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"STUDY OF EFFECT OF DIFFERENT DONOR PARAMETERS (DEMOGRAPHY AND RBC INDICES) ON SINGLE DONOR PLATELET APHERESIS AT BLOOD BANK SRG HOSPITAL AND MEDICAL COLLEGE, JHALAWAR"

Pathology

Dr Charu Singh* Resident, Department Of Pathology, Jhalawar Medical College, Rajasthan, *Corresponding Author

Dr.Sumit Prakash Rathore Professor And Head, Department Of Pathology,jhalawar Medical College, Rajasthan

Dr.Saroj Kumari Meena Senior Resident, Department Of Pathology, Esic Medical College, Alwar, Rajasthan

ABSTRACT

Introduction: Use of single donor platelets (SDP) has increased by radical change over past few years. SDP not only increase the quality of product in terms of decreased cellular contamination but also increases the overall yield of platelet collected. However various donor parameter exert their effect on yield of single donor platelet apheresis.**Aim:** This study is designed to analyze the effect of various donor variables such as age, gender, height, weight, blood group, BMI, pre donation Hb concentration, hematocrit, RBC count, MCV and RDW on the yield of platelets.**Materials and Methods:** A Cross sectional study was conducted in the blood bank of Jhalawar Medical College and Hospital. Study population included voluntary blood donors who fulfilled the eligibility criteria for plateletpheresis donation as per the guidelines of Directorate General of Health Services (DGHS) in the blood bank of Jhalawar Medical College and Hospital from Aug 2021 to Aug 2023.**Results:** The mean platelet yield was 2.7x1011/unit. A positive correlation was observed between the yield of platelets and the following donor variables: Age (r = 0.3861), gender (r=0.177), blood group (r=0.61), weight (r = 0.45), height (0.2999) and BMI (r = 0.3272). This correlation was significant with age, weight, height and BMI. While platelet yield had negative correlation with Hb count (r= -0.22), hematocrit(r=-0.217), RBC count(-0.217), MCV (r= - 0.048), RDW sd (r = -0.312) and RDW cv (r= -0.022). This correlation was significant with MCVand Hb.**Conclusion:** There are multiple factors affecting the yield of SDP. There is a negative correlation between donor's pre donation Hb, MCV and platelet yield. Platelet yield correlated positively with age, height, weight and BMI also. 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.

KEYWORDS

Apheresis, Platelet yield, Single donor platelet (SDP), Parameters.

BACKGROUND-

Apheresis is a procedure wherein whole blood removed from the body is passed through an apparatus that separates out one (or more) particular blood constituent and returns the remainder of the constituents to the individual's circulation.[1] In plateletpheresis procedure, a portion of donor's platelet and some plasma is removed with the return of donor s RBCs, WBCs and remaining plasma back into the circulation.[2]

The role of platelets (PLTs) in the control and prevention of thrombocytopenic hemorrhage was noted in 1910, and since then there has been continuous progress toward understanding the physiologic characteristics of PLTs and how to prepare them for therapeutic use.[1] PLTs can be isolated from whole blood or by apheresis. The procedure of collecting PLTs from a donor with the help of an automated cell separator is known as plateletpheresis. In this procedure, blood is withdrawn from the donor and separated into various components; then, the desired component is retained and the remaining constituents are returned to the donor.[2] PLTs collected using this method are known as single-donor PLTs (SDPs). SDPs have several advantages compared to concentrated units of pooled random-donor PLTs (RDPs), including: higher PLT count per unit and a relatively larger amount of product volume, thereby increasing the PLT dose per bag; avoiding the need for leucoreduction; increasing efficiency by avoiding unnecessary separation of components; and reducing recipient exposure to multiple donors, thereby reducing the risk of infections and human leucocyte antigen (HLA) and human PLT antigen (HPA) alloimmunization.[3-7]

Despite improvements in apheresis technology, some problems remain, such as the prolonged duration of the apheresis procedure, donor discomfort from the hypocalcemic symptoms produced by citrate added to prevent coagulation, and PLT activation in the products. Apheresis instrument manufacturers try to minimize these problems. Presently, a variety of plateletpheresis instruments are available on the market; various studies [8-10] have been conducted that focus on comparison of different plateletpheresis cell separators.

