Factors Influencing Platelet Apheresis Yield and Effects of Donation among Platelet Apheresis Donors

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ABSTRACT

Introduction: The development of transfusion medicine involving single donor apheresis (SDP) or platelet apheresis has many advantages especially producing high platelet yield. The aim of the study was to investigate the donor and procedure (machine related) factors influencing the platelet apheresis yield.

Materials and Methods: It was a prospective study involving thirty-five apheresis blood donors. Age, height, weight, frequency of donation, pre donation haemoglobin level, pre donation platelet count and ABO blood group were included as donor related variables. Anticoagulation infusion rate, processing time and plasma volume collected were assessed as procedure related parameters. We evaluated the post-donation effectiveness by studying the effect of platelet count, haemoglobin level, and haematocrit count and serum ferritin.

Results: The platelet apheresis yield correlated positively with pre donation platelet count \( (r = 0.596) \) and negatively with height \( (r = -0.338) \). Anticoagulation infusion rate and processing time had a positive impact on the platelet apheresis yield. There was a significant difference between pre- and post-donation of platelet count, haemoglobin level and haematocrit count with post-donation had a lower level. A positive correlation between serum ferritin level and platelet apheresis yield was found.

Conclusion: Optimization of the platelet apheresis yield by identifying donor and procedure factors related to machine may help in screening donors and selecting certain procedure to obtain high quality and productivity of platelet collection.

KEY WORDS platelet, apheresis, yield, donors, procedure

INTRODUCTION

Single donor platelet (SDP) also known as platelet apheresis is a collection process of platelet using automated blood separator machine. It is the greatest evolution in transfusion medicine and has more advantages to patients especially to those who develop refractoriness due to frequent transfusion. Furthermore, platelet apheresis is able to minimise the risk of donor exposure, transmission of infection and platelet alloimmunization. It also promotes less hospital preparation including pooling and point of care for bacterial testing.

However, stringent regulations were implemented for donors who participated in a serial apheresis program (more than once in 4 weeks)\(^2\). Regular donors required a proper assessment and careful monitoring of their age, height, weight, pre donation platelet count, pre donation haemoglobin level and haematocrit level. These donor related variables contributed to a good platelet yield collection\(^2\). Previous study also reported that procedure related parameters including processing time, duration of the procedure, anticoagulation infusion and plasma volume collected had a significant effect to the platelet apheresis yield\(^2\).

The aim of the present study was to determine donor related variables and procedure related parameters on platelet yield apheresis. The donor related variables including age, weight, height, frequency of donation, pre donation haemoglobin level, pre donation platelet count and ABO blood group. Procedure related parameters included were anticoagulation infusion rate, processing time and plasma volume collected. We also evaluated the post-transfusion effectiveness by estimating platelet count, haemoglobin level, haematocrit count and iron status.

MATERIALS AND METHODS

Apheresis Donors

It was a prospective study of 35 apheresis donors from who had been registered with Transfusion Medicine unit, Hospital USM within one year duration. All donors had fulfilled the inclusion criteria with age ranging from 18-55, weight > 55 kg with a good venous access and a pre platelet count > 200 x 10\(^9\)/L. The approval and ethical clearance were attained from the Human Research Ethics Committee, Universiti Sains Malaysia (USM/JEPeM/17100421).

Apheresis Procedure

Trima Accel cell separator machine (TerumoBCT, Lakewood, USA) was used for apheresis procedure. The apheresis procedure was performed as per standard operating procedure using a separation chamber. The blood flow rate was maintained at 40-50 mL/min for all collections with anticoagulant ratio (ACD-A) of 12:1. The target end points were set at 3 x 10\(^9\)/L. Pre- and post-donation blood test were performed using Sysmex XE-5000 (Sysmex Corporation, Kobe, Japan) and Bio Architect Plus (Abbott, NYSE, USA). Platelet apheresis yield produced by the
RESULTS

The mean age of donors was 39.8 years (range 25-50 years). The majority (85.7%) of donors were Malays. All the donors were males. A donor was considered to be frequent donors when they donated twice per month persistently. A negative and positive correlation of height (r = -0.338) and pre donation platelet count (r = 0.596) were observed in influencing the platelet apheresis yield, respectively. No significant correlation was observed between age, weight, pre haemoglobin level and frequency of donation with the platelet apheresis yield (Table 1). ABO blood group of donors also had no significant correlation with the platelet apheresis yield (Table 2).

