

Original Research Article

Evaluation of hematological parameters and platelet yield in voluntary blood donors by plateletpheresis: a one-year study at the blood centre in a teaching hospital

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ABSTRACT

Background: The present study was planned to compare of pre and post donation hematological parameters in healthy donors by plateletpheresis. Also to assess the platelet yield following plateletpheresis procedure with its correlation to pre donation platelet count.

Methods: This is a retrospective cross-sectional study carried out in the Blood Centre of a tertiary care hospital in Haryana, India between January to December 2022. Plateletpheresis was done on Trima Accel Automated Collection System with ACD-A as an anticoagulant. The data was collected from the hospital for hematological parameters (Hb, hematocrit, Total WBC count, total platelet count) pre and post donation. Categorical data is presented as frequency, percentage, mean±SD range. Correlation was established between the pre donation platelet count and the platelet yield.

Results: A total of 125 donors were included in the study with majority of the donors 69 (55.2%) in the age group 21-30 years. Mean age of the donors included in the study was 31.58±7.5 years. The levels of hemoglobin dropped from 14.16±0.95 to 13.92±1.002 gm/dl, hematocrit dropped from 41.19±1.33 to 40.91±2.89%, total WBC count reduced from 7.64±1.38 to 7.61±1.36 10³/μl and platelet count dropped from 279.5±62.96 to 259.9±58.38 lac/μl. There was a significant drop in the levels of platelet post donation by 7.01% compared to pre donation levels. majority of the donors (44%) had a mean platelet yield 2.49±0.33 with a platelet count between 1.5-2.5x10¹¹/l. The maximum platelet yield was 4.93±0.34 in 6% donors with pre-donation platelet count of >4.5 5x10¹¹/l. A linear significant relationship was established between the platelet count and the platelet yield (r=0.99).

Conclusions: There were significant changes in the pre donation and post donation hematological parameters among the donors. It was concluded that donors with a high pre-donation platelet count can be considered for better platelet yield.

Keywords: Apheresis, Hematological Parameters, Platelet yield

INTRODUCTION

The development of transfusion medicine in the field of component therapy by advanced cell separators (apheresis) yield high platelet products which has proved beneficial for patients with severe thrombocytopenia.

Apheresis machine is programmed to obtain the required component therapy and the rest of the components are returned back to the donor. Single donor platelets (SDP) derived from the plateletpheresis procedure is equivalent to 6-8 random donor platelet concentrates derived from whole blood.¹ A single donor platelet concentrate was

expected to raise platelet count by 30,000-60,000/ μ l, while random donor platelets increased the platelet count by 5,000-10,000/ μ l in an average-sized adult.²⁻⁴ Platelet concentrates obtained by apheresis are associated with less risk of infection and HLA alloimmunization. Moreover, SDP is better than RDP (random donor platelets) in leukoreduction, decreasing the risk of platelet transfusion reactions, reducing exposures to multiple donors and transfusion frequency, and treating alloimmunization.^{2,3}

Donor can donate platelets at a minimum interval of 48 hours, not more than twice a week and not more than 24 times a year.² This study is planned to compare the pre-donation and post-donation donor factors that could be a good predictive value to obtain a product with good platelet apheresis yield.

METHODS

The present study was a retrospective cross-sectional study carried out in the Blood Centre, Department of Pathology of a tertiary care hospital in Haryana, India between January 2022 and December 2022.

Inclusion criteria

All the blood donors screened according to the standard donor screening criteria were included.

Exclusion criteria

Plateletpheresis procedures which could not be completed due to adverse donor reactions and errors produced by the machinery during the procedure were excluded.

Plateletpheresis was done on Trima accel automated collection system. ACD-A was used as an anticoagulant. Details of plateletpheresis were explained to each donor before the procedure. Plateletpheresis is performed after donor was considered eligible for the procedure as per the national guidelines and departmental standard operating procedure. Informed consent was taken from donor. The data collected from the records included demographic information like the age, weight, blood group; hematological parameters (Hb, hematocrit, Total WBC count, total platelet count) pre and post donation.

The other parameters automatically calculated by the machine that were taken in the study are total amount of blood processed, amount of ACD used, volume of SDP collected and platelet yield. Data from clinical records will be analyzed using SPSS version 27 (IBM Corp., Armonk, NY, USA).

