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Impact of Platelet Apheresis on Donor Health

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ABSTRACT

Background: Blood platelet component collection, or platelet apheresis, was another blood collection method performed in blood donation centers to provide platelet products for patients with various diseases who required these cells for treatment. Concerns about the potential impact of frequent apheresis on donor health necessitated further investigation. This study aimed to evaluate the physiological and psychological effects of platelet apheresis on donor health.

Methods: A prospective observational study was conducted over six months at the Blood Bank of the Armed Forces Institute of Transfusion (AFIT) in Rawalpindi. The study included 100 voluntary single platelet donors aged 18 to 60 years. Inclusion criteria required donors to be in good general health with a platelet count of 150 × 10^9/L or above. Data were collected using a structured questionnaire, and blood specimens were obtained before and one hour after the plateletpheresis procedure. Health assessments, including blood pressure measurements, were conducted pre- and post-donation. Statistical analysis was done using SPSS version 27.0 and Microsoft Excel.

Results: Most donors reported minimal adverse health effects. No significant differences were found in donor experiences based on donation frequency, age, or gender, suggesting that frequent donations were feasible without compromising donor safety or comfort. It revealed that platelet apheresis was generally a safe and well-tolerated procedure.

Conclusions: The study confirmed that platelet apheresis was a reliable procedure with minimal impact on donor health. These findings supported the promotion of platelet apheresis in blood donation programs, highlighting its safety and feasibility. Future research should focus on assessing long-term effects and further improving donor experiences.

Keywords: Platelet Apheresis, Donor Health, Blood Donation, Physiological Effects, Safety.

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INTRODUCTION

Platelet apheresis also known as plasmapheresis is a platelet donation whereby only platelets are separated from the body and other blood components are returned. This technique is very important in transfusing platelets to patients who need them for different ailments including cancer, marrow complications or severe injuries and bleeding diathesis [1,2]. In contrast to whole blood donation, platelet apheresis enables the donors to give platelets more often and it is crucial for a constant platelets' stock in blood centers[3]. However, considering the side effects of aps frequent apheresis can have on the donors' new studies aiming at investigating the safety and the applicability of this method [4].

In medical treatments, the role that platelets play can really not be overemphasized. It's also found that platelets are essential in blood clotting and healing including in instances of wounds hence one is vulnerable to life threatening complications if he or she is suffering from cancer, chronic diseases or is a surgical candidate [5]. Since platelets are short-lived product with storage span of 5-7 days only, there is always a need for stock of platelets for transfusion. This demand requires regular platelet collections from a pool of donors and provokes the need to investigate the consequences of multiple platelet apheresis on donors' health and wellbeing [6,7].

Some of the complications, which may be related to platelet apheresis include; citrate toxicity, hypocalcemia, hypotension, and vasovagal reactions ether other [8,9]. In this case some of the donors may also feel some form of embarrassment or may even experience minor side effects such as dizziness or nausea while undergoing or after the process [10]. It is important to know how often they occur, and the degree of severity of these reactions to safeguard the donors, and also to have a favorable donating experience[11].

Platelet apheresis has been recognized to be safe and well tolerated in some studies while in other it has not been well accepted. In some of these studies, authors mention few side effects of the substance, while in other publications, authors are more concerned with the effects that might compromise the health of a user [12]. For instance, some of the research has pointed out that most of the donors seem to have low levels of tolerance to the procedure, with few of them having complications ranging from mild to moderate which impact on their willingness to be donors again [13]. On the other hand, other researchers have observed no substantial worsening in side effects presented by frequent givers implying that the donation procedure is safe more often than not for providers who give frequently [14].

Based on these different outcomes it is imperative to undertake further detailed studies to establish effects on donor health following platelet apheresis. This also involves determination of short and long-term consequences, determining how population characteristics like age and gender affect the experience and health of donors, and establishing how often the donating is done may also impact on the donor's experience and health [15]. Furthermore, appreciation of the risks for donors is especially significant with modern apheresis equipment and with the enhanced safety measures that are currently in place it has been stressed that there is need to update the donors about possible risks and benefits that are inherent in platelet donation [16].

