\text{L}$ pre-donation platelet count. (Table 2)

Table 2: Pre-donation Platelet Count among Donors

Platelet Count ($\times 10^5/\mu\text{L}$)	No. of Donors (n)	Percentage (%)
2.0 - 2.5	34	22.08
2.6 - 3.0	76	49.35
3.1 - 3.5	34	22.08
> 3.5	10	6.49
Total	154	100%

Hemoglobin (Hb) levels were found to be in a range of 12.0 to 17.6 g/dl (average level 15.2 g/dl), and the majority of donors, i.e., 128 (83.12%), had hemoglobin levels more than 13.5 g/dl. Total leukocyte count (TLC) ranged from 3.8 to $12.0 \times 10^3/\text{mm}^2$ with a mean value of $7.2 \times 10^3/\text{mm}^2$. The most common blood group observed was B positive in 75 (48.70%), followed by O positive in 53

(34.42%). Rh-positive 138 (86.61%) groups were much more common than Rh-negative. Mean donation procedure time was 59.8 minutes (range 40 to 96 minutes).

Platelet yield among platelet apheresis donors ranged from 1.4 to $4.4 \times 10^{11}/\text{unit}$, and the mean yield was $2.8 \times 10^{11}/\text{unit}$. (Table 3)

Table 3: Platelet Yield Distribution among Platelet Donors

Platelet Yield ($\times 10^{11}/\text{unit}$)	No. of Donors (n)	Percentage (%)
< 2	5	3.27
2.1 - 2.5	40	25.96

2.6 – 3.0	76	49.35
> 3.0	33	21.42
Total	154	100%

Pearson correlation values as well as p-values for donor & procedure-related parameters in accordance with platelet yield are given in Table 4.

Table 4: Pearson Correlation Values for Donor Factors with Platelet Yield

PARAMETER	MEAN	CORRELATION	p-VALUE
Age	28.5	0.308	0.022
Weight	69.8	-0.482	< 0.01
Hemoglobin	15.2	0.222	0.089
TLC	7.2	-0.202	0.111
Pre-donation platelet	2.82	0.258	0.044
Procedure time	59.8	0.244	0.067

DISCUSSION:

Platelets are primary mediators of hemostasis and are activated in several different inflammatory conditions. Activated platelets express different pro- or anti-inflammatory molecules; they are part of innate and acquired immunity, act as antigen-presenting cells, and, most importantly, drive the coagulation cascade. This function makes platelet transfusions extremely important in thrombocytopenic patients^{9,10}

Plateletpheresis has become an increasingly demanding practice in blood banks all over the world. In the presence of limited donors, hematologists look to increase the platelet yield, the measure of the main output. Collecting more than one apheresis platelet unit from a single donor has made the shrinkage of donors somewhat less troubling.¹¹ Plateletpheresis from a single donor mainly depends on the donor's own CBC parameters, but other factors like age and weight of the donor and processing time of platelets have been attributed to influence platelet yield in literature.¹² In our study, we also studied all these factors and their influence on platelet yield.

Arguably, the most promising factor to positively increase platelet yield by single donor plateletpheresis is the pre-donation platelet count of the donor. This is supported by every study ever conducted.

Mangwana et al in 2014 reported that with higher pre-donation platelet counts and more volumes processed, platelet yield increased rapidly with statistical significance.¹³ Building on this evidence, a 2023 study by Malodan et al. conducted in Brazil demonstrated that donors with elevated pre-donation platelet counts were able to provide high-dose (HD) and double-dose (DD) platelet units. The overall platelet yield procured from these selected donors was substantially greater than standard yields.¹⁴ These results are further corroborated by the work of Geetha et al., who also confirmed a statistically significant correlation between pre-donation platelet count and final yield, with findings that closely align with our own study outcomes.⁸

Age and weight of donors in our study had a strong correlation with platelet yield. In our study, the more the weight, the less the platelet yields. Fateen et al reported a similar correlation. She stated platelet yield as high as $790.9 \times 10^3/\mu\text{l}$ in the 50-70kg group and as low as $445.75 \times 10^3/\mu\text{l}$ in the 90-110kg group.¹⁵ However, a few authors, such as Patel et al., have noted no such correlation between the weight of the donor and single donor plateletpheresis yield.¹⁶ Fateen et al. also stated a positive correlation between age and platelet yield, while Eren et al. had opposite results with respect to age.³

Another factor that influences platelet yield is the hemoglobin levels of the patient. This positive correlation was observed in our study. Some studies have reported that donors having Hb levels of more than 16g/dl had relatively lower platelet yield, while Choudhary et al stated no correlation between platelet yield and pre-donation hemoglobin levels of donors. Both Geetha et al, and Fateen et al, also reported a linear correlation between the two said variables¹⁷⁻¹⁸

Other influencing factors, like total leukocyte count, also correlate with effective platelet yield. Although our study has not found a strong correlation between these two variables, studies by Fateen and Geetha et al considered TLC count among confounding factors and reported its influence on overall platelet yield, as did Mangwana et al. Eren et al placed Hematocrit above TLC count as a more influential factor.^{3,8,13,15}

Our study found no statistical significance between procedure time and platelet yield. Fateen, Geetha, Eren et al, all showed linear correlation. As the processing time is increased, platelet yield can be enhanced. The same is true for the volume being processed. Most studies denied the influence of the ABO blood grouping system on platelet yield¹⁹⁻²⁰

Considering our study, it is possible to effectively enhance the platelet yield by single donor plateletpheresis through multiple factors. However, we are limited by our small sample size and single-center study. Large multicenter studies are needed to address this issue and then formally make guidelines on how to increase platelet yield by single donor plateletpheresis to improve overall patient care and departmental burden.