Categorical data was presented as frequency, percentage, mean \pm SD range. Pre and post donation hematological parameters were correlated to find out the significance (p<0.05). The platelet yield was calculated using the following formula. Platelet yield=Product volume (ml) \times product count (platelets/ μ l) \times conversion factor (1000 μ l).⁵ Correlation will be established between the pre donation platelet count and the platelet yield.

RESULTS

A total of 125 donors were included in the study with majority of the donors 69(55.2%) in the age group 21-30 years, 36 (28.8%) in 31-40 years and 20 (16.0%) in 41-50 years age.

Table 1: Donor factors and their mean \pm SD, range and p value (pre & post donation).

Parameters	Pre-donation		Post-donation		P value	Decrease (%)
	Mean \pm SD	Range	Mean \pm SD	Range		
Haemoglobin (gm/dl)	14.16 \pm 0.95	12.3-17.1	13.92 \pm 1.002	11.2-15.6	0.04	1.69
Haematocrit (%)	41.19 \pm 1.33	35-49.6	40.91 \pm 2.89	36.2-46.9	0.01	0.68
TLC (10 ³ / μ l)	7.64 \pm 1.38	5.2-10	7.61 \pm 1.36	5.1-9.2	0.03	0.39
Platelet count (lac/ μ l)	279.5 \pm 62.96	216.54-342.46	259.9 \pm 58.38	201.52-318.28	0.02	7.01

Table 2: Effect of pre-donation platelet count on platelet yield (mean).

Pre-donation platelet count (10 ¹¹ /l)	N (%)	Mean platelet yield \pm SD	Coefficient correlation
1.5-2.5	55 (44)	2.49 \pm 0.33	
2.5-3.5	33 (26.4)	3.23 \pm 0.24	
3.5-4.5	31 (24.8)	3.99 \pm 0.29	
>4.5	6 (4.8)	4.93 \pm 0.34	0.99

The mean age of the donors included in the study was 31.58 \pm 7.5 years.68% of the donors were in the category of 61-80 kg weight. The distribution of the blood group according to the ABO Rh blood group system in the study was found to be 23 (18.4%) A⁺, 2 (1.6%) A⁻, 26

(20.8%) B⁺, 1 (0.8%) B⁻, 43 (34.4%) O⁺, 11 (8.8%) O⁻, 19 (15.2%) AB⁺ and 0 (0%) AB⁻.

There was a significant drop (p<0.05) (Table 1) in the pre and post donation values hemoglobin, hematocrit, total leucocyte count and platelet count (Figure 1-4).

The coefficient of correlation calculated was 0.99 which shows a statistical linear relationship between the pre-donation platelet counts and the platelet yield (Figure 5).

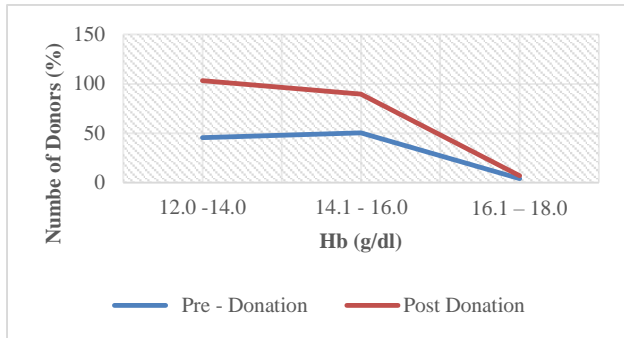


Figure 1: Pre and post donation hemoglobin levels.

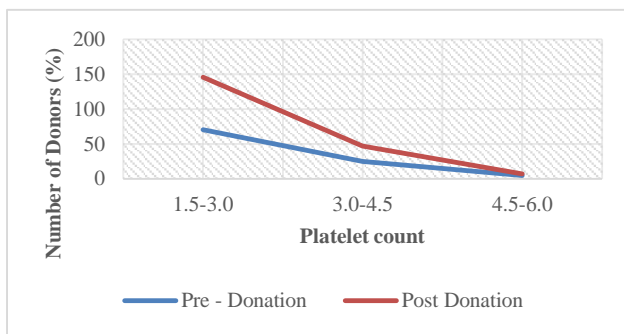


Figure 2: Pre and post donation platelet count.

