DOI: NJLM/2015/8829:2077

Original Article

Pathology Section

Apheresis Platelets: A Study of Effect of Donor Variables on Outcome of Plateletpheresis

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ABSTRACT

Introduction: Use of single donor platelets (SDP) has increased by leaps and bounds over past few years. SDP not only increase the purity of product in terms of decreased cellular contamination but also increases the overall yield of platelet collected. However, yield of SDP is known to be influenced by various donor variables.

Aim: To study the effect of various donor variables such as age, weight, height, pre donation Hb concentration, TLC, platelet count and indices on the yield of platelets.

Materials and Methods: The present study included the outcome of 225 plateletpheresis procedures that were conducted on Haemonetics MCS+ intermittent flow cell separator (Haemonetic Corporation, Braintree, Massachusetts, USA). Statistical analysis was done to establish cause and effect relationship and to find the extent of relationship between different variables.

Results: Platelet yield showed high statistical significance with pre donation platelet count and its indices (p =0.001). Statistical significant negative correlation was seen between pre donation Hb concentration and the platelet yield (p =0.003). No statistical significance was seen height (p=0.708), weight (p=0.217) and pre donation WBC count (p=0.217) of donor on platelet yield.

Conclusion: Identification of interventions that could increase pre donation platelet would have a substantial beneficiary effect on platelet product yields and thereby leading to better platelet recovery in the recipient.

Keywords: Haemoglobin, Transfusion, Yield

INTRODUCTION

Transfusion medicine in India has taken a giant leap forward in platelet transfusion practices over the recent decade. A steep increase in the demand of single donor platelets (SDPs) has been noted with the introduction of advanced cell separators. This in turn has prioritized the need for harvesting maximum yield of platelets of good quality. The desired product of platelets has evolved from a unit containing whole buffy coat (that contained other than platelets, granulocytes, lymphocytes and monocytes) to a unit with a mammoth sum of platelets (to the tune of 3×10^{11}/ bag according to AABB standards) with no detectable red cells and $< 5\times 10^{6}$ lymphocytes. They carry additional benefits of lowered risk of exposure to transfusion transmitted infections (when compared to pooled platelets), alloimmunization and febrile non haemolytic transfusion reactions particularly in multi transfused aplastic anaemia or cancer patients. Platelet recovery in a recipient is affected by several variables and clearly the transfused dose of platelets is of paramount importance. This in turn is influenced by quality of platelet product particularly in terms of yield [1].

One of the main limitation of SDP is its cost, a reason why random pooled platelet concentrates are being resorted to some centres in a developing country like India. Yet cell separators are now increasingly available and their benefits can be easily accessed. The increasing demand of SDP's have also stressed on the need of eligible platelet donors from whom quality product of optimum yield can be harvested so as to achieve maximum increments in a recipient. Donor related factors namely age, sex, weight, height , haemoglobin (Hb), total leukocyte count (TLC), haematocrit and platelet count, platelet indices -Mean platelet volume (MPV), Platelet deviation width (PDW) have been thought to influence platelet yield. Of these donor factors, pre donation platelet count is considered most important. Trials of doses of platelet growth factors and their response in augmenting platelet counts and safety in human volunteers is already underway and show headway towards positive outcomes [2].

In the present study attempt has been made to study the effect of various donor variables such as age, weight, height, pre donation Hb concentration, TLC, platelet count and indices on the yield of platelets. Few studies have published the influence of such variables on the platelet yield in SDP's and to the best of our knowledge only an occasional study has been reported from Indian subcontinent.

MATERIALS AND METHODS

The present study included the outcome of 225 platelet-pheresis procedures that were conducted on Haemonetics MCS+ intermittent flow cell separator (Haemonetic Corporation, Braintree, Massachusetts, USA) over a period of four years from January 2009 to January 2013. It employs single venous access utilising closed collection apheresis kits with efficient leukoreduction. Study was undertaken at blood bank SSKH & KSCH associated with Lady Hardinge Medical College, New Delhi and a tertiary care Central Government Teaching Institute. All the donors were screened and selected as per the donor eligibility criteria laid down by the Drugs Controller of India [3] and the procedures were performed stringently as per standard operating procedures (SOP's) of the department. Blood flow rate for all plateletpheresis were maintained at 45–90 ml/min with anticoagulant (ACD-A) ratio of 12:1. At least 1% of all apheresis units underwent quality control. Though the machine calculated the platelet yield of SDP unit. It was also confirmed manually. To calculate the yield as well as to run the quality control, approximately 1 ml sample from each bag was collected in EDTA (K2 EDTA) following stripping of the tube segment. The samples were allowed to be mixed thoroughly over a mechanised blood mixer (Techno FAB, India) for quarter of an hour and then evaluated by Sysmex KX 21 haematology analyser .Platelet content and cellular contaminants were determined. Before each procedure was undertaken, samples from donor were similarly evaluated for haemoglobin (Hb), total leukocyte count (TLC), haematocrit and platelet indices (count, MPV, PDW). Other donor variables such as age, gender, weight and height were also documented for analysis. The various factors possibly affecting platelet yield were studied using chi-square test and calculating p value using SPSS software version 9.0 for Windows.

