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ASSESSMENT OF MACHINE RELATED FACTORS AFFECTING PLATELET YIELD IN SINGLE DONOR PLATELETS

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ABSTRACT

Background: The quality of single donor platelets (SDP) in terms of yield influences the platelet recovery in the recipient. Various machine/procedure related factors such as volume of whole blood processed and time taken for the procedure may affect platelet yield.
Aim: The aim of present study was to assess the effect of various machine/procedure related factors on platelet yield.
Materials and methods: A total of 171 plateletpheresis procedures performed using continuous flow cell separator (Amicus Automated Blood Collection System version 2.52/3.1) were evaluated for platelet yield.
Results: The mean platelet yield was 3.8 + 1.65 X 1011 /unit. Platelet yield correlated positively with total whole blood processed (r=0.503; p < 0.001), time taken for the procedure (r = 0.284; p < 0.001) and ACD used (r = 0.519; p < 0.001). No correlation was observed between MIR and platelet yield (r = 0.101; p = 0.248).
Conclusion: Appropriate importance should be given to various machine/procedure related factors during the plateletpheresis procedure to have improved product quality.

Introduction

Platelets can be prepared either from whole blood or by apheresis technology. There has been substantial increase in production of apheresis platelet products also called as Single donor platelet (SDP) products [1]. This is because of their several advantages like reduced donor exposure, higher therapeutic dose, ability to collect multiple units from a single donor, reduced risk of transmission of infections and decreased chances of alloimmunization, thus decreased platelet refractoriness [2-4]. SDP transfusion provides transfusion support in patients on chemotherapy for various haematological disorders [5]. Platelet recovery in the patient is influenced by dose of platelets, which in turn is dependent on the quality of platelet product in terms of yield [6]. Automated apheresis techniques became available in 1975 and since then there have been various technical modifications and standardization so as to enhance platelet yield and collect better quality products. The new generation cell separators have made it possible to obtain high quality platelets with minimum donor manipulation [7].

There are two types of apheresis equipment available those based either on intermittent or continuous centrifugation. Various donor and machine/procedure related parameters can affect platelet yield [8]. There have been many studies on effect of donor haematological parameters on the platelet yield but few have studied the effect of machine/procedure related factors on platelet yield [9]. The aim of present study was to analyze various machine/procedure related factors such as volume of whole blood (WB) processed, time taken for the procedure, maximum inlet rate (MIR) and the amount of anticoagulant used.

Materials and methods

The study included all the donors who met the donor eligibility criteria as laid down by the Drug Controller of India [10]. The plateletpheresis procedures were performed as per the standard operating procedure (SOP) of the department on a continuous flow cell separator (Amicus Automated Blood Collection System version 2.52/3.1) using closed system apheresis kits over a period of one and a half year at our department [11]. The platelets are separated from the RBCs and WBCs in a belt shaped chamber with two compartments. After the elutriation process (one of the mechanism involved in concentrating the platelets), platelets reside in hyper concentrated form, so called dry platelets within the collection chamber until being manually re suspended in platelet poor plasma and transferred to the final storage bag. The machine/procedure related parameters which can have an effect on the platelet yield were assessed. These included the maximum inlet rate (MIR), the mean procedure duration, the total blood volume processed during plateletpheresis procedure, and the mean amount of anti-coagulant (ACD) infused to the donor. After the procedure, it was ensured that the segment in the collected bag was kept approximately 15cm for sampling to calculate the platelet yield. Approximately 1ml of sample from each bag was collected after through stripping of the segment to ensure representative product of the bag and subjected to determination of platelet count after appropriate dilution (one: five) with sample diluents on an automated hematology analyzer or with ammonium oxalate for manual count on Neubauer Chamber to calculate the yield [11,12].

Influence of machine related variables on the yield of platelets was studied by Pearson correlation coefficient and multivariate linear regression using SPSS Inc., Chicago, IL, and version 23.0 for Windows. All statistical tests were two-sided and performed at a significance level of $\alpha = 0.05$. A p value of < 0.05 was taken as significant.

Results

During the study period, a total of 171 healthy donors (mean age 28.1 ± 7.6 years) weighing 72 ± 11.1 kg underwent plateletpheresis procedure. The effect of machine related variables on the platelet yield was observed and shown in table 1. Platelet yield was found to be positively correlated with total whole blood processed (r=0.503; p < 0.001), time taken for the procedure (r = 0.284; p < 0.001) and ACD used (r = 0.519; p < 0.001). No correlation was observed between MIR and platelet yield (r = 0.101; p = 0.248).

Table 1: Machine/procedure related parameters

Machine/Procedure related parameters			
Variable	**Mean**	**Standard Deviation**	**Range**
Total ACD used (ml)	400.5	67.1	205-634
Total whole blood processed (ml)	3030.7	633	1080-5185
Time taken (min)	66.8	14.3	20-118
MIR (ml/min)	109.4	17.6	45-150

Discussion

Plateletpheresis has become a routine procedure in most of the

blood centres in developing countries. There have been significant improvements in productivity and quality of apheresis platelets which is affected by a number of variables. The present study addressed the effect of machine/procedure related variables on platelet yield. According to the AABB requirements[12], 75% of the plateletpheresis products prepared must contain ≥ 3 x 10^{11} platelets per unit, while the European guidelines (Council of Europe publishing, 2006) recommend platelet count of ≥ 2 x 10^{11}/unit [13]. These levels have been determined from the studies to provide required haemostatic dose to the recipient [14]. In our study 76% of products had platelet yield of > 3x 10^{11}/unit.

We found significant positive correlation between ACD used and platelet yield. It was observed that with increase in the amount of ACD used during the procedure, there was increase in the platelet yield. Our findings were corroborated from a study by Enein et al who also found that anticoagulant infusion rate had a positive impact on platelet yield [14]. Other variable which has significant positive correlation with platelet yield was volume of whole blood processed. Similar findings were reported by Enien et al who found that platelet yield correlated positively with total blood volume processed [14].

We studied the effect of time taken for the procedure on the platelet yield and observed that the platelet yield was positively related with the time taken for the procedure. Other studies also reported a positive correlation between processing time and platelet yield [14, 15]. Factors like maximum draw rate, maximum return rate, whole blood processed, processing time and pre-procedure platelet count could have a significant effect on the yield in plateletpheresis [16].

We observed no correlation between MIR and platelet yield. However, in contrast, Ogata et al while determining the effect of draw rate on platelet yield of apheresis products by discontinuous centrifugation found to have a significant positive correlation[17].

There were certain limitations in our study. We performed all the procedures on a single machine which was based on continuous separation mechanism. As this machine is based on formation of platelet pellet and then its re-suspension into the plasma, this could have effect on calculation of platelet yield if sufficient time was not allowed between the collection and re-suspension of product. More studies can be done on machines which are based on collection of platelet rich plasma (PRP) where no re-suspension is required. Factors like inlet line occlusion, return line occlusion and other alarms which were encountered during the procedure were ignored for the purpose of calculation of platelet yield. In addition, since double dose platelet collections (collection of two units from a single donor) were not performed in any of our cases, we could not address issues regarding quality of products in these settings. Percentage platelet recovery is another better indicator of how efficiently a machine can collect platelets and measurement of this parameter would be more advantageous than platelet yield alone.

Hence, appropriate importance should be given to various machine related factors during the plateletpheresis procedure to have improved product quality. However, donor safety and convenience should not be overlooked and the procedure should have minimum adverse effects on the donor.

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