Original Article:

Donor demographic and laboratory predictors of single donor platelet yield

R. Arun, A. Yashovardhan, K. Deepthi, B. Suresh, K.V. Sreedhar Babu, D.S. Jothibai

Department of Transfusion Medicine, Sri Venkateswara Institute of Medical Sciences, Tirupati

ABSTRACT

Background: Platelet transfusions are essential to prevent morbidity and mortality in patients who are severely thrombocytopenic and are at risk of spontaneous bleeding. Platelets are currently obtained either by fractionation of whole blood or by platelet apheresis. The quality of single donor platelets (SDP) in terms of yield influences platelet recovery in the recipient and allows prolonging intervals between transfusions.

Material and Methods: Donor demographic and laboratory data were analyzed prior to performing plateletpheresis to identify donor factors that influence platelet yield. The study was conducted on 130 healthy, first-time plateletpheresis donors over a period of 4 years. The plateletpheresis procedures were performed using Fresenius Kabi COM.TEC and Hemonetics MCS plus separator. A relationship between pre-donation donor variables and yield of platelets was studied using the Pearson correlation.

Results: The mean platelet yield was $3.16 \pm 0.62 \times 10^{11}$ per unit. A positive correlation was observed between platelet yield and pre-donation platelet count, body mass index (BMI; Kg/m^2) of the donor, while a negative correlation was observed between age and the platelet yield.

Conclusion: Donor pre-donation platelet count, BMI and donor age influence platelet yield. Young healthy donors with a high platelet count and better BMI can give a better platelet yield in the SDP.

Key words: *Demography, Donor, Plateletpheresis, Predictors*

Arun R, Yashovardhan A, Deepthi K, Suresh B, Sreedhar Babu KV, Jothibai DS. Donor demographic and laboratory predictors of single donor platelet yield. J Clin Sci Res 2013;2:211-5.

INTRODUCTION

Platelet transfusions are indicated in patients who are bleeding or at increased risk of bleeding secondary to thrombocytopenia or platelet dysfunction. Platelets for transfusion can be provided by platelet concentrates, which are harvested from routine whole blood donation or by apheresis.[1] Plateletpheresis procedures are by design intended to collect large number of platelets from an individual, thereby providing a more consistent product with fewer donor exposures for the patient.[2] It is estimated that 79% of therapeutic platelet doses transfused in the United States of America are apheresis platelets.[3] During the last decades, there have been significant improvements in the productivity and quality of apheresis platelets.[4] Platelet transfusion success depends on rational use of platelet components and also on the quality of the component. With newer technology and more efficient processes, higher yields of platelets may be obtained from one donor. Platelet recovery in a patient is influenced by the transfused dose of platelets which in turn is dependent on the platelet yield.[5] The possibility of obtaining higher platelet yields has important clinical implications: it reduces frequency of platelet transfusions and number of donor exposures with important consequent clinical and economic advantages.[6,7] This study was planned to investigate the influence of donor demographic and laboratory factors on platelet yield.

MATERIAL AND METHODS

This is a retrospective study of records pertaining to the period January 2009 to December 2012. The study included 130 healthy, first time plateletpheresis donors. All the donors were selected according to the guidelines laid down by Drugs and Cosmetics Act.[8] Details of plateletpheresis were explained to each donor who

Received: 10 March, 2012.

Corresponding Author: Dr R. Arun, Assistant Professor, Department of Transfusion Medicine, Sri Venkateswara Institute of Medical Sciences, Tirupati. **e-mail:** arundr_83@yahoo.co.in

gave due consent before the procedure. Most of the donations were performed by Fresenius Kabi COM.TEC apheresis machine (Fresenius Kabi AG, Bad Homburg) and the rest by Hemonetics MCS plus apheresis machine (Hemonetics Corporation, Braintree, Massachusetts). Haematological parameters of the donors were analysed using calibrated automated analyzer (BC-5300 Auto Hematology Analyser, ShenZhen Mindray Bio-medical Electronics Co., Ltd, Nanshan, ShenZhen, P.R. China). The plateletpheresis procedure was done in those donors who are eligible and non-reactive for mandatory infectious markers and it is done according to our departmental standard operating procedure. Blood flow rate for all collections was maintained at 50 to 60 mL/min with anticoagulant-blood (ACD-B) ratio of 1:12. The end point was the target yield of 3×10^{11} platelets per unit. As a part of quality control of the component, platelet yield was calculated after the component collection. Hence 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. This sample was used to calculate the platelet yield in the product using the same automated analyzer. The platelet yield was calculated using the following formula:[9] Platelet yield = Product volume (mL) $\times$ product count [platelets/μL $\times$ conversion factor (1000)]. Age, gender, body mass index (BMI; Kg/m^2) platelet count, haemoglobin concentration, haematocrit and blood group were included as donor variables. Relationship between pre-donation donor variables and yield of platelets was studied using the Pearson correlation coefficient. Statistical analysis was done using SPSS software version17.