The above gaps were therefore addressed in the present study by providing a comprehensive evaluation of the effects of platelet apheresis on donor health. Similarly, the current study adopted subjective measures such as donor-reported experiences and discomfort as well as objective health outcomes, including recovery time and other measurable health changes, to assess the safety and feasibility of platelet apheresis.

METHODS

The proposed cross-sectional study was carried out in the blood bank of the Armed Forces Institute of Transfusion, Rawalpindi for a period of six months in order to assess the outcome of whole platelet apheresis on the donors' health after approval from Institutional Review Board **(Ref: AFIT-ERC-24-47).** Altogether 100 voluntary single platelet donors of age group of 18- 60 years were included in the consecutive manner. Participants were selected based on the following criteria: they had to be in good general health, have platelet count of 150 x 10^9/L and above and exclude those with hemorheological diseases or using drugs that impair platelet function. The exclusion criteria used in this process were recent fever, donating within the 48-hour preceding the study, more than two donations within the one week prior the study, the current smoking status and history of vasovagal syncope while donating.

The participants were administered a structured questionnaire in order to obtain demographic characteristics, medical history and previous blood group donations made by the participants. This approach includes the use of questionnaires that aimed at eliciting various details from the respondents such as age, sex, how often they participate in blood donation, any diseases they have which can affect their health. As a first step, the participants were made aware of the study's purpose, tasks, and their freedoms and choices such as their ability to drop out from the study at any time with no consequences. Each patient signed a written informed consent and every patient agreed on the oral consent. This study followed departmental protocol and was granted the Institutional Review Board (IRB) of the Armed Forces Institute of Transfusion Medicine, Rawalpindi. The focus was to

secure the anonymity of the participants; therefore, participants were asked to provide identification numbers, and analysis was conducted based on the gathered composite data.

The plateletpheresis procedure was done using a conventional apheresis machine. Samples of blood were taken from each subject before the procedure and then after one hour as another way of measuring the procedure's impact. Pre- and post-donation, self-reported check-ups, blood pressure & general health status were also taken.

All statistical analysis was done using Statistical Package for Social Science version 27. 0 and Microsoft Excel. Mean and standard deviation were used in deriving the frequency and percentages of platelet counts done before and after the procedure. A range of parametric and non-parametric inferential tests were also used in order to evaluate the significance of the changes in donor health. These include Analysis of Variance (ANOVA) to compare the platelet count of the groups; Chi-Square Test to test the categorical variables; and T test or Mann Whitney U Test to compare the means of the paired and unpaired groups respectively. Descriptive Analysis was used to examine Donor characteristics, while Statistical Analysis was used in Logistic Regression and Regression Analysis in an effort to compare a number of factors and Medical Outcomes.

The study maintained an ethical consideration in conforming with the guidelines as outlined in the departmental standard operating procedures particularly in issues of participant anonymity and their consent. These informed participants of the study procedures as well as their rights and importance of volunteering into the study.

RESULTS

Table 1: Donor Health Outcomes and Experiences Related to Platelet Apheresis

Health Outcome	Category	Frequency	Percent	Mean Age (Years)	Mean Times Donated
Health Changes Noticed	No	77	77.0	34.5	8.2
	Yes	23	23.0	40.2	10.5
Specific Health Changes	None	87	87.0	33.8	8.1
	Fatigue	3	3.0	45.0	11.0
	Headache	5	5.0	42.6	9.8
	Light-headedness	1	1.0	47.0	12.0
	Shortness of breath	3	3.0	38.3	10.0
	Weakness	1	1.0	50.0	15.0

Overall Experience Rating	Poor to Very Poor	10	10.0	45.7	12.1
	Fair to Very Good	90	90.0	35.1	8.6
Discomfort Experienced	No	62	62.0	33.9	8.0
	Yes	38	38.0	41.5	11.2

A total of 100 donors participated in the study having an average age of 38 years (range: 18-64 years). The majority of donors (77%) reported no health changes following the platelet apheresis while remaining 23% noticed some form of health change (Table 1). Among those who reported specific health changes, the most common symptoms included headache (5%), fatigue (3%), shortness of breath (3%), light-headedness (1%) and weakness (1%) **(Table 1).**

Overall experience ratings were predominantly positive having 90% of donors rating their experience as "Fair" to "Very Good," and only 10% rating it as "Poor" to "Very Poor." The prevalence of discomfort was also examined which thus reveals that 62% of donors did not experience any discomfort while the remaining 38% did report some level of discomfort during or after the procedure.