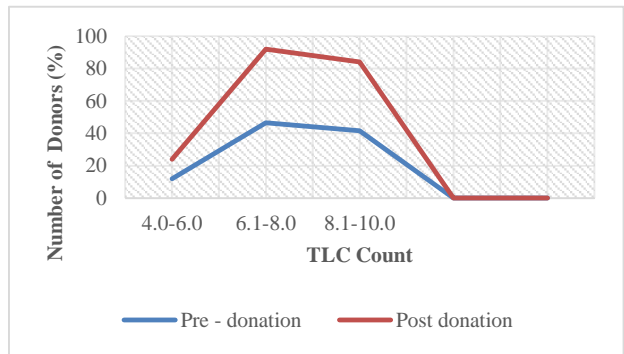


Figure 3: Pre and post donation TLC count.

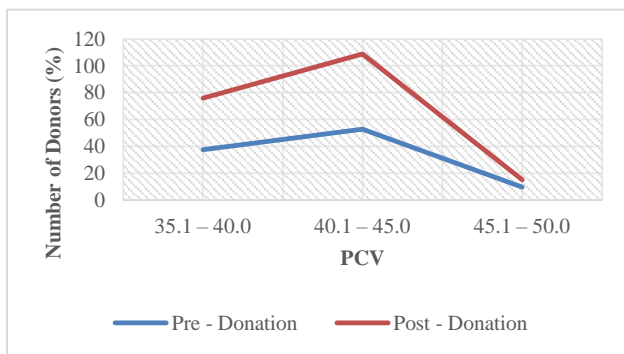


Figure 4: Pre and post donation hematocrit.

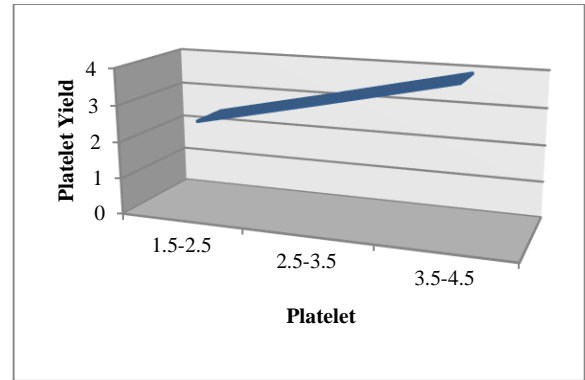


Figure 5: Correlation between the pre-donation platelet count and platelet yield.

DISCUSSION

According to the National blood transfusion council of India and DGHS standards platelet concentrates should contain minimum 3×10^{11} platelets in 75% of the units tested amongst 1% of monthly production or 4 platelet concentrates per month, whichever is higher.⁶ In present study 56% of the plateletapheresis procedure with the pre-donation platelet count $>2.5 \times 10^{11}/l$ met the standard criteria. In the study done by Chada in 2022 out of 168, 108 SDPs (64.2%) have met the Indian criteria with a yield of $\geq 3 \times 10^{11}$ per unit. In the present study, there was a significant drop in the pre and post donation values of hematological parametera in the donor like hemoglobin, hematocrit, total leucocyte count and platelet count. The levels of hemoglobin dropped from 14.16 ± 0.95 to 13.92 ± 1.002 gm/dl, hematocrit dropped from 41.19 ± 1.33 to $40.91 \pm 2.89\%$, total WBC count reduced from 7.64 ± 1.38 to $7.61 \pm 1.36 \times 10^3/\mu l$ and platelet count dropped from 279.5 ± 62.96 to 259.9 ± 58.38 lac/ μl . There was a significant drop in the levels of platelet post donation by 7.01% compared to pre donation levels.

Das et al found a significant reduction in the pre and post donation levels of hemoglobin from 12.2-17.2 to 10.5-16.3 g/dl, hematocrit 31.8-54.1 to 28.5-49.2%, total WBC count 3.8-15.1 to $2.5-14.6 \times 10^6/l$ and platelet count from 150-467 to $79-413 \times 10^9/l$.⁸ Khurshid et al concluded a significant fall in haemoglobin, platelet, haematocrit and RBC count but the changes in WBC count were not significant.⁹ In study done by Atluntas et al showed decline in haemoglobin value from 15.6 to 15.4, decline in haematocrit (%) value from 44.5% to 41.4%, platelet count reduced from pre donation $198 \times 10^9/l$ to $144 \times 10^9/l$, WBC count reduced from $6.95 \times 10^9/l$ to $6.6 \times 10^9/l$. Tendulkar et al, also showed post donation decrease in haemoglobin from 13.7-13.4 g/dl, WBC count from $6.6 \times 10^9/l-6.0 \times 10^9/l$, platelet count from $255.2 \times 10^9/l-176.8 \times 10^9/l$, haematocrit values from 41.9%-40.6%.⁹⁻¹¹ In the study by Nikhil, the reduction the pre and post donation hematological parameters WBC count, haemoglobin, haematocrit (%), RBC count was 10.59%, 10.71%, 2.21% and 3.38%.¹² The decrease in post donation platelet count in donors was around 18.01%.¹² In