RESULTS

The mean age of the donors (n=130) was 28.7 years (range19-48years), there were, 129 males. Their age distribution is shown in Table 1. Hemonetics MCS plus machine was used in 45 procedures and Fresinius Kabi COM.TEC machine in 85 procedures. Single needle procedure was done in all plateletpheresis when Hemonetics MCS plus machine was used. Single needle procedure was done in 18 plateletpheresis using Fresinius Kabi COM.TEC machine and the rest 67 procedures were done using double needle. Mean pre-donation platelet count was $2.69 \pm 0.65 \times 10^5/\mu L$; 76 donors (58.5%) had the pre-donation platelet count of more than $2.5 \times 10^5/\mu L$ (Table 2). The mean platelet yield was $3.16 \pm 0.62 \times 10^{11}$; 86 (66.1%) donors gave a platelet yield of more than 3×10^{11} per unit (Table 3). Haemoglobin level was more than 14 g/dL in 110 (84.7%) donors. The mean BMI was 29.4±0.86 Kg/m^2. A positive correlation was observed between pre-donation platelet count and platelet yield ($r = 0.284$, $p<0.01$) and a negative correlation was observed between age (years) and platelet yield ($r = –0.229$, $p<0.01$) but no such correlation was noticed between platelet yield and haemoglobin (0.052), haematocrit ($r = – 0.011$), gender (0.054), or blood group ($r = – 0.098$) of the donor (Table 4). A positive correlation was also observed between BMI and platelet yield ($r = 0.257$, $p<0.01$).

Table 1: Age distribution of plateletapheresis donors

Age (years)	No.of donors	%
18-20	11	8.5
21-30	73	56.2
31-40	37	28.5
41-50	09	6.9
Total	130	100

DISCUSSION

Platelets are essential for the formation of primary haemostatic plug and maintenance of haemostasis.

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

Platelet count ($\times 10^5/\mu L$)	No. of donors	%
1.5- 2	17	13.1
2.1-2.5	37	28.5
2.6-3.0	40	30.8
3.1-3.5	24	18.5
>3.5	12	9.2
Total	130	100

Table 3: Platelet yield distribution among plateletpheresis donors

Platelet yield ($\times 10^{11}$/unit)	No. of donors	%
<2	9	6.9
2.1-2.5	12	9.2
2.6-3.0	23	17.7
3.1-3.5	45	34.6
>3.5	41	31.5
Total	130	100

Platelet transfusions are needed either prophylactically or therapeutically. Either a pool of 4 to 6 units of random donor platelet or 1 unit of single donor platelet(SDP) is transfused.[10] One unit of SDP should contain a minimum of 3×10^{11} platelets as per American Association of Blood Bank (AABB) guidelines[11] while European guidelines advocate that one SDP should contain 2×10^{11} platelets.[12] This will give an increment of 30,000 to 60,000/ μL. SDPs have now become the main source of platelets in many countries.[13] Recently the use of platelet concentrates has grown steadily due to its employment in chemotherapy protocols. This is especially due to lower alloimmunization and transmission of viruses to patients afforded by reduced donor exposure.[9] Different trials have shown that transfusion of high platelet doses could reduce number of platelet concentrates required by thrombocytopenic patients even in patients with adverse clinical factors in which refractoriness to transfusion is common.[6,7,14] Nevertheless, there are very few studies related to donor clinical and laboratory factors that may influence number of platelet yield and none from South India.[2,15] Identification of these factors would allow for better selection of donors resulting in higher platelet yield and consequently a lower number of donor exposures to the patients. Instruments which collect SDP are programmed to calculate the yield from the donor's haematocrit, platelet count, height and weight.