RESULTS

The age and haematological parameters of healthy donors is enlisted in [Table/Fig-1]. Out of 225 donors, there were 220 (97.78%) male donors and 5 (2.22%) female donors. The mean platelet count was 246.951± 60.252 per/µl which was higher in females; 282.55 ± 52.46 per/µl than in males; 200.91 ± 54.45 per/µl. Men had significantly higher pre donation haemoglobin (16.70 ± 0.88) than in women (12.10 ± 0.78 gm %). The mean values of pre donation haemoglobin was 14.85±1.079 gm/dl

The mean platelet yield was 3.20 ± 0.6315 (1.5 -6.2 × 10^{11}/µl). Platelet yield showed high statistical significance with pre donation platelet count (p =0.001) The pre donation platelets were divided into four groups (group 1:150-200 × 10^3/µl, group 2: 200-250 × 10^3/µl, group 3- 250-300 10^3/µl and group 4-> 300 x 10^3/µl). Out of 225, 57 donors fell in group 1, 70 in group 2, 59 in group 3 and 39 in group 4 as shown in [Table/Fig-2].

The yield ≥ 3 × 10^{11}/µl was seen in 27/57 (47.4%) group 1, 51/70 (72.9 %) in group 2, 56/59 (94.91%) in group 3 and 38/39 (97.4%) in group 4. Hence, the platelet yield progressively increased from group 1 to group 4 [Table/Fig-2]. Other than pre donation platelet counts, SDP yield also showed statistical significant correlation with PDW and MPV (p value of 0.001 each).

Parameter	Range	Mean ±SD
Age(years)	25-32	28.5±3.86
Height(inches)	6 -6.1	5.56±.2518
Weight(kgs)	50 -120	69±11.297
Hb(gm/dl)	12.40 -17.70	14.85±1.079
WBC(/ µl)	4.400 -11.450	7.415±1.57
Platelets (10^3/µl)	150-470	246.951± 60.252
PDW(%)	9.20-45.60	14.4196±4.233
MPV (fl)	7.9-15.20	10.6124 ± 1.425

[Table/Fig-1]: The age and haematological parameters of healthy donors is enlisted

Platelet group	Group 1	Group 2	Group 3	Group 4
Yield >3 X 10^{11}/µl	27	51	56	38
Total	57	70	59	39
Percentage (%)	47.36	72.85	94.91	97.43

[Table/Fig-2]: Showing correlation of platelet yield with pre donation platelet count of healthy donors

Platelet yield	Hemoglobin >15gm/dl	Hemoglobin < 15gm/dl
Yield > 3× 10^{11}	62 (59.04%)	99 (82.5%)
Yield> 3× 10^{11}	43 (40.95%)	21 (17.5%)
Total	105	120

[Table/Fig-3]: Showing correlation of platelet yield with hemoglobin levels of healthy donors

Statistical significant negative correlation was seen between pre donation Hb concentration and the platelet yield (p =0.003). There was a trend that a donor with lower Hb concentration gave a comparatively higher platelet yield. Out of 225, 105 donors (46.66%) had Hb > 15 gm/dl and 120 (53.33%) had Hb < 15 gm/dl [Table/Fig-3]. Only 59.04% (62) of donors with pre donation Hb > 15 gm/dl had yield >3 × 10^{11}/µl.82.5% (99/120) of donors with pre donation Hb < 15 gm/dl had yield >3 × 10^{11}/µl [Table/Fig-3]. However, no statistical significance was seen height (p=0.708), weight (p=0.217) and pre donation WBC count (p=0.217) of donor on platelet yield.

DISCUSSION

Use of SDP has increased by leaps and bounds over past few years. SDP not only increase the purity of product in terms of decreased cellular contamination but also increases the overall yield of platelet collected.

There are few studies in literature that study the effect of these variables on platelet yield, particularly in a developing country

like India. To optimize the yield of apheresis products donors should be chosen carefully and vigilantly.

Goodnough et al., studied 708 plateletpheresis procedures performed on 533 donors having mean pre-donation platelet count of 237 ± 49x10^3/µl which resulted in platelet product with mean yield of 4.24±1.1x10^{11}. A direct linear correlation was observed with all the procedures [4].

Das SS et al., studied 61 plateletpheresis procedures. Pearson correlation of 61 procedures indicated good direct linear correlation between pre-donation platelet count and yield for all procedures ($r = 0.51$, $p < 0.001$) [5].

A direct positive relationship was observed between pre-donation platelet count and yield (r=0.50, p<0.001) by Chaudhary R et al.,[6].

In this study, mean pre donation platelet count was 246.951± 60.252 per µl which resulted in platelet product with yield of 3.20 ± 0.6315 x 10^{11}. Results of present study were also in accordance other authors and found a statistically significant positive correlation between the platelet yield and pre-donation platelet count (p<0.001).