For whole blood–derived platelets, the preparation method must yield at least 5.5×10^{10} platelets per unit in at least 75% of the units tested by the manufacturing facility. With whole blood–derived platelets, typically 4 to 6 units are pooled immediately prior to transfusion, for a dose comparable to a single apheresis-derived platelet unit. For apheresis-derived platelets, the collection method must yield at least 3×10^{11} platelets per unit in at least 90% of the units tested by the manufacturing facility. Large-yield plateletpheresis collections can be divided into two separate apheresis- derived platelets units, also known as splits, as long as the platelet count in each unit is greater than or equal to 3×10^{11} . [11,12]

This study is designed to analyze the effect of various donor variables such as age, gender, height, weight, blood group, BMI, pre donation Hb concentration, hematocrit, RBC count, MCV and RDW on the yield of platelets.

MATERIALS AND METHODS

Study design

This study is a cross sectional study conducted in the blood bank of Jhalawar Medical College and Hospital and was approved by the respective Institutional Ethical Committee.

Study population

Study population includes voluntary blood donors who fulfilled the eligibility criteria for plateletpheresis donation as per the guidelines of Directorate General of Health Services (DGHS) in the blood bank of Jhalawar Medical College and Hospital from Aug 2021 to Aug 2023.

Inclusion criteria

Donor undergoing apheresis procedure must meet the same criteria as a whole blood donationas per Director General Health Services guidelines.

1. Age 18-60 years
2. Platelet count greater than or equal to 150×10^9 /L
3. Haemoglobin levels greater than or equal to 12.5 g/dl and donor body weight greater than or equal to 60 kg
4. No consumption of non-steroidal anti-inflammatory drugs and acetyl salicylic acid in the last 3 days with absence of any illness
5. Time lapse of at least 3 months since last whole blood donation and time lapse of at least 3 days since last platelet pheresis donation.
6. Adequate venous access
7. Written informed consent will be obtained before the procedure.
8. Tests for Haemoglobin, ABO Rh and TTI (Human

immunodeficiency virus (HIV) 1, 2 antibodies and hepatitis B surface antigen, hepatitis C antibody, malaria and syphilis).

Exclusion criteria

Blood donors who are unfit to donate blood according to standard blood donor s selectioncriteria (As per the Drugs and Cosmetics Act, 1940).

Sample size- Minimum required sample size - 150

Statistical Analysis- Data was entered into MS-EXCEL and statistically analysed using SPSS software Version Demographic details will be given in descriptive statistics. Quantitative data will be given in summary statistics. Pre- and post-procedure parameters analysed using paired "t" test. Pearson s correlation was used for analysing correlation between variables. P <0.05 was considered significant.

OBSERVATION & RESULTS

Table 1- Age And Sex Distribution Of Donors

Age groups (In years)	Number	Percentage
< 20	10	6.67%
20- 30	91	60.7%
31- 40	39	26%
41- 50	8	5.3%
>50	2	1.33%
Sex		
Male	148	98.67%
Female	2	1.33%
Total	150	100%

Mean Age = 28.5 years

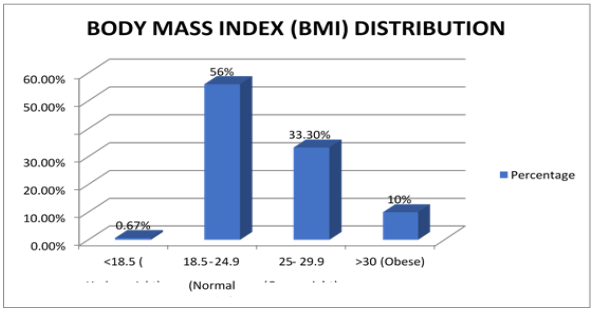
Table 2- Mean Height And Mean Weight Of Donors

MEAN HEIGHT (Cm)	171.7
MEAN WEIGHT (Kg)	74.7

Mean height of donors in our study was 171.7 cm and mean weight was 74.7 kg.