In our study, the mean pre-donation platelet count was $2.69 \pm 0.65 \times 10^5/\mu L$ and the mean platelet yield was $3.16 \pm 0.62 \times 10^{11}$. A good direct linear correlation was obtained between the pre-donation platelet count and the platelet yield ($r = 0.284$, $p<0.01$). Another study[15] reported that out of 94 plateletpheresis procedures, the mean platelet yield

Table 4: Correlation between platelet yield and donor variables

	Age	Sex	BMI	Hb	PLT	Hct	PY
Age	1						
Sex	–0.088 (0.318)	1					
BMI	–0.230 (0.009)	0.074 (0.406)	1				
Hb%	–0.112 (0.206)	–0.173 (0.049)	–0.056 (0.528)	1			
PLT	–0.112 (0.203)	0.311 (0.000)	0.352 (0.000)	–0.115 (0.192)	1		
Hct	–0.135 (0.126)	–0.143 (0.105)	–0.097 (0.270)	0.741 (0.000)	–0.088 (0.319)	1	
PY	–0.229 (0.009)	0.054 (0.541)	0.257 (0.001)	0.052 (0.558)	0.284 (0.001)	–0.011 (0.905)	1

All data are expressed as r (p-value)
BMI=body mass index (Kg/m^2); Hb=haemoglobin (g/dL); PLT=platelet count ($\times 10^5/\mu L$); Hct= haematocrit; PY=platelet yield

was $3.65\pm0.80\times10^{11}$ when the pre-donation platelet count was $<3\times10^5/\mu L$, while the mean yield was $2.5\pm0.59\times10^{11}$ when the pre-donation platelet count was $>2\times10^5/\mu L$. They also observed a direct relationship between platelet count and platelet yield ($r=0.50$, $p<0.001$). In a study,[2] 708 plateletpheresis procedures having a mean pre-donation platelet count of $2.37\pm49\times10^5/\mu L$ resulted in a platelet product with mean yield of $4.24\pm1.1\times10^{11}$. A direct linear correlation was observed with all the procedures. In a study[16] donor pre-donation platelet count was found to positively correlate with the platelet yield ($r=0.51$, $p<0.001$). A direct positive correlation was also observed in another study[17] ($r=0.512$). Our observations were smilar.

In our study, 86 (66.1%) donors gave a platelet yield of more than 3×10^{11} per unit and thus 66.1% of our platelet yield met AABB guidelines[11] while 93% of our collection met European guidelines.[12] In comparison, only 41.5% of the SDPs met AABB guidelines[11] in another study.[15] Our study showed a significant negative correlation between the donor age and platelet yield ($r=-0.229$, $p<0.01$) but no such observation was reported in another study.[15] Our study did not show any correlation with between platelet yield and either haemoglobin ($r=0.052$) or haematocrit ($r=-0.011$). While a positive correlation between platelet yield and donor haemoglobin and haematocrit in some studies,[5,17] no correlation was observed between the haemoglobin concentration and platelet yield in another study.[15] They reported that donors with a haemoglobin levels of 16 g/dL or more gave a comparatively lower platelet yield. This could be related to the higher plasma volume processed in donors with low haemoglobin concentration thereby giving a higher platelet yield.

We also observed a positive correlation between BMI and platelet yield ($r=0.257$, $p<0.01$). Similar observations were reported is another study[18] where BMI correlated consistently with a good platelet yield. But, in another study[19] where the quality of SDP in relation to low weight (40.8-49.9 Kg) of the donors was studied, donor weight was not found to have any effect on platelet yield. Since there was only one female donor, we are not able to calculate the correlation between the platelet yield and gender. In a study[20] it was found that gender also influences platelet yield and women had higher yields. This was possibly because there is a higher prevalence of iron deficiency among women with consequent increase in platelet count; hormonal influence could also play a role.

Donor platelet count and haemoglobin concentration influence platelet yield. A higher donor platelet count corresponded to a higher yield. Age showed an inverse relationship, i.e., the lower the age, higher the platelet yield. Healthy donor of young age with high platelet count can yield a better platelet yield in the SDP. Identification of such factors may help in selecting donors to obtain higher platelet yield and consequently better clinical outcome in the patients.

ACKNOWLEDGEMENT

We thank Dr. Alok Sachan, Professor and Head, Department of Endocrinology and Metabolism, Sri Venkateswara Institute of Medical Sciences, Tirupati, for his help with statistical analysis.

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