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Analysis of single-donor plateletpheresis procedure parameters and its association with yield in a blood center of Eastern India

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Abstract:

BACKGROUND: Single-donor platelets are most commonly used to prevent and treat bleeding in thrombocytopenic patients. Plateletpheresis machines should take less procedure time, optimal yield, and donor comfort. This study aimed to compare different donor parameters such as predonation platelet count and hematocrit (Hct), blood volume (BV) processed, and blood group association with yield.

MATERIALS AND METHODS: A retrospective study was conducted in the transfusion medicine department and blood center for 12 months. One hundred and fifty-nine plateletpheresis procedural data on Trima Accel were collected from the register and compiled in the Excel sheet. Donor procedure variables were calculated as mean ± standard deviation. Correlation between donor parameters with yield and anticoagulant (AC) infused to the donor with run time was analyzed using Pearson correlation coefficient in Excel sheet with Microsoft Windows 7 software. The association between blood group and yield was analyzed in GraphPad 9 software, CA. $P < 0.05$, <0.001 was statistically significant.

RESULTS: Predonation platelet count ($r = 0.61$, $P < 0.001$) and BV processed ($r = 0.18$, $P < 0.05$) were positively correlated with yield. Predonation hemoglobin, Hct, and Run time was positively correlated with AC infused to the donor ($r = 0.72$, $P < 0.001$). Different blood groups had no statistical significance association with yield.

CONCLUSION: In our study, predonation platelet count directly relates to yield; hence, donors with high platelet count may be considered for better yield. Run time also had a direct relation with AC going to the donor; minimal run time also had a role in preventing adverse effects on the donor.

Keywords:

Donor comfort, plateletpheresis, run time, Trima Accel, yield

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Introduction

Platelet transfusion is a treatment modality, mostly in various hemato-oncology thrombocytopenic patients due to chemotherapy. Platelets are prepared either from whole blood (platelet-rich plasma/buffy coat method) or by plateletpheresis. Plateletpheresis is a platelet donation procedure in which platelets are collected and remaining blood components such as red cells and plasma are returned to the donor. In general, a single dose of platelet in adults refers to one single-donor platelet (SDP) unit equivalent to six random donor platelet units. Platelet transfusion is associated with various reactions such as febrile nonhemolytic transfusion reaction (FNHTR), transfusion-transmitted reaction, sepsis, and alloimmunization.

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FNHTR, alloimmunization, and sepsis transfusion reactions are due to leukocytes present in the cellular blood components. The above reactions are less common in SDP as it is processed from a single donor and leukoreduced.[1,2] SDP processing is a relatively safe procedure, but it is costly and requires qualified staff for smooth operation.[3] Trima Accel cell separator is an automated apheresis machine that collects SDP based on the principle of continuous flow centrifugation. The efficiency of SDP collection depends on predonation platelet count and hematocrit (Hct). Based on different study results, the predonation count has a direct relation with yield.[4,5] The association between predonation hemoglobin (Hb) or Hct with yield is not uniform.[6-8] A study from Turkey has reported O blood group and Rh D-positive plateletpheresis donors have more platelet count than other blood groups and Rh D negative individuals.[9] Moreover, very few studies have analyzed the association between blood groups of donors with yield. An Indian study reported no association of blood group with platelet yield.[10] This study analyzed different procedure parameters, the correlation between predonation platelet count, and Hct, run time, blood volume (BV) processed with yield, the association between blood groups with yield, changes in predonation and postdonation procedure platelet count, and Hct of plateletpheresis donors.

Materials and Methods

This retrospective study was conducted at PG Department of Transfusion Medicine and Blood center, IMS and SUM Hospital, Bhubaneswar, from March 2019 to March 2020. The institutional ethical board permission was wavered for this study due to retrospective analysis.

Plateletpheresis procedure and demographic data of 159 donors were collected from the SDP register. All the procedures were performed using Trima Accel (Terumo BCT, Lakewood, CO, USA).