CONCLUSION:

Platelet yield optimization is a big challenge in blood bank settings. A few factors can be indicated before donation, which can greatly affect platelet yield and, thus, by identifying such parameters, yield can be enhanced by proper donor selection. In our study, donors' pre-donation platelet counts, age, and weight of the donor, and other CBC parameters like hemoglobin, had a positive correlation with platelet yield. These factors can contribute to the selection of donors to enhance platelet yields, but vast multicenter studies are required before implementing it at greater levels.

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CONFLICTS OF INTERESTS:

Authors declared no conflicts of interests.

ETHICAL CONSIDERATIONS:

This study was approved by hospital's ethical review committee / institutional review board.

REFERENCES:

- Alcaina PS. Platelet transfusion: and update on challenges and outcomes. *J Blood Med.* 2020; 11:19.
- Newland A, Bentley R, Jakubowska A, Laibman H, Lorens J, Peck-Radosavljevic M, Taieb V, Takami A, Tateishi R, Younossi ZM. A systematic literature review on the use of platelet transfusions in patients with thrombocytopenia. *Hematology.* 2019; 24(1): 679-719.
- Eren C, Çeçen S. Analysis between Platelet Count and Blood Groups in Apheresis Platelet Donors with Demographic Features. *Med Lab Technol J.* 2019. 5(2):131-7.
- Jaime-Pérez JC, Beltrán-López AL, Alvarado-Navarro DM, Esponzo-Mares M, Ancer- Rodríguez J, Gómez-Almaguer D. Assessing the performance of a plateletpheresis unit at a tertiary-care academic medical center in Mexico: A 6-year experience. *J Clin Apher.* 2021. 36(6): 808-14.
- Yazdani MS, Ahmad S, Rathore MA, Iqbal H. Plateletpheresis: A Donors Perspective. *PAFMJ.* 2022; 72(2):493-96.
- Karim S, Hoque MM, Hoque E, Islam K, Al Mamun AB. Effect of Donor Variables on Platelet Yield Among Donor Undergoing Plateletpheresis at Transfusion Medicine Department, Dhaka Medical College Hospital (Experience of 350 Procedures. *J Dhaka Med Coll.* 2019; 28(2): 179-83.
- Kukar N, Handa A, Maharishi RN, Syal N, Arora H, Aggarwal D. Effect of Donor Parameters on the Yield of Plateletpheresis by Intermittent Flow Cell Separator. *Ann Int Med Dent Res.* 2018;4(2):2-5.

- Geetha C, Pavani M, Korti P, Jayashankar E, Deshpande AK. Factors affecting platelet yield in single donor plateletpheresis: A single institution experience. *Indian j. pathol. Oncol.* 2017;4(1):23-6.
- Maouia A, Rebetz J, Kapur R, Semple JW. The immune nature of platelets revisited. *Transfusion medicine reviews.* 2020 Oct 1;34(4):209-20.
- Yong J, Toh CH. Rethinking coagulation: from enzymatic cascade and cell-based reactions to a convergent model involving innate immune activation. *Blood.* 2023 Dec 21;142(25):2133-45.
- Delabie W, De Bleser D, Vandewalle V, Vandekerckhove P, Compennolle V, Feys HB. Single step method for high yield human platelet lysate production. *Transfusion.* 2023 Feb;63(2):373-83.
- Liu S, Yang G, Zeng G, Zhou X, Chen R, Chen B, Chen J, Wen X, Zhang X, Ren H, Zu R. Factors influencing platelet isolation: a prospective multicenter study from Western China. *Platelets.* 2023 Dec 31;34(1):2194445.
- Mangwana S. Influence of donor demographics on the platelet yield during plateletpheresis-experience of 1100 procedures at a tertiary-care hospital. *Journal of pathology of Nepal.* 2014 Apr 25;4(7):525-9.
- Malodan R, Murugesan M, Nayanar SK. Predicting donor-related factors for high platelet yield donations by classification and regression tree analysis. *Hematology, Transfusion and Cell Therapy.* 2023 Jul 7;45(2):217-23.
- Fateen T, Farhan S, Shafqat F, Saqlain N, Butt S, Abid F, Ahsan M. Factors affecting platelet yield in a single donor plateletpheresis. *Pakistan Journal of Medical & Health Sciences.* 2022 Oct 15;16(09):209.
- Patel J, Nishal A, Pandya A, Patel P, Wadhvani S. Factors influencing yield of platelet aphaeresis using continuous flow cell separator. *Int J Med Sci Public Health.* 2013 Apr 1;2(3):309-12.
- Chaudhary R, Das SS, Khetan D, Sinha P. Effect of donor variables on yield in single donor plateletpheresis by continuous flow cell separator. *Transfusion and apheresis science.* 2006 Apr 1;34(2):157-61.
- Guerrero-Rivera S, Gutiérrez-Espíndola G, Talavera JO, Meillón-García LA, Pedraza-Echevarría M, Pizzuto-Chávez J. Hemoglobin and platelet count effect on platelet yields in plateletpheresis. *Archives of medical research.* 2003 Mar 1;34(2):120-3.
- Bahadur S, Puri V, Nain M, Pahuja S, Jain M. Apheresis platelets: A study of effect of donor variables on outcome of plateletpheresis. *National Journal of Laboratory Medicine.* 2015;25(32):28-5.
- Adesina OO, Yusuff SO, Ejikeme CF, Abolanle KA, Oyebanjo OT, Onifade D. Quality of Blood, Blood Products and Effect of Processing on Platelet. *RPC Journal of Medical Sciences.* RPC Publishers. 2024 1(1).