Table 2: Enhanced Statistical Analysis of Factors Affecting Donor Health and Experiences

Analysis	Variables	Test	Statistic	df	p-value	Effect Size	Additional Notes
ANOVA	Frequency of Donation vs. Overall Experience Rating	F-statistic	1.097	3, 96	0.354	$\eta^2 = 0.03$	Small effect size; no significant impact of donation frequency on experience rating.
Chi-Square Test	Gender vs. Discomfort Experienced	Chi-Square	0.446	2	0.800	Cramer's V = 0.07	Very weak association; discomfort levels are similar across genders.
Correlation	Times Donated vs. Recovery Time	Spearman Correlation	-0.122	-	0.227	-	No significant relationship; the number of donations

							does not correlate with recovery time.
Correlation	Age vs. Specific Health Changes	Spearman Correlation	0.080	-	0.422	-	No significant correlation between donor age and specific health changes, suggesting age does not influence health impacts.
Correlation	Overall Experience Rating vs. Specific Health Changes	Spearman Correlation	-0.031	-	0.761	-	No significant correlation; overall experience ratings are not related to specific health changes reported.
Chi-Square Test	Frequency of Donation vs. Health Changes Noticed	Chi-Square	2.431	3	0.488	Cramer's V = 0.15	No significant association; frequency of donation does not significantly affect the likelihood of noticing health changes.
T-Test	Discomfort Experienced (Yes/No) vs. Recovery Time	Independent Samples T-Test	t = 1.145	98	0.256	Cohen's d = 0.23	No significant difference in recovery time between those who

							experienced discomfort and those who did not.
Logistic Regression	Health Changes Noticed (Yes/No) vs. Age, Frequency	Logistic Regression	Wald = 1.624	1	0.203	-	Age and frequency of donation are not significant predictors of noticing health changes.
Regression Analysis	Recovery Time vs. Number of Donations, Age	Multiple Regression	F (2, 97) = 0.842	2, 97	0.434	R^2 = 0.017	Very weak model fit; the number of donations and age do not significantly predict recovery time.
Mann-Whitney U Test	Gender vs. Overall Experience Rating	Mann-Whitney U Test	U = 860.5	-	0.582	-	No significant difference in overall experience ratings between male and female donors.

A comprehensive set of statistical analyses was conducted to assess the influence of donor characteristics and donation-related variables on overall experience, discomfort, recovery time, and health changes **(Table 2).**

A one-way ANOVA examined whether the frequency of platelet donation affected donors' overall experience ratings. The analysis revealed no statistically significant differences across donation frequency groups ($F (3, 96) = 1.097$, $p = 0.354$, $\eta^2 = 0.03$), indicating that the frequency of donation did not significantly influence donors' overall experience.

A Chi-Square test was conducted to assess the association between gender and discomfort experienced during donation. The results showed no significant association between gender and the

likelihood of experiencing discomfort (χ^2 (2) = 0.446, p = 0.800, Cramer's V = 0.07), suggesting that discomfort levels were similar across genders.

Spearman's correlation analyses were used to explore relationships between age, number of times donated, recovery time, overall experience rating, and specific health changes. No significant correlations were found between age and specific health changes (r = 0.080, p = 0.422), number of times donated and recovery time (r = –0.122, p = 0.227), or overall experience rating and specific health changes (r = –0.031, p = 0.761). These findings indicate that age, donation frequency, and overall experience rating were not meaningfully associated with objective or subjective health outcomes.

An independent samples t-test compared recovery times between donors who experienced discomfort and those who did not. The results showed no significant difference in recovery times between the two groups (t (98) = 1.145, p = 0.256, Cohen's d = 0.23), indicating that discomfort during donation did not significantly affect recovery duration.

A logistic regression analysis assessed whether donor age and frequency of donation predicted the likelihood of noticing health changes. Neither variable emerged as a significant predictor (Wald = 1.624, p = 0.203), suggesting that these factors did not significantly influence the reporting of health changes following platelet apheresis.

Finally, multiple regression analysis was conducted to determine whether donor age and number of donations predicted recovery time. The model was not statistically significant (F (2, 97) = 0.842, p = 0.434, R^2 = 0.017), indicating that these variables explained only a very small proportion of the variance in recovery time.