Donor selection

Donors were selected according to the latest national guidelines of the D and C act. SDP donor criteria are age–18–60 years, weight – 50 kg or more, Hb ≥12 g/dl, and platelet count – 1.5 × 10^9/cumm. Inadequate data were excluded from the study. (D and C act).[11]

Data collection

Donor demography parameters such as age in years, weight (kg), height (cm), BV (ml), predonation and postdonation platelet count, Hct, predonation Hb, and white blood count (WBC) count (cumm) were collected from SDP register. Procedural details such as total anticoagulant (AC in ml) used during the procedure, procedural run time, and yield were collected and also recorded. Collection efficiency (CE) and collection rate (CR) were calculated from the below formula: [12]

CE = total platelet yield (10^{11}) × 100/(preapheresis platelet count + postapheresis platelet count/2) × BV processed.

BV processed = total blood volume (TBV) processed – acid-citrate-dextrose solution (ACD)-A (mL). (ACD-A is the AC used).

CR = Platelet (PLT) yield/separation time.

%BV (blood volume) = BV processed/total BV of donor.

Y/L (×10^9/L) = platelet yield (10^{11})/BV processed in liter.

Y/H (×10^{11}/min) = platelet yield (10^{11})/separation time in minute.

Statistical analysis

All data were typed in an Excel sheet (Microsoft Windows 7 software) and mean ± standard deviation (SD) was calculated. Statistical analysis was done with GraphPad Prism 9, CA. Correlation between yields with the pre-HB, preplatelet count, BV processed, run time, and AC infused to donor and run time were analyzed by Pearson correlation coefficient using Microsoft Windows 7. One-way analysis of variance analyzed a comparison between different blood groups and yield. $P < 0.05$, <0.001 was statistically significant.

Results

SDP donor characteristics such as age, weight, height, TBV, Hb, and WBC count were summarized in mean ± SD [Table 1]. Different procedural parameters such as volume processed (ml), yield (×10^{11}), platelet volume (ml), ACD used (ml), AC in the bag (ml), AC to the donor (ml), time (min), CE, Total processed blood volume, (TPBV) (ml), CR, BV (BV%), yield per liter (Y/L), and yield per hour (Y/H) were shown in Table 2. Changes in predonation and postdonation Hct, platelet count, and correlation between different parameters were displayed in Tables 3 and 4, respectively. Predonation platelet count ($r = 0.61$, $P < 0.001$) and BV processed ($r = 0.18$,

Table 1: Plateletpheresis donor characteristic (*n*=159)

Parameters	Mean±SD
Age (years)	28.90±7.40
Weight (kg)	79.74±10.51
Height (cm)	169.88±6.69
TBV (ml)	4974.32±457.30
HG (g/dl)	14.77±1.22
WBC count (10^3/cumm)	7.06±1.56

SD=Standard deviation, TBV=Total blood volume, HG=Hemoglobin, WBC=White blood cell

Table 2: Plateletpheresis procedure characteristics (*n*=159)

Parameters	Mean±SD
Volume processed (ml)	2673.24±555.30
Yield ($\times 10^{11}$)	3.75±0.89
Platelet volume (ml)	266.02±78.12
ACD used (ml)	294.45±53.69
AC in bag (ml)	36.34±15.91
AC to donor (ml)	244.17±53.74
Time (min)	58.39±12.81
Collection efficiency (%)	65.59±6.40
TPBV (ml)	2378.80±504.07
CR ($\times 10^{11}$/min)	0.067±0.002
BV (%)	48.20±1.1
Y/L ($\times 10^{9}$/L)	145.2±40.9
Y/H ($\times 10^{11}$/min)	6.7±0.2

BV=Blood volume, Y/L=Yield per liter, Y/H=Yield per hour, CR=Collection rate, SD=Standard deviation, TPBV=Total processed blood volume, AC=Anticoagulant, ACD=Acid citrate dextrose