Table 3- Body Mass Index (bmi) Distribution

BMI [Wt (kg)/ height^2 (m^2)]	Number	Percentage
<18.5 (Underweight)	1	0.67%
18.5- 24.9 (Normal weight)	84	56%
25- 29.9 (Overweight)	50	33.3%
>30 (Obese)	15	10%
Total	150	100%

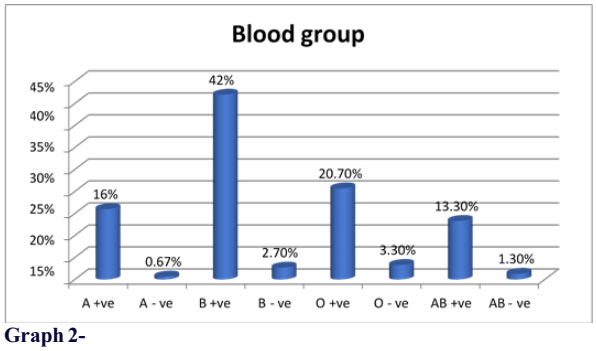


Graph 1-

In our study majority of donors (56%) were of normal weight i.e. BMI- 18.5- 24.9, followed by 33.3% who were overweight i.e. BMI- 25- 29.9. 10% were obese and only 1 donor was underweight.

Table 4- Blood Group Of Donors

BLOOD GROUP	Number	Percentage
A +ve	24	16%
A - ve	1	0.67%
B +ve	63	42%
B - ve	4	2.7%
O +ve	31	20.7%
O - ve	5	3.3%
AB +ve	20	13.3%
AB - ve	2	1.3%
TOTAL	150	100

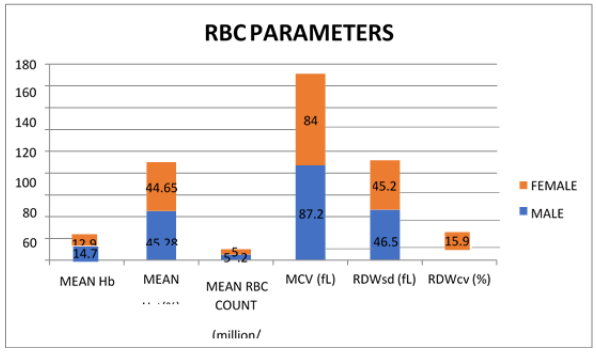


Graph 2-

Above table states that maximum donors i.e. 42% had B +ve blood group, followed by 20.7% who had O +ve blood group, followed by 16% who had A +ve blood group, and 13.3% who had AB +ve blood group. 3.3 % had O –ve blood group, followed by 2.7% who had B –ve blood group, 1.3 % had AB – ve blood group and only 0.67% had A –ve blood group.

Table 5- Rbc Indices In Donors

RBC PARAMETERS	MALE	FEMALE
MEAN Hb (g/dl)	14.70	12.9
MEAN Hct(%)	45.28	44.65
MEAN RBC COUNT (million/ mm^3)	5.2	5
MCV (fL)	87.2	84
RDWsd (fL)	46.5	45.2
RDWcv (%)	15.98	15.90



Graph 3-

Mean Hb of males and females was 14.7 g/dl and 12.9 g/dl respectively. Mean Hct of males and females was 45.28 % and 44.65% respectively. Mean RBC count of males and females was 5.2 million/ mm^3 and 5 million/ mm^3 respectively. Mean RDW sd and Mean RDW cv in males was 46.5 fL and 15.98 % respectively. Mean RDW sd and Mean RDW cv in females was 45.2 fL and 15.90 % respectively.

