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Effect of Donor Parameters on the Yield of Plateletpheresis by Intermittent Flow Cell Separator

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ABSTRACT

Background: Platelet Transfusion are used for the treatment and prevention of bleeding in patients with decreased number and function of platelets. Platelet for transfusion can be provided by platelet concentrates, which are obtained either by PRP or buffy coat method from whole blood or by apheresis. Platelet Recovery in a patient is influenced by the transfused dose of platelets which in turn is dependent on the platelet yield. Aim of Study: In this study, our main objective is to identify the donor parameters that influence the platelet yield obtained by apheresis. **Methods:** This prospective study was undertaken in the Department of IHBT.140 healthy donors were selected for plateletpheresis according to guidelines laid down by Drugs and cosmetics Act over a period of one year. The plateletpheresis procedures were performed on Haemonetics MCS plus separator. Yield predicting donor variables included in the study were Age, Gender, Haemoglobin concentration, Haematocrit and Platelet count. The relationship between predonation donor variable and yield was studied using pearson correlation. **Results:** The Mean platelet yield was $3.19\pm0.48\times10^{11}$ per unit. Mean predonation platelet count of donor was $2.77\pm 0.46\times10^{5}$/µl. Mean age of the Donor was 30.31±8.14. Positive Correlation was observed between platelet yield and predonation platelet count of donor(r=0.318, P value 0.0001) which is significant. No such correlation was seen between platelet yield and Haemoglobin(r=0.131, P value 0.122), Haematocrit (r=0.058, P value 0.499), Age of Donor(r=0.034, P value 0.692). **Conclusion:** The possibility of obtaining higher platelet yield reduces the frequency of platelet transfusion and number of donor exposures with important consequent clinical and economic advantages.

Keywords: Plateletpheresis, Platelet Yield, Predonation platelet count.

INTRODUCTION

Platelet Transfusions are used for the treatment and prevention of bleeding in patients with decreased number and function of platelets.[1] Platelet transfusion in thrombocytopenic patients remains one of the most important support measures available as treatment success depends on rational use of platelet transfusion.[2] Platelets for transfusion are provided by platelet concentrates, which are obtained either by PRP/PC or buffy coat method from whole blood or by apheresis.[3] A decreasing blood donor pool in the presence of increasing blood transfusion demand has resulted in the need to maximally utilize donation from each blood donor which led to a trend in the increasing use of automated blood collection.[2] Automated apheresis techniques were introduced to meet the platelet inventory needs of transfusion services. Apheresis is a procedure in which separation of blood components is performed by centrifugation, filtration or combination of both. This procedure is usually accomplished by removing venous whole blood from the body, separating the blood into cellular and non-cellular (plasma) parts or "fractions", collecting the desired part and returning the remaining blood to the donor.[4]

In Plateletpheresis, platelets are separated and other consitituents of blood are returned back into the donor. It is intented to collect a large number of platelet from an individual, thereby providing more consistent product with fewer donor exposures for the patient.[5] The new generation cell separators have made it possible to obtain high quality platelets with minimum donor manipulation. During the last decades, there has been significant improvement in the productivity and quality of the component.[6]

Platelet recovery in a patient is influenced by the transfused dose of platelets which in turn is

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dependent on the platelet yield.[7] It has been shown that transfusion of high yield platelet products could reduce transfusion requirements of thrombocytopenic patients with consequent reduction in transfusion transmitted diseases, transfusion reactions and possibly allo-immunization.[8-9] When a high yield is obtained, the original plateletpheresis unit can be divided into multiple units, each of which must meet minimum standards independently which has significant economic impact.[5]

It is not only the collection of platelets which is important but also paying attention to devise better methods to increase product yield and improve the quality with minimum alteration in donor hematological parameter.[10] Donor related both clinical and laboratory factors might control the platelet yield.[11] Platelet yields were primarily related to the biologic contribution (baseline platelet count) of the donor. Procedure parameters selected for harvest, and the efficiency of the device also had a significant, but less important role in determining the final platelet yield.[5] Donors with suboptimum platelet count (<2.0 x 10^5/µl) are deferred which decreases a large number of potential plateletpheresis donors from the donor pool & delay occurs in platelet transfusion for critically bleeding patients.[12] Main objective of the present study was to identify the donor parameters like predonation platelet count, haemoglobin, hematocrit , age and gender that influence the platelet yield obtained by apheresis and to make the product more cost effective.

MATERIALS AND METHODS

This prospective study was undertaken in the Department of ImmunoHaematology & Blood Transfusion. 140 healthy donors were taken, who were selected for plateletpheresis according to guidelines as per DGHS technical manual, 2003, Government of India, New Delhi for over a period of one year.[13] Details of plateletpheresis procedure were explained and informed consent was taken from the donor before each procedure.