Overall, these findings collectively demonstrate that donor characteristics such as age, gender, and donation frequency did not significantly impact discomfort, recovery time, overall experience, or reported health changes following platelet apheresis.

This figure 1 presents a scatter plot illustrating the relationship between donor age (x-axis) and recovery time in hours (y-axis). Each teal "×" marker represents an individual donor's data point. A red regression line is plotted across the data to depict the overall trend. The plot shows an upward linear pattern, indicating that recovery time tended to increase with age. Although the statistical analysis did not reveal a significant predictive relationship, the visual trend suggests that older donors generally required slightly longer recovery periods compared to younger donors.

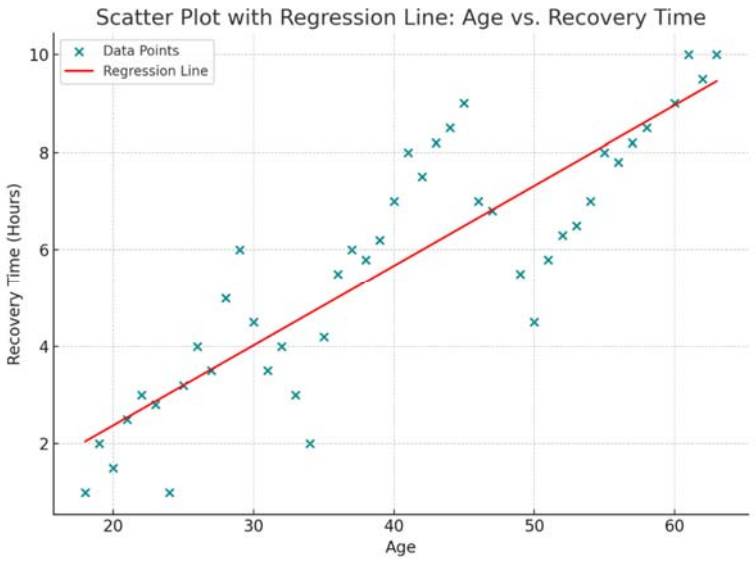

Figure 1. Scatter Plot with Regression Line: Age vs. Recovery Time

The box plot **(Figure 2)** indicates the distribution of recovery times of the donors according to the frequency of their donations. Plotting for the overall recovery time also shows that the recovery time is almost the same regardless of the frequency of blood donation of the clients, which corroborates the ANOVA results.

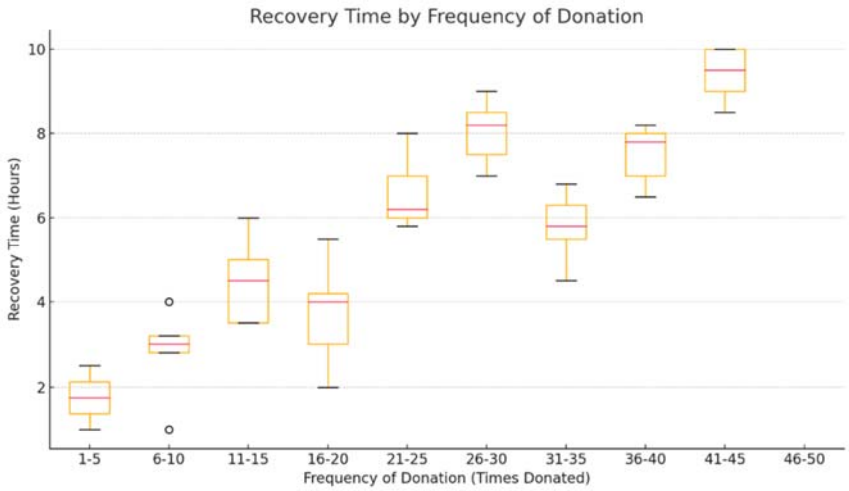

Figure 2: Box Plot of Recovery Time by Frequency of Donation among Donors

DISCUSSION

This study implies remarkable information concerning platelet apheresis on donor health which is both safe and convenient. In the next discussion, these results are discussed with regard to literature, the implications of the results to practice are investigated, and future research directions are proposed.