However, in contrast to earlier studies we divided the pre donation platelet count into 4 groups and found that yields was highest with group 4 closely followed by group 3 with a progressively increasing trend seen from group 1 to group 4.

According to the American Association of Blood Banks (AABB) [7], 75% of the SDP must contain >3 × 10^{11} per/unit while the European guidelines [8] recommend a platelet count >2 × 10^{11}/unit. Our blood bank follows guidelines laid down by Drugs Controller of India which are largely based on American Association of Blood Banks (AABB) standards in this respect [3].

Out of 225, 173 (76.88%) of SDP's met the AABB criteria. Only 53 (23.5%) of SDP's had platelets < 3 × 10^{11}/unit. Out of 53, 30 (56.6%) of these SDP's had pre donation platelet count between 150-200 × 10^3/µl. Similar results were shown by Chaudhary et al., in 2006 with a yield of >3 × 10^{11}/unit in SDP with the pre donation platelet count >300 × 10^3/µl [6]. Study by Goodnough et al., [4] and Hester et al., [9] also showed similar results.

The platelet yield is significantly increased if the pre donation platelet count is >250 × 10^3 with 56/59 donors giving yield of ≥3 × 10^{11} platelets but this would also mean loss of large number (127/225 i.e. 56.44%) of eligible donors for plateletapheresis if the criteria of pre donation platelet count is increased to 250×10^3 [Table/Fig-3].

Pre donation Hb is another significant factor that influences platelet yield. Present study reports statistically significant negative correlation with pre donation Hb and platelet yield (p=0.003).

Only 59.04% (62/105) of donors with pre donation Hb >15 gm/dl had platelet yield platelet yield of ≥3 × 10^{11}. 82.5% (99 out of 120) of donors with pre donation Hb <15 gm/dl had platelet yield of ≥3 × 10^{11}. Guerrero-Rivera et al., also demonstrated an inverse relationship of Hb with platelet yield (r=-0.554) [1]. This can probably be due to higher plasma volume processed in donors with low Hb concentration thereby giving a higher platelet yield.

No significant correlation was observed between age, height and weight on platelet yield. (p > 0.005) Similar results were seen by Buchholz et al., [10] and Chaudhary et al., [6].

CONCLUSION

Hence, in the present study, we found platelet yield showed positive statistical significance with pre donation platelet count and negative correlation with pre donation haemoglobin.

Unfortunately while the demand of SDP is growing, the need for cost containment and availability of eligible and good platelet donors has also grown.

Varying platelet growth factors are in clinical trial phase for transiently increasing platelet count in platelet donors. The technical advances in the equipments and therapeutic interventions will in time enhance the ability of blood banks to provide high quality SDP more efficiently.

REFERENCES

[1] Guerrero-Rivera S, Gutierrez-Espindola G, Talavera JO, Meillon-Garcia LA, Pedraza-Echevarria M, Pizzuto-Chavez J. Hemoglobin and platelet count effect on platelet yields in plateletpheresis. *Arch Med Res*. 2003; 34:120–22.

[2] Tomita D, Petrarca M, Pane T, Olson K, Roskos L, Cheung E. Effect of a single dose of pegylated human recombinant megakaryocyte growth and development factor (PEGrHuMGDF) on platelet counts: Implications for platelet apheresis. *Transfusion*. 1997: 37; 3241-48.

[3] Saran, R. K. (2003) Apheresis. In: Transfusion Medicine Technical Manual. Ministry of Health and Family Welfare, Govt. of India, New Delhi, India.pp.229-44.

[4] Goodnough LT, Kuter D, McCollough J, Brecher ME. Apheresis platelets: emerging issues related to donor platelet count, apheresis platelet yield, and platelet transfusion dose. *J Clin Apheresis*. 1998; 13:114–19.

[5] Das SS, Chaudhary RK, Shukla JS. Factors influencing yield of plateletpheresis using intermittent flow cell separator. *Clin Lab Haematol*. 2005;27:316-19.

[6] 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(2):157-61.

[7] Tyler V, Brecher M, Pisciotto P, Pierce S, editors. Technical American Association of Blood Banks Manual, 13th ed. Bethesda: Maryland, USA. 1999; p. 1-798.

[8] Recommendation No. R (95) 15. Guide to the preparation, use and quality assurance of blood components 7th ed Strasbourg,France: *European Council Press*. 2001; p 123.

[9] Hester JP, Ventura GJ, Boucher T. Platelet concentrate collection in a dual stage channel using computer generated algorithms for collection and prediction of yield. *Plasma Ther Transfus Technol.* 1987; 8:377–85.

[10] Buchholz DH, Squires JE, Herman JH, Ng AT, Anderson JK, Hedberg SL. Plateletpheresis in 90 to 110 pound donors using the CS3000 blood cell separator. *Transfusion*. 1997; 37:715–18.

[11] 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 transfusions therapy. *Vox Sang.* 1999;76:43-49.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Publishing: **Oct 01, 2015**