Hematological parameters of the donor like predonation platelet count, Hb, HCT were measured using caliberated automated analyser (Sysmex cell counter) and TTI testing of each donor was done prior to procedure. The plateletpheresis procedures were performed on Haemonetics MCS+(mobile collection system) cell separator as per the standard operating procedure (SOP) of the department. Haemonetics MCS+ cell separator is an intermittent flow cell separator. Blood enters the centrifugation bowl and platelets are separated and collected in platelet bag and RBCs are returned to the donor along with the plasma during each cycle. The cycle is repeated. Blood rate flow was maintained at 60-70ml/min and anticoagulant ratio of 1:9. The end point was the target yield of 3×1011 platelets per unit. After completion of the procedure blood bag is kept undisturbed for 30 minutes. 2 ml of the component was collected in the sample pouch attached to the parent bag after proper mixing in a closed system so that it constituted a representative of the bag and CBC of the sample was done using sysmex cell counter and platelet yield was calculated.

The platelet yield was calculated using the following formula.

Platelet yield = Product volume (ml) x product count (platelets/µl) x conversion factor (1000µl)

RESULTS

During the study period, a total of 140 (Mean Age 30.31 ± 8.14 years) donors underwent plateletpheresis procedures on intermittent flow cell separartor (Haemonetics MCS+).Platelet yield predicting donor variables included in the study were age, gender, haemoglobin concentration, haematocrit and platelet count. The relationship between predonation donor variables and yield was studied using pearson correlation. Mean predonation platelet count of donors was 2.77±0.46×10^5/µl. Mean platelet yield distribution among plateletpheresis donor was 3.19±0.48×10^{11}/unit. However, effect of the gender on the yield of platelet could not be studied as all the donors were males.

Fifty one donors had a pre-donation platelet count of 2.0 x 10^5/µl -2.59 x 10^5/µl and it was observed that the mean yield of the product prepared from these donors was 3.04±0.39 x 10^{11}/unit. While in the donors with pre-donation platelet counts in the range of 2.60 – 3.10 x 10^5/µl who were 49 in number the product prepared showed a mean yield of 3.13±0.42 x 10^{11}/unit. The pre-donation platelet count was 3.10 x 10^5/µl -3.59 x 10^5/µl in 33 donors and the product prepared had a mean yield of 3.41±0.56 x 1011/unit. 7 donors with pre-donation count of >3.59 x 10^5/µl gave a yield of 3.59±0.53 x 10^{11}/unit.

Positive correlation was observed between platelet yield and predonation platelet count of donor(r=0.318, P value 0.0001) which is significant.

No such correlation was seen between platelet yield and haemoglobin(r=0.131, P value 0.122), haematocrit (r=0.058, P value 0.499) and age of Donor(r=0.034,P value 0.692).

Table 1: Distribution of Predonation platelet count of the donors.

Predonation plateletcount of donors(×10^5/µl)	No.of Donors	%age of Donors
2.0-2.59	51	36.42%
2.60-3.09	49	35%
3.10-3.59	33	23.57%
>3.59	7	5%

Table 2: Platelet yield distribution among plateletpheresis donor

Platelet yield ($\times10^{11}$/unit)	No.of Donors	%age of Donors
2.0-2.49	6	4.28%
2.50-2.99	35	25%
3.00-3.49	67	47.85%
3.50-3.99	21	15%
>3.99	11	7.85%

Table 3: Effect of pre-donation platelet count on platelet yield (mean).

Predonation platelet count ($\times10^5$/µl)	No.of Donors	Mean platelet yield±SD
2.0-2.59	51	3.04±0.39
2.60-3.09	49	3.13±0.42
3.10-3.59	33	3.41±0.56
>3.59	7	3.59±0.53
Total	140	3.19±0.48

Table 4: Pearson Correlation of donor hematological parameters with the platelet yield

	Platelet yield	Haemoglobin	HCT	Donor PLT Precount	Age
Platelet yield	1				
Haemoglobin	0.131 (0.122)	1			
HCT	0.058 (0.499)	0.542 (0.000)	1		
Donor PLT Precount	0.318 (0.0001)	-0.021 (0.806)	-0.098 (0.251)	1	
Age	0.034 (0.692)	-0.103 (0.224)	-0.121 (0.155)	0.027 (0.749)	1

All data are expressed as r (P-value)

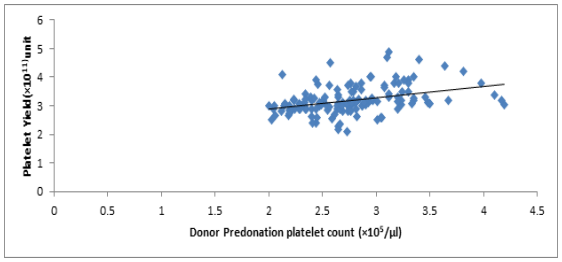

Figure 1: Effect of platelet count on platelet yield.