Table 3: Changes in platelet count and hematocrit before and after the procedure (*n*=159)

Parameters	Mean±SD
Preplatelet count (/cumm)	253.02±64.28
Postplatelet count (/cumm)	191.04±57.24
Pre-HCT (%)	44.18±3.33
Post-HCT (%)	43.16±3.2

SD=Standard deviation, HCT=Hematocrit

Table 4: Correlation between various donor parameters with yield and AC infused to the donor with run time by Trima for yield (*n*=159)

Donor parameters	Trima parameter	*r*	*P*
Predonation platelet count	Yield	0.61	<0.001
Blood volume processed	Yield	0.18	0.02
Predonation hemoglobin	Yield	0.04	0.66
Predonation HCT	Yield	0.05	0.55
Run time	Yield	0.03	0.73
Run time	AC infused to donor	0.72	<0.001

HCT=Hematocrit, AC=Anticoagulant

$P < 0.05$) were positive correlated with yield. Predonation Hb, Hct, and run time were not statistically significantly correlated to yield. Run time was positively correlated with AC infused to the donor ($r = 0.72$, $P < 0.001$). Different blood groups had no statistically significant association with yield [Figure 1].

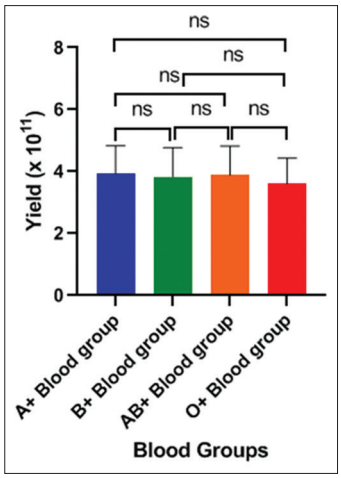

Figure 1: Association between blood groups and yield. NB: ns= Nonsignificant

Discussion

The demand for SDP is increased nowadays due to its quality, efficacy, and fewer adverse reactions such as citrate reactions, vasovagal reactions, and hematoma. In our study, three donors had hematoma due to poor flow. Platelet yield is an essential factor affecting posttransfusion platelet increment in a recipient. Modern apheresis devices available are donor and user-friendly and associated with high-yield quality products in a short period. Trima Accel is a preferred device for plateletpheresis as it is a single-needle procedure with better CE and CR.[13,14] Moreover, citrate-related adverse donor reactions are less in this device as compared to other plateletpheresis devices.[15] On analyzing the various procedural and donor factors affecting the yield, we found a positive and significant correlation between the predonation platelet count and BV processed with yield. The blood group has got no association with the yield.

Studies from different corners of the world stated predonation platelet count correlated with the yield positively. The higher the predonation count, the higher is the yield. However, the impact of predonation Hb and Hct level is controversial. Egyptian study reported platelet yield to be negatively associated with predonation Hb level.[6] On the contrary, an Indian study found donor Hct does not influence concentrated-SDP collection using Trima.[16] A significant drop in the postdonation platelet count and HCT was perceived in contrast to Kumawat *et al*. study, which saw no difference in donor Hb and HCT before and after the standard yield SDP collections procedure.[17] The drop in HCT could be explained by the blood loss in the kit and cell lysis. This evidence is relevant to securing the procedure's efficiency and safety, improving selection processes, or determining the number of donations that can be performed without affecting donors' health.[18] Hence, we must be vigilant with SDP donors with a predonation platelet count of >200 × $10^3/\mu L$[19] and low HCT. Trima has a safety feature of maximum yield alarm to prevent the postplatelet count of the donor from falling below 100 × $10^3/\mu L$.[17]

Procedure time is an essential parameter for donor retention. Prolonged procedural run time by the machine may cause distress to donors. Longer procedural time is associated with more AC infusion, leading to more

citrate-related adverse events. The mean procedure duration was similar to another study.[20]