There was a significant difference between pre- and post-donation of platelet count, haemoglobin level and haematocrit level (Table 4). Post-donation level of these three variables was lower than the pre-donation level. There was a positive correlation between serum ferritin level and platelet apheresis yield (Table 5).

In our study, we investigated the factors influencing platelet apheresis yield in terms of the donor related variables (age, height, weight, frequency of donation, pre donation of haemoglobin level, pre donation platelet count and blood group) and procedure related parameters (anti-coagulation infusion rate, processing time and plasma volume). We also evaluated on pre- and post-donation of platelet count, haemoglobin level and haematocrit count among apheresis donors. All of these factors played a significant role in optimizing the platelet collection and improving the clinical and economic constraints.

On the evaluation of donor related variables, we found that age and weight had no significant correlation with the platelet apheresis yield. Consistent with previous studies suggested that no significant correlation between age and weight with platelet apheresis yield (1). A significant negative correlation was observed between height and the platelet apheresis yield. This could be explained based on body mass index (BMI) as it was previously reported a positive correlation with platelet yield. Based on BMI formulation height is inversely proportionate to BMI, thus, a donor who is shorter could have a higher BMI index reading relatively (2).

In this study, the frequency of donation had no significant correlation with platelet apheresis yield as the majority of the samples were not frequent donors as they have long time lag between each donation. In contrast, previous study demonstrated a positive correlation between the frequency of donation and platelet yield. This could be triggered by megakaryocyte receptors that found on circulating platelets and endothelial cells. These receptors were up regulated in the frequent donors and helped to raise back their platelet level after every bout of donation (3).

Pre donation haemoglobin level also had no significant correlation with the platelet apheresis yield as all donors were male. Previous studies reported that pre donation haemoglobin level had an inverse relationship with platelet yield (4). The higher platelet apheresis yield possibly due to the repulsive increase in platelet count among the female donors with low haemoglobin level prior to donations (5). In term of pre donation platelet count, it had a positive correlation with the platelet yield. This was supported by previous studies showed that a positive correlation between pre donation platelet count and platelet apheresis yield (6). On the evaluation of donor related variables, we found that age and weight had no significant correlation with the platelet apheresis yield. Consistent with previous studies suggested that no significant correlation between age and weight with platelet apheresis yield (1). A significant negative correlation was observed between height and the platelet apheresis yield. This could be explained based on body mass index (BMI) as it was previously reported a positive correlation with platelet yield. Based on BMI formulation height is inversely proportionate to BMI, thus, a donor who is shorter could have a higher BMI index reading relatively (2).

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The anticoagulation infusion rate and processing time showed a positive correlation with platelet apheresis yield. Consistent with previous study reported that a positive correlation between anticoagulation infusion rate and processing time with platelet yield as both of these parameters increased pump rate and blood passes resulted in higher platelet collection. Furthermore, our data showed a negative correlation between plasma volumes collected with the platelet apheresis yield probably due to shorter procedure time in the Trima Accel machine.

The platelet count, haemoglobin level and haematocrit count among donors were a significant difference between pre- and post-donation. Consistent with previous studies that a significant difference of platelet count, haemoglobin and haematocrit level between pre and post donation. Approximately 20% reduction of platelet count between pre- and post-donation among our donors. This probably due apheresis procedure especially membrane separation method which contributed 15% decrease in platelet count. Haemorrhage associated with intravascular expansion may decrease by 10% of haemoglobin and haematocrit level in donor after donation. None of our apheresis donors experienced bleeding.

There was a positive correlation between serum ferritin and the platelet apheresis yield and this was not significant in apheresis donors with low serum ferritin level. This is because all male donors had been recruited in this study. Furthermore, our donors were not frequent donors and they had longer time lag between each donation. Serum ferritin gradually returned back to normal baseline in apheresis donor who has long time lag.

CONCLUSION

In order to optimize the efficacy of platelet apheresis yield, it is important to consider the donor related variables and procedure related parameters as both had significant effects in influencing the platelet yield. The identification of these factors may help in screening for a suitable donor and selecting the best cell separator machine to collect larger platelet yield for better clinical outcome.

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