

Factors affecting platelet yield in single donor plateletpheresis: A single institution experience

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Abstract

Transfusion of single donor platelets (SDP) is emerging as effective therapy in patients with platelet(PLT) insufficiencies with the advantage of preventing alloimmunisation and transfusion related infections by limiting recipient's exposure to platelets from multiple donors.

The aim of the present study is to analyze the effect of various donor and procedure related parameters on the yield of single donor platelets facilitating effective screening of blood donors in less time

Materials and Methods: It is a retrospective study of one hundred and nine plateletpheresis procedures performed at our (tertiary-care) hospital over a period of 16 months. The procedure was carried on Fresenius. Kabi COM.TEC apheresis machine (continuous flow cell separator) using closed system kits, single needle procedure with program selected 5d-SN. Statistical analysis was done with SPSS software to find the extent of relationship between different variables using "r" value and "p" value.

Results: Age, weight, platelet count, haemoglobin(Hb), total leucocyte count(TLC) and blood volume processed of donors, processing time of machine had significant positive correlation with platelet yield. ABO group did not show any correlation with platelet yield. Rh negative donors had longer processing time than Rh positive donors.

Conclusion: Platelet yield correlated positively with pre-donation platelet count, weight, haemoglobin, processing time and blood volume processed. Optimization of platelet yield by identifying donor factors may help in selecting donors to obtain higher platelet yields in shorter time and consequently better clinical outcome.

Keywords: Plateletpheresis; Haemoglobin; Total leucocyte count; Weight; Platelet Count; Platelet yield

Introduction

Platelet transfusion is an effective supportive therapy and is often life-saving in patients with thrombocytopenia.

Plateletpheresis is the collection of platelets using an automated blood cell separator device. In present days, there is a shift in trend towards using SDP over pooled random donor platelet (RDP).⁽¹⁾ Single donor platelets are a better platelet product due to better platelet recovery, reduced transmission of infectious diseases, transfusion reactions and allo-immunization.⁽²⁻⁴⁾ In India, due to limited resources and economic constraints, SDP has relative limited utility till date.⁽⁵⁾ Quality of SDP is determined by platelet yield which directly influences patient recovery.^(2,6)

Aim of Study

The aim of the present study was to assess the effect of various donor and machine related factors on PLT yield to help blood bank personnel in effectively selecting appropriate donor for platelet pheresis. Age, gender, volume processed, Hb, TLC and PLT precounts, blood group were included as donor-predicting variables. Machine-related parameters included processing time.

Materials and Methods

It is retrospective study of 109 apheresis procedures carried out in our blood bank during a

period of 1yr 4 months i.e from Jan 2015 to April 2016. Donor selection was done according to the guidelines laid down by Drugs and Cosmetics Act, Ministry of Health and Family Welfare, Government of India.⁽⁷⁾ Details of platelet pheresis procedure were explained to each donor before the procedure. Informed consent from all the eligible donors who were non-reactive for mandatory infectious markers was taken.

All donations were performed by Fresenius Kabi COM.TEC apheresis machine (continuous flow cell separator) using closed system kits, single needle procedure with program selected 5d-SN using ACD as an anticoagulant in the proportion of 1:8 and blood flow rate of 50-60ml. Haematological parameters of the donors were analysed using calibrated automated analyzer (BC-5300).

The end point was volume yield of 280-300 ml. Two ml. of component collected in sample pouch after proper mixing was used for assessing platelet count of the product using the same automated analyzer. The platelet yield was calculated using the below formula:

$$\text{Platelet yield} = \text{Product volume (mL)} \times \text{Product count (platelets}/\mu\text{L)} \times \text{Conversion factor (1000)}$$

Age, weight, platelet count, hemoglobin concentration, total leucocyte count and blood group were included as donor variables. Processing time and plasma volume collected were considered as machine variables. Relationship between pre-donation donor and

machine variables and yield of platelets was studied using the Pearson correlation coefficient. Statistical analysis was done using SPSS software version 17.

Results

The mean age of the donors (n=109) was 27.7 years (range 19-43 years). Age distribution of donors is shown in Table 1. Majority (67%) of donors are in the range of 21-30 yrs.

Table 1: Age distribution of platelet apheresis donors

Age (years)	No. of donors	%
18-20	06	5.6
21-30	73	67
31-40	27	24.7
41-45	03	2.7
Total	109	

All the donors are males. Female donors were rejected due to low hemoglobin, difficulty in obtaining venous access because of lack of prominent veins and increased subcutaneous fat.

Mean body weight of donors is 72.9kg (range 55-96 kg).