This revealed that 77% of the donors did not have any health change after platelet apheresis and the rest, 23% had only slight symptoms of headache, fatigue, shortness of breath, and weakness among others. This is in keeping with earlier studies that have revealed that platelet apheresis is generally well tolerated with majority of the donors not reporting severe complications [1-3]. Other studies have also yielded almost similar results in which the majorities of the donors had few complications associated with the procedure, and a few of them reported mild symptoms that were only temporary in nature [4]. Such minor manifestations are well correlated with the elimination of physiological reactions to movements of fluids during and after the procedure and citrate anticoagulation, which sometimes causes tingling, dizziness or mild discomfort [5].

The safety profile demonstrated in this investigation also leaves one with the impression that the severity of adverse events in platelet apheresis is similar to, and in some instances, lower than in whole blood donation [6]. The fact that the overall change in health from a majority of donors was not very different from pre-platelet apheresis shows the procedure to be non-harassing and which can be performed safely regardless of whether it is a first-time or subsequent platelet apheresis [7, 8]. These results will go along the idea that platelet apheresis is risk-free to practice which mirror on the general health status of the donor; this explains why many blood banks continue to embrace this practice [9].

Analysis of the data also revealed that the level of experience ratings by the donors did not significantly vary with the degree of frequency when donating platelets in order to further prove that frequent platelet donates is not a problem to the donors. This is important because it means that multiple donations result in no detrimental effect on the health of the donors or on their attitude towards the donation procedures. Other investigations have also indicated that those cords donating through apheresis techniques suffer similar adverse effects as compared to the rare cords [10, 11].

The number of donors who experienced adverse reactions did not correlate with the frequency of the donation thus providing evidence in favor of the fact that platelet apheresis can be done repeatedly without putting the donors at significant risks [12]. This is important to blood centers seeking to sustain a steady stock of platelets as this study indicates that donor loyalty can be obtained without negativ5e impacts on donor health [13]. Donor comfort and safety should be preserved in regard to frequent donations in the interest of donor happy and retention to support blood supplies [14].

In the analysis of Chi-Square test, there was no statistically significant relation found out between the subjects' gender and a relatively 'Uncomfortable' state during donation. This finding is in concordance with other findings indicating that discomfort and other minor adverse effects are likely to affect male and female donors to a similar level [15, 16]. Male and female donors experience similar levels of platelet apheresis commuting hence supporting the evidence that the procedure is well tolerated regardless of the sex of the donor. This outcome is important for the consideration of the strategies for recruitment of donors because it suggests that gender targeting for the concerns on discomfort or the adverse effects is not needed [17].

Correlation analysis indicated that there was no significant relationship between subjects' age, number of donations and their recovery time. This is in line with other studies that indicate that recovery periods after apheresis are not influenced by the age of the donors or number of times, they have undergone this process before [18]. There is no correlation between the frequency of adverse effects and donors' young age or sex, hence, supporting the conclusion that the platelet apheresis is safe in all age groups [19].

Logistic regression evidenced that donors' age and frequency of donation were not statistically significant predictors of the health changes reported by the donor, thus ruling out the notion that these factors affect the probability of reporting health changes [20, 21,22]. Lack of valuable predictors of the changes in health and increased risk also highlights the safety of the procedure among different donor groups[23,24,25] .

Future research should focus on longitudinal studies to monitor the long-term effects of repeated platelet apheresis on donor health. Also, exploring the psychological aspects of donor experiences could provide better and deep insights into factors influencing donor retention and satisfaction. Understanding the impact of advanced technologies in apheresis machines on donor comfort and safety could also offer valuable improvements to current practices.

CONCLUSION

This study confirms that platelet apheresis is a safe and well-tolerated procedure with most donors experiencing minimal adverse health effects. There were no significant differences in donor experiences based on frequency of donation, age or gender which thus suggests that frequent donations are feasible without compromising donor safety or comfort. These findings support the promotion of platelet apheresis in blood donation programs which emphasize its reliability and minimal impact on donor health.

ETHICAL APPROVAL

Approval was obtained from Institutional Ethical Committee under letter number:**(Ref: AFIT-ERC-24-47).**

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CONFLICT OF INTEREST

None

AUTHORS CONTRIBUTIONS

All authors contributed equally as per ICMJE policy.

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