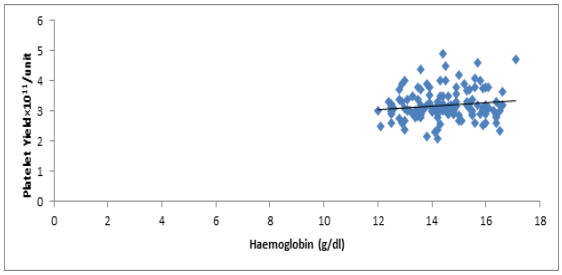

Figure 2: Effect of Haemoglobin on platelet yield

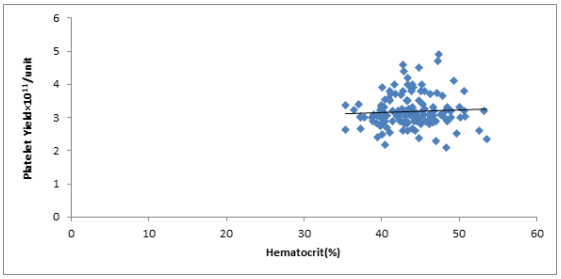

Figure 3: Effect of Hematocrit on platelet yield

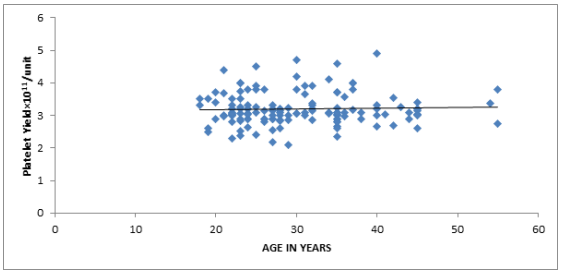

Figure 4: Effect of Age on platelet yield.

DISCUSSION & CONCLUSION

Platelet transfusions are needed either prophylactically or therapeutically for bleeding patients as platelets are essential for primary haemostatic plug.[6] Treatment success depends on rational use of platelets transfusion. There has been increased trend towards use of SDPs over the last decade. High yield platelets allow prolonging intervals between transfusions.[14]

Identification of factors influencing platelet yield would allow for better selection of donors resulting in decreased donor exposures and maintaining a better donor pool.

The present study was conducted to know the factors affecting the quality of products prepared by plateletpheresis donations.

Analysis of donor related parameters on platelet yield we found 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 140 procedures, the mean yield obtained was $3.19\pm0.48\times10^{11}$/unit.

According to the FDA requirements and AABB, 75% of the plateletpheresis products prepared must contain $\geq 3 \times 10^{11}$/unit platelets per unit, while the European guidelines (Council of Europe publishing, 2006) recommend platelet count of $\geq 2 \times 10^{11}$/unit.[15] These levels have been determined from the studies to provide required hemostatic dose to the recipient. In our study 99 (70.71%) procedures had platelet yield of $> 3\times 10^{11}$/unit which met AABB criteria and 100% met Europian guidelines.

Goodnough et al studied 708 plateletpheresis procedures and a direct correlation between platelet yield and pre-donation platelet count was observed in all the procedures. Mean platelet count was 2.37 x

10^5/µl and Mean yield was 4.24 x 10^{11}/unit. In only 12% of the procedures, the mean yield was < 3 x 10^{11}/unit when the pre-donation platelet count was < 2 x 10^5/µl.[5]

S.S.Das et al studied 61 plateletpheresis procedure on intermittent flow cell separator and observed direct linear relationship between predonation platelet count and yield(r=0.51,P<0.001). The yield was ≥3 x 10^{11}/unit in 80% of procedure when predonation platelet count was ≥2.5 x 10^5/µl.[16]

In present study we found no significant correlation of the donor age with the yield (r = 0.034, P value 0.692). Chaudhary et al also did not find any relation between platelet yield and age.[17]

There was no correlation in our study between platelet yield and haemoglobin(r=0.131, P value 0.122), haematocrit(r=0.0577, P value 0.499). Other authors also reported no correlation between pre-donation Hb and the yield, Chaudhary et al also did not find any correlation between the pre-donation Hb and the yield (r = - 0.10, P value > 0.005), but three donors with Hb > 16 g/dl gave a lower yield as compared with donors having Hb < 16g/dl.[17] In contrast, an inverse relationship between the Hb and the yield had been demonstrated by Guerrero-Rivera et al and Enien et al.[7,18] They concluded that this might be related to the greater amount of plasma processed in donors with low Hb.

Optimization of platelet yield which is influenced by predonation platelet count,is an important issue in blood transfusion services. The possibility of obtaining higher platelet yield reduces the frequency of platelet transfusion and number of donor exposures with important consequent clinical and economic advantages.[8]

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