Mean pre-donation platelet count was 2.7 lakhs/mm³ (range 2.0-4.0 lakhs/mm³). 68 donors (62.4%) had the pre-donation platelet count of more than 2.5 x 10⁵/μL (Table 2).

Table 2: Pre-donation platelet count distribution among platelet apheresis donors

Platelet count (10 ⁵ /μL)	No. of donors	%
2.0-2.5	41	37.6
2.6-3.0	48	44
3.1-3.5	14	12.8
>3.5	6	5.5
Total	109	

The mean platelet yield was 2.7x10¹¹(range 1.3-4.6) (Table 3).

Table 3: Platelet yield distribution among platelet apheresis donors

Platelet yield (□ 10 ¹¹ /unit)	No. of donors	%
< 2	2	1.8
2.1-2.5	25	22.9
2.6-3.0	61	55.9
>3.0	21	19.2
Total	109	

Mean Hemoglobin (Hb) level was 15.5 g/dl (range 12.6-19.8g/dl). 100 donors had Hb more than 14 g/dL (91.7%).

Mean total leucocyte count (TLC) was 7670 / mm² (range 4200-13000).

Mean duration of procedure was 65.5 minutes (min). (range 45 min- 100min)

Majority (103) of donors are of Rh positive groups. Most common blood group among donors was O Positive (52) followed by B Positive (35). Mean processing time in Rh positive donors is 65min and 70 min in Rh negative donors.

A positive correlation was observed between the yield of platelets and the following donor variables: Age (r = 0.3861), weight (r = 0.4898), hemoglobin (r = 0.4823), total leucocyte count (r = 0.2587), platelet count (r = 0.4253), processing time (r = 0.2999) and volume of blood processed (r = 0.3272). P value for all these variables was significant at p<0.05.

Pearson correlation values for donor & procedure related factors with platelet yield in different studies in comparison with our study is given in Table 4.

Table 4: Pearson values for correlation of donor & procedure related factors with yield of SDP in different studies

Parameter	Chaudhry et al	Das et al	Enein et al	Patel et al	Mangwana	Present study
Pre-donation PLT. count	0.506 (<0.001)	0.51 (<0.001)	0.512	0.302 (<0.0001)	0.577 (<0.001)	0.4253 (<0.001)
Pre-donation Hb	-0.1 (>0.005)	-0.05 (>0.005)	-0.306	-0.001	0.022 (>0.05)	0.4823 (<0.05)
Pre-donation TLC	-	-	-	-	0.095 (<0.05)	0.2587 (<0.05)
Donor age	-	-	-	-	-	0.3861 (<0.05)
Donor weight		0.18 (>0.05)		0.023 (>0.05)	0.092 (<0.05)	0.4898 (<0.05)
Processing time				-0.07 (>0.05)	-0.516 (<0.001)	0.2999 (<0.05)
Volume processed			0.404 (<0.05)	0.158 (<0.05)	-0.648 (<0.001)	0.3272 (<0.05)

Discussion

Many developing countries have adopted plateletpheresis as a routine procedure in their blood banks. Platelet yield which is a measure of quality of SDP, affects platelet recovery in the patients requiring platelet transfusion.

The present study addressed the influence of donor hematological and demographic parameters on the platelet yield.

On evaluation of donor related hematological parameters, we found that pre-donation platelet count has significant linear correlation with the platelet yield ($r = 0.4253$, $p < 0.001$). Higher platelet yield is obtained in patients with high platelet count because more platelets are available for collection. Out of the 109 donors, 41 (37.6%) had a pre-donation platelet count $< 2.5 \times 10^3/\mu\text{l}$. Forty eight (44%) had a pre-donation count in the range of $2.6-3.0 \times 10^3/\mu\text{l}$. Twenty (18.4%) donors had pre-donation counts $> 3.00 \times 10^3/\mu\text{l}$. Mean platelet yield in donors with pre-donation counts $\geq 300 \times 10^3/\mu\text{l}$ is $2.9 \times 10^{11}/\text{unit}$ and is $2.7 \times 10^{11}/\text{unit}$ in donors with platelet counts ranging from $2-2.9 \times 10^3/\mu\text{l}$.

Chaudhary *et al.*⁽⁹⁾ studied 94 plateletpheresis procedures and found a mean yield of $2.8 \pm 0.73 \times 10^{11}/\text{unit}$. In their study, when the predonation platelet count was greater than $300 \times 10^3/\mu\text{l}$, the yield was greater than 3×10^{11} platelets/unit in 80% of the products. They also reported that the mean yield was $2.5 \pm 0.59 \times 10^{11}/\text{unit}$ when the pre-donation platelet count was $< 200 \times 10^3/\mu\text{l}$. Our results were in accordance with these observations and the platelet yield correlated linearly with the pre-donation platelet count of the donor.

