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ORIGINAL ARTICLE

Factors Affecting Platelet Yield in a Single Donor Plateletpheresis

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ABSTRACT

Background: This procedure, known as plateletpheresis, involves the removal of platelets from a donor's blood. This method produces eight times as many platelets as would be obtained by using whole blood.
Aim: To evaluate the effect of different donor related factors on platelet yield.
Method: This research was carried out at the Children's Hospital & Institute of Child Health Science in Lahore, Pakistan, specifically in the Immunohematology & Blood Transfusion Unit. Forty plateletpheresis donors meeting the criteria were enlisted for the study. The COM.TEC cell separator apparatus and the TRIMA automated blood collection system were used to perform the plateletpheresis. Before and after a plateletpheresis, the patient's hematocrit, haemoglobin, platelet count, white blood cell count, processed volume, and processing time were recorded.
Results: Platelet yield demonstrated a substantial positive link with the pre-platelet count of the donors, as well as their age, weight, and the volume processed. Platelet production was not correlated in any way with blood group, total leukocyte count, high-content testing, or processing time.
Conclusion: A patient's pre-platelet count, age, weight, and processed volume were positively correlated with their platelet production.
Keywords: Plateletpheresis, Hemoglobin, Total leukocyte count, Platelet count, Platelet yield

INTRODUCTION

Single Donor Platelets are those collected during apheresis (SDP). SDP are superior to RDP in a number of ways. Donor haematopoiesis is harmed by apheresis in both the short and long term, resulting in conditions such anemia, thrombocytopenia, and lymphocytopenia[1]. Platelet transfusion dose, determined from SDP, determines how rapidly patients' platelets recover. The patient's platelet recovery is controlled by the SDP's platelet yield. Many SDP donors are postponed because to poor platelet count or hemoglobin concentration[2,3].

Those with low platelet counts or abnormally functioning platelets often require platelet transfusions to prevent bleeding. While some patients with low platelet counts really need a transfusion, others are able to survive without it. Platelets extraction requires precision and care throughout processing, preparation, and transfusion in order to maintain quality. The importance of platelet transfusion among healthcare professionals is highlighted in multiple studies[4].

Platelet extraction is now an essential part of modern transfusion practice, made possible by advances in component extraction and next-generation apheresis platforms that are more efficient than their predecessors. This is in response to an upward trend in platelet demand caused by an increase in the number of patients with a wide range of bleeding manifestations and other medical advances[5].

Platelet transfusions are given to patients who are extremely thrombocytopenic and who are in danger of bleeding spontaneously. This is done to lower the patients' risk of complications and death. When someone gives blood, a specialised tool is used to separate the platelets from the rest of the blood, which is then given back to the person who gave the blood. Platelets of this quality can be obtained by this method, and they are about similar to six to eight platelets generated from whole blood. The entire process typically takes between 45 and 90 minutes to complete.

The aim of study was to evaluate the affect of different factors including donor related parameters such as Hb, TLC, HCT, age and weight and machine related parameters such as volume processed and processing time on platelet yield to help the blood bank donor for the selection of donor with maximum platelet yield.

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MATERIAL AND METHOD

It was cross sectional study of 40 apheresis procedures carried out in our hematology department during a period of four month i.e. from October 2021 to January 2022. Donor selection was done according to the donor selection criteria. After checking the prominent veins, the procedure of plateletpheresis was done using either FRESENIUS KABI or TRIMA ACCEL. After the procedure, the machine related parameters such as volume processed and processing time was noted. Then from the tubing of the platelet bag, a 2ml of the sample was taken in Eppendorf for determining the platelet count using automated hematology analyzer SYSMEX XP-100.

Age, platelet count, weight, hematocrit, blood group, hemoglobin and total leukocyte count were included. Processing time and processed volume were considered as machine variables. Relationship between donor and machine related variables and platelet yield was studied using Pearson correlation coefficient. Analysis of all the data collected in the study was done using the software SPSS-23.

RESULTS

A total of 40 healthy donors underwent plateletpheresis on intermittent flow cell separator. The 40 donors were included to analyze the affect of different variables such as age. Weight, hemoglobin, total leukocyte count, pre-platelet count, blood group, volume processed and processing time. There was not a single female donor because of the low haemoglobin levels, the difficulties in establishing venous access due to the lack of visible veins, and the increased subcutaneous fat that was seen in female donors. The majority (30) of donors were Rh positive group and majority were of B positive group (11) followed by A positive (8), among the patients enrolled as donor.

A positive correlation was observed between the yield of platelets and the following donor variables: Age (r=0.315), platelet

pre-count (r=0.297), volume processed (r=0.269), weight (r=0.497). The p value for these variables was significant at p<0.05.

Processed volume is another factor that had positive correlation with platelet yield (r=0.269 and p=0.043).out of 40 donors 29 had processed volume in range of 2000-3000ml, and 11 donors have processed volume during procedure have in range of 3000-4000 ml. The 29 donors have mean platelet yield of712 × 10^3/µl and 11 donors have mean platelet yield of 595× 10^3/ µl.According to Enein AA et al, Patel J et al, Mangawanas (r = 0.404; r = 0.158, r=0.648 p < 0.05 respectively that volume processed and platelet yield also had positive correlation.

