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Donor Variables as Major Determinants of Platelet Yield in Plateletpheresis

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Abstract

Objective: To identify the major donor variables that can affect the platelet yield so that improvement in donor selection criteria can be suggested.
Methodology: This is a cross-sectional study conducted at the Department of Hematology, Chughtai Institute of Pathology May 2022 to May 2023. A total of 116 male donors were recruited in the study. The procedure of plateletpheresis was performed on Cobe spectra, Fresenius Kabi, Trima Accel or Spectra Optica. Platelet yield was calculated and data was analyzed using SPSS 23.00. Relationship between continuous donor variables and platelet yield was studied by using Pearson coefficient. For categorical donor variables one way ANOVA test was used. A p-value < 0.05 was considered significant.
Results: No significant correlation was seen between platelet yield and donor´s age, weight, hemoglobin levels, blood group and Rh factor. However, a significant correlation was observed between total pre-donation platelet count of the donor and platelet yield.
Conclusion: While factors like age, weight, and blood group showed no significant correlation, pre-procedure platelet count strongly influenced platelet yield. Donors with higher platelet counts yielded more platelets, emphasizing the importance of donor selection based on platelet count.
Key Words: Plateletpheresis, Platelet yield, Blood donor

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Introduction

Platelet transfusion is often a lifesaving procedure in patients with thrombocytopenia. It is done both for therapeutic as well as prophylactic purposes to prevent clinically significant bleeding or hemorrhages. [1] There are 2 major techniques to obtain platelet concentrates for transfusion, one is by centrifuging the whole blood and pooling together platelets from random donors known as random donor platelets (RDP) and second method is through apheresis in which platelets are drawn from a single donor known as single donor platelets (SDP). [2] Plateletpheresis is a safe procedure which takes about 90 minutes in which donor's blood is passed through a blood cell separator and a platelet concentrate containing around 3 $x10^{11}$ platelets is formed. [3] These SDP raise platelet count by 30,000-60,000/µL in the recipient and have therapeutic dose equivalent to that of 4-6 RDP. [4]

Plateletpheresis is now encouraged as SDP are superior to RDP due to better platelet recovery in recipients, reduced risk of alloimmunization and transmission of infectious diseases. The quality of SDP is determined by platelet yield. [5] The total platelet yield in the component is calculated by multiplying the platelet count of the sample times the volume of the component (platelet count x component volume = actual platelet yield). [6] Multiple donor related factors along with procedural differences can influence the platelet yield. The platelet yield can be affected by donor's age, gender, weight, blood group, pre-donation hemoglobin, platelet count and hematocrit. [7]

As plateletpheresis is an expensive procedure, we aim to identify the major donor variables that can affect the platelet yield so that the blood banks recruit appropriate donors so that platelet concentrates with high platelet yield can be formed which will eventually lead to better clinical outcomes in patients. Secondly, it will also reduce production cost for platelets when compared to RDP.

Methodology

This descriptive cross-sectional study was performed at the Department of Hematology, Chughtai Institute of Pathology from May 2022 to May 2023 for a period of one year, after taking approval from Institutional Review Board (IRB), vide reference number CIP/IRB/1114. After a thorough literature search, we calculated a sample size of

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116 via the WHO calculator, keeping the margin of error at 5%, a confidence level at 95%, and prevalence of donations in our region as reference. [8] Sampling was done using a non-probability consecutive sampling technique.

Inclusion Criteria: Male patients between 18 to 50 years of age were included in the study. These donors were recruited in the study after taking their informed consent. Detailed history of donors was taken and those donors who were not eligible for donation according to AABB (Association for the Advancement of Blood & Biotherapies) donor selection criteria were deferred. History was taken to ensure a gap of eight weeks from the last whole blood donation or three days from last plateletpheresis. Negative serology for HIV, HBsAg, HCV, Syphilis and Malaria was also confirmed.

Exclusion Criteria: Female donors were excluded from the study due to various reasons such as low hemoglobin, difficulty in obtaining venous access because of lack of prominent veins and increased subcutaneous fat.

All donors undergoing plateletpheresis were educated about pros and cons of the procedure. Donor variables like gender, age, weight, body mass index (BMI), Pre-donation hemoglobin, platelet count, hematocrit, TLC and blood group was noted before the procedure. Peripheral blood counts were assessed by Sysmex XN-1000 automated hematology analyzer. Donors with platelet count less than $150x10^9$/L, total leucocyte count more than $11x10^9$/L or less than $4x10^9$/L, hemoglobin less than 12g/dL were excluded.

The procedure of plateletpheresis was performed on Cobe spectra, Fresenius Kabi, Trima Accel or Spectra Optica using either single needle or double needle kit depending upon the accessibility of the veins and donor comfort. Anticoagulant Citrate Dextrose (ACD) was used as the anticoagulant in the component bags and the lost plasma in the donors was replenished by 0.9% normal saline. The donors were strictly monitored for any adverse donation reactions and were managed accordingly. Platelet yield was then calculated by using post-donation platelet component volume and count. All the data was entered in excel sheet and manually corrected were required.

Data was analyzed by using Statistical Package for the social sciences (SPSS) version 23.00. Mean±SD was calculated for continuous variable. Frequency and percentage were calculated for categorical variables. Relationship between continuous donor variables and platelet yield was studied by using Pearson coefficient. For relationship between categorical donor variables such as blood group and Rh factor with platelet yield, one way ANOVA test was used. A p-value < 0.05 was considered significant.