Table 6-platelet Yield Distribution Among Platelet Apheresis Donors

Platelet yield (10^{11}/unit)	No. of donors	%
<2	3	2
2.1 – 2.5	34	22.7
2.6 – 3	84	56
>3.0	29	19.3
TOTAL	150	100%

The mean platelet yield was $2.7x10^{11}$/unit (range 1.3- 4.6)

Table 7- Correlation Of Platelet Yield With Demographic Data And Rbc Indices

	CORRELATION COEFFICIENT AND p VALUE
AGE	0.3861 (<0.05)
GENDER	0.177 (>0.05)
BLOOD GROUP	0.61 (>0.05)
WEIGHT	0.45 (<0.05)

HEIGHT	0.2999 (<0.05)
BMI	0.3272 (<0.05)
Hb	-0.22 (<0.05)
Hematocrit	-0.217 (>0.05)
RBC count	-0.217 (>0.05)
MCV	-0.048 (< 0.05)
RDWsd	-0.312 (>0.05)
RDWcv	-0.022 (>0.05)

A positive correlation was observed between the yield of platelets and the following donor variables: Age (r = 0.3861), gender (r=0.177), blood group (r=0.61), weight (r = 0.45), height (0.2999) and BMI (r = 0.3272). This correlation was significant with age, weight, height and BMI. While platelet yield had negative correlation with Hb count (r= -0.22), hematocrit(r=-0.217), RBC count(-0.217), MCV (r= - 0.048), RDW sd (r = -0.312) and RDW cv (r= -0.022). This correlation was significant with MCVand Hb.

DISCUSSION

Globally, blood transfusion services have seen a major change in the process of blood donation through the advent of automated technologies. There has been a constant demand for recruitment of donors and a mismatch in the demand-supply chain of blood components as seen in the statistics issued by World Health Organisation.[17,19]Hence, blood transfusion services need to maintain a fine balance between a good donor base and optimal with rational usage of platelet products, a scarce resource material.

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. In the present study, effect of donor parameters on platelet yield was evaluated which may help clinicians and blood bank personnel in selecting appropriate donors for plateletpheresis effectively in less time.

A total of 150 donors had undergone plateletpheresis procedure during the study period using Fresenius Kabi COM.TEC apheresis machine (continuous flow cell seperator). In the present study, mean age of all plateletpheresis donors was observed to be 28.5 years with majority 91 of the donors belonging to the younger age group: 20-30 years (n=91; 60.7%) as seen in a similar study conducted by Suresh B et al [5] (n=55;61.1%) .In the present study majority of participants (148) were males, and only 2 were females. The results are similar to study of Suresh B et al and Patidar et al [13]. Voluntary blood donation among female gender is low in our ethnic population. The major reasons might be attributed to the prevailing anaemic status of our female population failing to meet the minimal eligibility requirements (i.e. hemoglobin).
A positive correlation was observed between the yield of platelets and age (r = 0.3861) along with height (r = 0.2999). Since there are only 2 female donors, it was not possible to calculate correlation of gender and platelet yield. Similarly study Of Geetha et al [14] showed a positive correlation with age(r=0.386, p>0.05). In contrast, negative correlation was observed by Arun et al.[15] In our study, coincidentally patients with more age were found to have more weight, hence more blood volume, more available platelets, better the yield.

In the present study, the mean weight was 74.7 kgs similar to a study conducted by Mangwana S et al [16] (77.32±23.53) but was lower than the studies conducted by Sachdeva et al [28] (72±11.1) and Patidar et al [13] (71.86±9.79). Our study showed a strong positive correlation with weight(r=0.45, p<0.05). Similar findings were observed by Mangwana S et al[17], Arun et al[18],Patel J et al[19] and Chaudhary R et al[20]. 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.