a study by Bhardwaj et al mean pre donation haemoglobin, platelet count and WBC was 13.6 gm in 34% donors, $250 \times 10^9/l$ in 42% donors and $8.1 \times 10^9/l$ in 37% donors while post donation, it was reduced to 13.2 gm in 33% donors, $185 \times 10^9/l$ in 40% donors and $7.6 \times 10^9/l$ in 35% donors.¹³⁻¹⁵ Mitali et al observed that decline in the post-donation platelet count was significant with decrease of 25.21%. The range of post-donation haemoglobin was 10.5-15 g/dl as compared to pre-donation range of 12.5-16.3 g/dl with a significant decrease in Hb value of 8.15. The post-donation haematocrit with a range 33.2-47.5% of while the pre-donation Haematocrit had range of 38-51%. with significant decrease of 7.02%.¹⁵ The blood losses with fall in post donation hemoglobin and hematocrit levels could be attributed to small amount of blood volume left behind in the apheresis kit at the end of the procedure and mechanical hemolysis of the red cells as they squeeze through the blood tubings by the device pump.¹⁶ Another reason that could be thought of is hemodilution caused due to infusion of saline and citrate solutions during the apheresis procedure.¹⁷ In the present study, majority of the donors (44%) had a mean platelet yield 2.49 ± 0.33 with a platelet count between $1.5-2.5 \times 10^{11}/l$. The maximum platelet yield was 4.93 ± 0.34 in 6% donors with pre-donation platelet count of $>4.5 \times 10^{11}/l$. It was concluded that a significant linear correlation existed between the pre-donation platelet counts and platelet yield. In a study by Chaudhary et al also found a direct correlation between the pre donation platelet count and platelet yield ($r=0.50$, $p<0.001$).¹⁴ Das et al studied 61 procedures which also indicated good linear correlation between the pre donation platelet count and platelet yield ($r=0.51$, $p<0.001$).⁸ The yield was $\geq 3 \times 10^{11}/unit$ in 80% of procedure when pre-donation platelet count was $\geq 2.5 \times 10^5/\mu l$.⁸ The study by Tendulkar also shows that pre donation platelet levels had a positive correlation to the product platelet yield ($r=0.30$, $p=0.000$).¹¹ Chada et al also found a statistically significant linear correlation between the pre donation platelet count and platelet yield ($r=0.327$, $p<0.001$).⁷ Kukar et al also concluded in their study that the pre-donation platelet count has a significant linear correlation with the platelet yield ($r=0.318$, p value 0.0001). Donors having pre-donation platelet count in the higher range yielded products having higher platelet count. In the study by Kukar et al 99 (70.71%) procedures had platelet yield of $>3 \times 10^{11}/unit$.⁵ Chada in their study found out that 60% of the single donor apheresis platelets obtained a platelet yield of $>3 \times 10^{11}$ per unit when the pre-donation platelet count was $>300 \times 10^3/\mu l$.⁷ Majority of donors (75%) have a pre-donation platelet count of $201-300 \times 10^3/\mu l$.⁷ Nikhil et al found that platelet count which was more than 3,51,000 gave the highest product yield of 4.9 lac/ μl . Majority of the donors were in the value between 251-300 with average platelet count of 1413 lac/ μl and platelet yield of 4.27 lac/ μl .¹² In a study by Kukar et al majority of the donors (49%) had a pre donation platelet count values between $2.60-3.09 \times 10^3/\mu l$. The maximum platelet yield was $3.59 \pm 0.53 \times 10^5/\mu l$ in the donors with platelet count

$>3.59 \times 10^5/\mu l$.⁵ The results of the present study also show a linear significant relationship between the platelet count and the platelet yield ($r=0.99$). This is in concordance with the other studies.^{5,7-14} A high platelet yield was obtained with increased pre donation platelet count.

CONCLUSION

Comparison of pre and post donation range of hematological parameters in the plateletpheresis donors helps to follow up the donors in terms of their safety and to avoid any adverse reaction for future platelet donations and helps in maintaining donor records. There were significant changes in the pre donation and post donation hematological parameters among the donors. It was concluded that donors with a high pre-donation platelet count can be considered for better platelet yield.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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