CE and CR are the two standard parameters taken into account while selecting an automated plateletpheresis device. It reflects the platelet collection ability of the device. CE is calculated by comparing the number of platelets collected versus the number of platelets that pass through the apheresis machine. CE depends on donor characteristics and BV processed. Different instruments have different CE as reported by the various study. CE of the Trima Accel and Trima Optia is said to be higher than other available devices. The CR provides a better guide to compare apheresis types of equipment for collecting platelets as it considers the duration of the procedure. Moreover, BV processed has no relation to it.[21-23] Here, the mean CR was 0.067, similar to other studies.[3,12]

Y/L and BV% were lower but Y/H higher than the findings reported by Chellaiya *et al*.[16] More citrate is infused with increased processing of BV, resulting in a decrease in ionized calcium levels. In Trima, citrate-related adverse events are less as less BV is processed, and targeted yield is achieved within a short duration. Low Y/L reflects a less concentrated product with more volume of plasma.

In a Nigerian study, O group healthy individuals have lower platelet counts than A Group individuals. Thus, they are more prone to thrombocytopenia.[24] On the contrary, an Indian study on 51 healthy individuals found no association of blood group with platelet count. Still, the AB blood group has a low platelet count.[25] Some studies report that O group individuals have more platelet count.[9,26] Here, we did not find any statistically significant relation between different blood groups with the yield. However, the study participants included only Rh D positive donors, so the effect of Rh D status on the yield could not be evaluated. Moreover, all the study participants were male, so the impact of gender was also not analyzed. It is a single-center retrospective study examining factors affecting standard SDP collection, and double plateletpheresis or use of platelet additive solution may have different outcomes. A prospective and large sample size study will help assess the association of the blood group with the yield. The yield effect on the donor reactions also needs to be evaluated to determine the procedure's safety, which was not addressed here.

Conclusion

With limited resources and budget, it is a challenging decision for transfusion medicine consultants to choose particular apheresis equipment in new blood centers. Trima Accel, with good performance, is a preferred device. Assessing various factors affecting the yield helps in appropriate donor selection with good quality products and least donor uneasiness. Donor satisfaction warrants donor retention. Hence, a donor with a high predonation platelet count, hemoglobin irrespective of blood group can provide a good yield product in a shorter duration.

Ethical Statement

Due to its retrospective nature, ethical approval was not required for this study.

Informed consent

consent from the donors was taken before this study.

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Conflicts of interest

There are no conflicts of interest.

References

1. Burgstaler EA. Blood component collection by apheresis. J Clin Apher 2006;21:142-51.
2. Ness PM, Campbell-Lee SA. Single donor versus pooled random donor platelet concentrates. Curr Opin Hematol 2001;8:392-6.
3. Arcot PJ, Kumar K, Coshic P, Andriyas V, Mehta V. A comparative study of five plateletpheresis machines in a tertiary care center of India: AmiCORE vs. COM.TEC vs Haemonetics MCS+vs Spectra Optia vs. Trima Accel. J Clin Apher 2021;36:41-7.
4. 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. Arch Med Res 2003;34:120-3.
5. Das SS, Chaudhary RK, Shukla JS. Factors influencing yield of plateletpheresis using intermittent flow cell separator. Clin Lab Haematol 2005;27:316-9.
6. Enein AA, Hussein EA, El Shafie S, Hallouda M. Factors affecting platelet yield and their impact on the platelet increment of patients receiving single donor PLT transfusion. J Clin Apher 2007;22:5-9.
7. Chaudhary R, Das SS, Khetan D, Sinha P. Effect of donor variables on yield in single donor plateletpheresis by continuous flow cell separator. Transfus Apher Sci 2006;34:157-61.
8. Goodnough LT, Ali S, Despotis G, Dynis M, DiPersio JF. Economic impact of donor platelet count and platelet yield in apheresis products: Relevance for emerging issues in platelet transfusion therapy. Vox Sang 1999;76:43-9.
9. Eren C, Çeçen S. Analysis between platelet count and blood groups in apheresis platelet donors with demographic features. Med Lab Technol J 2019;5:131-7.
10. Geetha C, Pavani M, Korti P, Jayashankar E, Deshpande A. Factors affecting platelet yield in single donor plateletpheresis: A single institution experience. Indian J Pathol Oncol 2017;4:23-6.
11. The Gazette of India: G.S.R 166(e) Extraordinary Ministry of Health and Family Welfare, New Delhi, the 11th March, 2020.