Weight is another factor that had strong positive correlation with platelet yield (r=0.497 and p=<0.01). Out of 40 donors 22(55%) had weight in range of 50-70kg with mean platelet yield 790.9× 10^3/µl. The 10(25%) donors had weight in range of 70-90kg with mean platelet yield of 627.3× 10^3/µl and 8(20%) donors had weight in range of 90-110kg out of 40 with mean platelet yield 445.75× 10^3/µl

Table 1: Frequency of different blood groups of donors

Blood Group	No. of donors	%age
A+	8	20.0
B+	11	27.5
AB+	1	2.5
O+	10	25.0
O-	5	12.5
A-	2	5.0
B-	1	2.5
AB-	2	5.0

Table 2: The analysis of continuous variables with Pearson values for correlation of donors & procedure related factors with platelet yield

Parameter	Mean	Std. Deviation	Correlation	Significance
Weight	73.97	13.12	-0.497	< 0.01
Age	25.97	5.39	0.315	0.025
TLC	8.89	1.65	0.196	0.116
Hb	15.52	1.29	-0.214	0.096
HCT	44.93	4.83	-0.022	0.447
Platelet pre-count	257.61	63.52	-0.297	0.033
Processing time	45.2750	18.25178	-0.243	0.068
Volume processed	2607.10	539.495	0.269	0.043

Table 3: Multiple linear regression of donors & procedure related factors with platelet yield

Parameters	Unstandardized Coefficients (Beta)	Standardized Coefficients (Beta)	t	P- value
PLT yield	2073.534		1.764	.088
Weight	-8.876	-.413	-2.312	.028
Age	-11.216	-.214	-.929	.360
TLC	39.230	.230	1.506	.142
Hb	35.891	.164	.914	.368
HCT	-21.806	-.372	-1.704	.099
Platelet pre-count	-1.214	-.272	-1.447	.158
Blood group	-11.657	-.081	-.542	.592
Volume processed	0.128	.244	1.160	.255

Dependent Variable: PLT yield

DISCUSSION

Despite a shrinking supply of donors, we are now able to increase or even quadruple platelet doses thanks to technological advancements. Platelet concentrations of the highest grade can be obtained via automated cell separators. However, plateletpheresis can influence the donor's hematological characteristics, and with the rise of high-yield plateletpheresis techniques, donor safety has emerged as a pressing issue6.

Plateletpheresis has become an established practice in the blood banks of a significant number of developing nations. Platelet recovery in a patient who needs platelet transfusion is affected by platelet yield, which is a measure of the quality of SDP. The purpose of this study was to investigate the effect that donor hematological and demographic factors could have on the platelet yield.

On evaluation of donor related hematological parameters, we found that pre-donation platelet count has significant linear correlation with platelet yield (r= 0.297, p=0.033). Out of 40 donors, 18(45%) had <250×10^3/µl pre-platelet count and 13(32%) had pre-platelet count in the range of 250-300×10^3/µl and 9(22.5%) had >300×10^3/µl pre-platelet count. The 18 donors had 70 0.87× 10^3/µl platelet yield and the donor with ≥300× 10^3/µl pre-platelet count had platelet yield of 591× 10^3/µl.

In an Indian study, Plateletpheresis on a continuous flow cell separator was performed on 230 healthy donors with a mean body weight of 67.60 10.5 kg. Pre-donation PC of the donor and SDP yield were found to have a positive and linear relationship. With a significance level of P 0.0001, the r value was 0.302. Pre-donation haemoglobin and hematocrit levels, as well as donor weight and duration of the surgery, showed no such relationships (r value were -0.001, -0.018, 0.023 & -0.047 respectively). The yield of SDP was found to be correlated with the volume of donors undergoing aphaeresis at 0.158 (P 0.05)[7].

In another study, analysis of 109 plateletpheresis procedures, Geetha et al. observed a linear relationship between the donor's platelet count and the platelet yield (r = 0.4253, p 0.001). Because there are more platelets available for collection, the platelet yield is higher in individuals with a high platelet count. Of the 109 donors, 41(37.6%) had a pre-donation platelet count of 2.5x103/l. Donors with platelet counts below 300 x 103/l had a mean yield of 2.9 x1011/unit, while those with counts between 2 and 2.9 x1011/unit have a yield of 2.7 x1011/unit on average[8].

While there was a significant link between platelet count before to donation and yield (r=0.50, p0.001), no such relationship was seen between donor haemoglobin concentration and yield (r=-0.10, p>0.005). The same was true for the donor's age (r=0.11), weight (r=0.18), or gender (r=0.05). Developing concern in the field of blood transfusion services is optimizing platelet yield, which is affected by the donor's platelet count before to collection. In order to select donors with higher platelet yields and improved clinical outcome, it may be useful to identify such characteristics[9].

SDP production is affected by many factors; most important of these is the donor platelet count. Studies have shown that Donor's platelet count is positively correlated with SDP yield and blood volume processed, and negatively correlated with the processing time of the procedure and the total blood volume processed. Platelet production and anthropometric variables of the donor are also associated. Similarly, relationship exists between the haemoglobin and speed and volume of blood processed. Platelet output is independent to donor age, gender, ABO blood group, or Rh status[10,11]. The question of how to extract the

maximum number of platelets is a new challenge in the field of blood transfusions. By identifying these characteristics, it may be possible to select donors who are able to yielding more platelets in a shorter amount of time, hence enhancing the outcomes of procedure.

CONCLUSION

One emerging problem in the blood transfusion service is optimising platelet yield, which is affected by factors including the donor's age, weight, and platelet count before donation, as well as machine-related parameters like the volume processed. The impact of donor-related parameters on platelet yield has to be studied in greater depth.

Conflict of interest: Nil

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