Results

The total of one hundred and sixteen donors were included in the study. All of the donors were males. Mean age of the donors was 28.97 years ranging from 19.00 to 49.00 Years. Mean weight of the donors was 75.16 kgs ranging from 56.00 to 138.00 Kgs.

Hematological parameters noted for the donors included total hemoglobin count, pre-procedure platelet count, unit platelet count, and total volume of the component. Out of 116 donors, 10 (8.6%) donors had an Hb of less than 14 gm/dl, 80 (68.9%) had an Hb between 14-15 gm/dl, and 26 (22.4%) had an Hb between 16-17 gm/dl. Total platelet count was measured before performing the procedure. Out of total studied donors, 3 (2.5%) donors had a platelet count of less than 200,000. 68 (58.6%) had a platelet count between 200-300,000 while 45 (38.7%) had a platelet count of more than 300,000. Unit platelet count and total volume were noted only to find out the final yield of platelets. Maximum platelet yield was observed to be 4.8 while minimum yield was observed to be 3.0. The average values of these parameters are described in Table I.

Table I: Hematological indices of included patients .(n=116)

Parameter	Mean values (range)
Total hemoglobin count (Normal range: 15-18 gm/dl)	15.25 (13.0-17.4)
Pre-procedure platelet count (Normal range: 150-400,000)	283.63 (192-432)
Unit platelet count	1388.28 (1060-1800)
Total Volume	297.59 (220-380)

Donor's blood group and Rh factor were also noted. Frequencies of these parameters is described in Table II.

No significant correlation was seen between platelet yield and donor´s age, weight, hemoglobin levels, blood group and Rh factor (p-values were >0.05). However, a significant correlation with a *p*-value of 0.011 was

observed between total platelet count of the donors measured before donation procedure and their platelet yield. Table-III shows correlation of platelet yield with donor´s age, weight, hemoglobin level, platelet count, blood group and Rh factor.

Table II: Blood group and Rh factor (n=116)			
Blood group	A	34 (29.3%)	Total:116
	B	36 (31.0%)	
	AB	6 (5.1%)	
	O	40 (34.4%)	
Rh factor	Positive	111 (95.6%)	Total: 116
	Negative	05 (4.3%)	

Table-III: Correlation of platelet yield with patient factors (n=116).	
Donor factors	*p*-value
Age	0.939
Weight	0.427
Hemoglobin level	0.820
Total platelet count (pre-procedure)	0.011
Blood group	0.082
Rh factor	0.861

Discussion

Platelet transfusion has emerged as a vital intervention in managing patients with thrombocytopenia to prevent or treat bleeding complications. Our study focused on the process of plateletpheresis and on establishing a comprehensive analysis of donor-related variables influencing platelet yield, thereby optimizing the process to enhance clinical outcomes.

The mean hemoglobin count in our study (15.25 gm/dl) was within the normal range for adult males (typically 13.5 to 17.5 gm/dl). This finding is consistent with previous studies assessing the hemoglobin levels in blood donors. The mean pre-procedure platelet count (283.63 × 10^3/μL) in our study aligned with the typical range observed in healthy adult males. Studies have shown variations in platelet counts among different demographic groups, but the overall range tends to remain within certain parameters. [9] The distribution of blood groups in our study (with O being the most common) corresponds to global trends, where blood group O is often the most prevalent. Various studies have reported similar distributions in blood donor populations worldwide. The predominance of Rh-positive individuals in our study aligns with the general population distribution, where Rh positivity is far more common than Rh negativity. This finding is in line with numerous studies documenting the prevalence of Rh factors in diverse populations. [10]

Our study found no significant correlation between platelet yield and several donor factors, including age, weight, hemoglobin levels, blood group, and Rh factor. However, a notable exception was observed in the correlation between pre-procedure platelet count and platelet yield, which exhibited statistical significance (p-value = 0.011). The findings of our study were very closely related to that conducted by Srivastava, Anubha et al. which revealed a positive correlation between pre-donation platelet count and yield. This suggests that individuals with higher platelet counts tend to donate more platelets. This finding is significant as it provides insight into factors influencing platelet donation efficiency. Interestingly, they did not find significant correlations between platelet yield and other factors such as hemoglobin (Hb) concentration, age, sex, and weight. This suggests that these variables may not strongly influence platelet donation outcomes. [11]

This finding underscores the pivotal role of donor platelet count as a predictor of plateletpheresis efficacy. Donors with higher pre-procedure platelet counts are likely to yield greater quantities of platelets during the plateletpheresis process, thereby enhancing the overall efficiency of platelet procurement. [12]

Conclusion

In conclusion, platelet transfusion is vital for managing thrombocytopenia and preventing bleeding in patients. Our study focused on optimizing plateletpheresis by analyzing donor factors affecting platelet yield. While factors like age, weight, and blood group showed no significant correlation, pre-procedure platelet count strongly influenced platelet yield. Donors with higher platelet counts yielded more platelets, emphasizing the importance of donor selection based on platelet count. These findings contribute to improving platelet transfusion efficiency, enhancing patient care, and reducing production costs compared to random donor platelets.

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