12. Keklik M, Keklik E, Kalan U, Ozer O, Arik F, Sarikoc M. Comparison of plateletpheresis on the haemonetics and trima accel cell separators. Ther Apher Dial 2018;22:87-90.
13. Keklik M, Korkmaz S, Kalan U, Sarikoc M, Keklik E. Effectiveness of the Trima Accel cell separator in the double dose plateletpheresis. Transfus Apher Sci 2016;55:240-2.
14. Keklik M, Eser B, Kaynar L, Solmaz M, Ozturk A, Yay M, *et al*. Comparison of double dose plateletpheresis on the Fenwal Amicus, Fresenius COM.TEC and Trima Accel cell separators. Transfus Apher Sci 2014;51:193-6.
15. Baruah S, Bajpai M. Comparative assessment of single-donor plateletpheresis by Haemonetics® MCS® plus and Trima Accel®. Asian J Transfus Sci 2020;14:23-7.
16. Chellaiya GK, Murugesan M, Nayanar SK. A study on influence of donor hematocrit on the procedural parameters of concentrated single donor platelets collected by two apheresis devices. Indian J Hematol Blood Transfus 2020;36:135-40.
17. Kumawat V, Goyal M, Marimuthu P. Analysis of donor safety in high yield plateletpheresis procedures: An experience from tertiary care hospital in South India. Indian J Hematol Blood Transfus 2020;36:542-9.
18. Gil-Betacur A, Mantilla-Gutiérrez CY, Cardona-Arias JA. Effect of plateletpheresis on hematocrit, hemoglobin and erythrocyte count: Meta-analysis 1980-2018. Sci Rep 2019;9:19770.
19. Das SS, Chaudhary R, Verma SK, Ojha S, Khetan D. Pre- and post- donation haematological values in healthy donors undergoing plateletpheresis with five different systems. Blood Transfus 2009;7:188-92.
20. Bueno JL, García F, Castro E, Barea L, González R. A randomized crossover trial comparing three plateletpheresis machines. Transfusion 2005;45:1373-81.
21. Salvadori U, Minelli C, Graziotin B, Gentilini I. Single-donor platelet apheresis: Observational comparison of the new Haemonetics Universal Platelet protocol with the previous Concentrated Single Donor Platelet protocol. Blood Transfus 2014;12:220-5.
22. Picker SM, Radojska SM, Gathof BS. A prospective crossover trial comparing performance and *in vitro* platelet quality of three new apheresis devices with current equipment. Transfus Med Hemother 2006;33:520-7.
23. Burgstaler EA, Winters JL, Pineda AA. Paired comparison of Gambro Trima Accel versus Baxter Amicus single-needle plateletpheresis. Transfusion 2004;44:1612-20.
24. Okeke CO, Iloka VC. Influence of ABO blood group on fibrinogen levels and platelet count in apparently healthy Nigerian subjects. Int J Blood Res Disord 2020;7:054.
25. Vala NH, Dubal GJ. A study to find out association between blood group and platelet count. Natl J Physiol Pharm Pharmacol 2019;9:71-3.
26. Sweeney JD, Labuzetta JW, Hoernig LA, Fitzpatrick JE. Platelet function and ABO blood group. Am J Clin Pathol 1989;91:79-81.