Goodnough *et al.*⁽²⁾ studied 708 plateletpheresis procedures and found a direct correlation between platelet yield and pre-donation platelet count. In 12% of the procedures, the mean yield was $< 3 \times 10^{11}/\text{unit}$ when the pre-donation platelet count was $< 200 \times 10^3/\mu\text{l}$.

Many other studies demonstrated similar significant positive correlation between the donor platelet count and the platelet yield in the product.⁽¹⁰⁻¹²⁾ According to the AABB requirements,⁽¹³⁾ 75% of the plateletpheresis products prepared must contain $\geq 3 \times 10^{11}$ platelets per unit, while the European guidelines⁽¹⁴⁾ (Council of Europe publishing, 2006) recommend platelet count of $\geq 2 \times 10^{11}/\text{unit}$. 107(98%) numbers of procedures in our study have platelet yield of $> 2 \times 10^{11}/\text{unit}$.

Pre-donation haemoglobin concentration is another donor factor that can affect the yield. No correlation of pre-donation hemoglobin concentration of the donor with platelet yield was observed by Mangwana S,⁽¹¹⁾ ($r=0.022$, $p>0.05$), Patel J *et al.*⁽⁵⁾ ($r = -0.001$, $P > 0.005$), Das SS *et al.*⁽⁸⁾ and Chaudhary R *et al.*⁽⁹⁾ ($r = -0.05$ & $r = -0.1$ respectively, $P>0.005$).

Negative correlation with donor pre-apheresis haemoglobin levels and yield was observed by

Guerrero-Rivera *et al.*⁽⁶⁾ and Enein AA *et al.*⁽¹⁰⁾ ($r = -0.306$). In contrast, our study showed a positive correlation ($r=0.482$, $p<0.05$) between platelet yield and pre-donation hemoglobin concentration. No such observation was made by any other study to the best of our knowledge. In our study group, patients with more hemoglobin were found to have higher platelet count and hence higher yield. Pre-donation hemoglobin concentration also showed positive correlation with processing time, blood volume processed and there by the platelet yield.

Total leucocyte count of donor showed positive correlation with platelet yield ($r=0.2587$; $p<0.05$) similar to Mangawana S,⁽¹¹⁾ ($r=0.095$; $p<0.05$).

Our study showed a positive correlation with age ($r=0.386$, $p>0.05$). In contrast, negative correlation was observed by Arun *et al.*⁽¹²⁾ In our study, coincidentally patients with more age were found to have more weight, hence more blood volume, more available platelets, better the yield.

Our study showed a strong positive correlation with weight ($r=0.4898$, $p>0.05$). Similar findings were observed by Mangwana S *et al.*⁽¹¹⁾ and Arun *et al.*⁽¹²⁾ Patel J *et al.*⁽⁵⁾ and Chaudhary R *et al.*⁽⁹⁾ did not show correlation between donor's weight & yield ($r = 0.023$, $p> 0.005$; $r = 0.18$ respectively). Greater the body weight, greater is the blood volume available for processing, higher is the yield.

Platelet yield can be increased by increasing the processing time, the ACD infusion rate, or the volume of plasma obtained. The present study also showed a correlation between donor's total volume processed & yield ($r=-0.327$, $p<0.001$) similar to findings of Enein AA *et al.*⁽¹⁰⁾ Patel J *et al.*⁽⁵⁾ Mangawanas⁽⁹⁾ ($r = 0.404$; $r = 0.158$, $r=0.648$ $p < 0.05$ respectively).

Conclusion

Optimization of platelet yield is an emerging issue in blood transfusion services. Identification of such factors may help in selecting donors to obtain higher platelet yields in shorter time and consequently better clinical outcome.

Multiple donor and machine related parameters affect platelet yield in SDP. The end product yield is often the interplay of various factors affecting the yield.

In our study, weight of the donor showed strongest positive correlation with yield.

Pre-donation platelet count showed a direct positive correlation with the yield of SDP and blood volume processed.

Platelet yield also correlated positively with age, pre donation Hb, pre donation TLC.

Rh negative donors showed significant correlation with processing time.

Processing time is the machine related variable correlating with yield.

Healthy adults with more body weight, predonation platelet count, pre donation Hb, pre donation TLC need

to be selected for better yield of SDP. The demographic and hematological characteristics of the donors need to be considered on an individual basis so as to ensure good quality of the product and also the safety of the donor.

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