In the present study, the mean BMI was 22.73±3.39 with majority belonging to normal category based on WHO classification, i.e., 18.5-24.9 (n=84; 56%) similar to a study conducted by Mangwana S et al [16] (22.80±8.32).Obesity definition and grading are evaluated based on body mass index (BMI) by the weight/height (kg/m^2) formula.Fantuzzi et al.[22] reported that the increase in adipose tissue in obesity triggers inflammation, while a study conducted by Farhangi et al.[23] showed that the platelet count increases with inflammation. On the contrary Guo N [21] stated that there was no statistically significant relationship between platelet count and BMI groups (p=0.134). 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.

Maximum plateletpheresis procedures performed belonged to Human Blood Group “B” Rh “D” positive (n=63; 42%). When considering a platelet transfusion, one must consider the ABO compatibility of the platelets themselves, as well as the accompanying plasma. Platelets, like red blood cells (RBCs), express ABO antigens, although expression is variable and strongly expressed in only 4% to 7% of individuals.[1] Platelets are also suspended in roughly 1 unit of donor plasma, which contains the ABO antibodies predicted by the donor blood type . Platelets do not express Rh antigens but contain small numbers of RBCs or fragments, which can cause alloimmunization to red cell antigens, including the RhD antigen when platelets obtained from RhD-positive donors are transfused to RhD-negative recipients. Unlike RBCs, platelets are not at risk for intravascular hemolysis when transfused out of group. However, the accompanying plasma may cause hemolysis when ABO incompatible with recipient RBCs. Because of this risk, AABB standards require transfusion services to have policies concerning transfusion of components that contain significant amounts of incompatible ABO antibodies.[2]

Mean hemoglobin of males and females was 14.7 g/dl and 12.9 g/dl respectively. Mean hematocrit of males and females was 45.28 % and 44.65% respectively. Mean RBC count of males and females was 5.2 million/ mm^3 and 5 million/ mm^3 respectively. Mean MCV in males was 87.2 fL and females was 85 fL . Pre-donation haemoglobin concentration is another donor factor that can affect the yield.In our study platelet yield had negative correlation with Hb count (r= -0.22). On the contrary correlation of pre-donation hemoglobin concentration of the donor with platelet yield was observed by Mangwana S,[16] (r=0.022, p>0.05) while similar results were seen in Patel J et al, [19] (r = -0.001, P > 0.005), Das SS et al,[9] and Chaudhary R et al,[20] (r = - 0.05 & r = -0.1 respectively, P>0.005). Negative correlation with donor pre-aphaeresis haemoglobin levels and yield was observed by Guerrero-Rivera et al.[23] and Enein AA et al, [24] (r = - 0.306).. Similarly, negative correlation was observed by Arun et al.[18].On the contrary Badami KG [25] found a positive correlation between platelet yield and either haemoglobin (r = 0.063) or haematocrit (r = 0.021).While as positive correlation between platelet yield and donor haemoglobin and haematocrit have been found in some studies[17]. No correlation was observed between the haemoglobin concentration and platelet yield in another study. 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 concentrationthereby giving a higher platelet yield [19].

Mean RDW sd and Mean RDW cv in males was 46.5 fL and 15.98 fL respectively. Mean RDW sd and Mean RDW cv in females was 45.2 fLand 15.90fL respectively. In our study a negative correlation was also observed between the yield of platelets and the haematocrit(r=-0.217), RBC count(r=-0.217), MCV(r=-0.048), RDW sd (r=- 0.312), and RDW cv (r= -0.022) but it was only statistically significant with MCV. Red cell distribution width (RDW) is defined as a coefficient of variation of circulating red cells. It is affected by changes of red cell volume and is measured in the routine complete blood count (CBC).

CONCLUSION-

There are multiple factors affecting the yield of SDP. There is a negative correlation between donor's pre donation Hb, MCV and platelet yield. Platelet yield correlated positively with age, height, weight and BMI also. 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.

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