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Comparison of the effects of apheresis and pooled platelet transfusions on platelet count

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ABSTRACT

Background: To compare the increase in platelet count after the transfusion of apheresis and pooled platelet suspensions among patients in the internal medicine intensive care unit.

Methods Patients who received platelet suspension transfusions and were followed up at the internal medicine intensive care unit at Mehmet Akif Inan Training and Research Hospital were evaluated. The patient's platelet counts were administered apheresis, and pooled platelet suspensions were recorded before and after transfusion. The increase in platelet count was calculated. The two groups were statistically compared.

Results: A total of 4,701 platelet suspension transfusions were performed at our hospital between January 1, 2020, and December 31, 2023. Of these transfusions, 2,990 belonged to pooled platelet suspensions and 1,711 to apheresis platelet suspensions.

Conclusion: Platelet suspension transfusion is frequently used in patients receiving internal medicine intensive care. However, there is an ongoing debate concerning whether apheresis or pooled platelet transfusion is more effective in increasing platelet count. In this study, we found a significantly higher increase in platelet count among patients in the internal medicine intensive care unit after apheresis platelet suspension transfusion than pooled platelet suspension transfusion.

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INTRODUCTION

Currently, platelet suspension is frequently used in patients receiving intensive care in internal medicine. Platelet suspension transfusion is commonly performed on patients admitted to the internal medicine intensive care unit due to haematological malignancies, solid tumours, and gastrointestinal bleeding. Platelet suspension is obtained through three methods: apheresis platelet transfusion, random platelet suspension derived from whole blood, and pooled platelet suspension.[1]

Platelet transfusion was initially performed using a random platelet suspension obtained from whole blood. Subsequently, pooled platelet suspensions began to be applied by combining these random platelet suspensions. In the 1970s, with the advancement of technology, apheresis platelet suspension started to be obtained from donor plasma using special techniques and devices through a procedure called apheresis.[2,3] During this procedure, blood is extracted from one arm, and platelets are separated using a cell separation device and collected in a bag. The remaining blood components are returned to the donor through the opposite arm. Thus, donors can donate more frequently than whole blood donations.

In recent years, single donor apheresis-derived platelets have steadily increased compared to random donor platelets.[4] However, implementing stringent exclusion criteria for platelet donation has posed challenges in recruiting and retaining donors.[5,6] Technical advances in automated cell sorters have improved the quality and efficiency of apheresis platelet collection.[7]

Several factors must be considered before selecting the method of platelet suspension. Alloimmunisation refers to the potential for infection, transfusion reaction risk, bone marrow suppression, and platelet value increase. Some adverse reactions may also develop with platelet suspension transfusion. Immunologically, febrile reactions, graft-versus-host disease, anaphylaxis, hemolysis, hypotension, and transfusion-related acute lung injury can be cited as such reactions.[8]

Platelet suspension also poses a risk of infection. In particular, immunodeficiency virus, hepatitis B virus, and hepatitis C virus infections were of great concern as transfusion-transmitted infections in the past. However, the wider adoption of additional nucleic acid tests in donors and the careful selection of donors have significantly reduced the risk of these viral transmissions through transfusion. Nevertheless, sepsis due to the bacterial contamination of platelets remains a significant threat to recipient safety.[8] This study aimed to compare the platelet increase in patients who received pooled and apheresis platelet suspensions.

MATERIAL AND METHODS

From January 1, 2020, through December 31, 2023, 160 adult patients aged ≥18 years were followed up at the tertiary step internal medicine intensive care unit at our hospital. Of these patients, 80 received apheresis platelet suspension, and 80 received pooled platelet suspension.

The hemogram examinations of patients who received a platelet suspension transfusion were performed before and 24 hours after the transfusion. Venous blood from the patient of 2 mL was taken into an EDTA tube. Patients with a history of coagulation disorders or anticoagulant drug use were excluded from the study. Additionally, patients with active bleeding, using medications that would affect platelet count, and patients whose platelet count could not be measured before and 24 hours after transfusion were excluded from the study. Data was collected from the hospital's information system. Pooled platelet suspensions were obtained from the regional blood centre of the Turkish Red Crescent. Pooled platelet suspensions were created by combining four random platelet suspensions. Apheresis platelet suspension was created using the centrifugation method with the Trima Accel® v7 (Terumo BCT, Inc., USA) device in the blood transfusion unit of our hospital. Platelet values were measured fully automatically using the laser technique on the Cell-Dyn Ruby (Abbott Laboratories, USA) device.

Patients who received platelet transfusions were divided into two groups: those who received apheresis platelet suspension and those who received pooled platelet suspension. The increase in platelet values was calculated and statistically compared between these two groups.

Before starting the study, approval was obtained from the Ethics Committee of the Harran University Faculty of Medicine (date: December 11, 2023, and approval number: H.R.U./23.23.21).

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (Statistical Package for the Social Sciences, IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as

Table 1. The most frequent comorbid diseases and the most frequently used drugs in patients undergoing platelet transfusion

Medication use	n (%)	Comorbidities	n (%)
Antihypertensive	56 (35%)	Respiratory diseases	83 (52%)
Antidiabetic	53 (33%)	Diabetes mellitus	53 (33%)
Diuretic	59 (37%)	Cancer	43 (27%)
Antibiotic	115 (72%)	Dyslipidemia	59 (37%)
Antiviral	72 (45%)	Hypertension	56 (35%)
Inhalation drugs	101 (63%)	Stroke	8 (5%)
Chemotherapeutics	40 (25%)	Cardiovascular diseases	54 (34%)
Antiarrhythmic	27 (17%)	Hematological diseases	43 (27%)
Antifungal	22 (14%)	Liver diseases	35 (22%)
Steroid	77 (48%)	COVID-19 infection	19 (12%)
Proton pump inhibitor	138 (86%)	Other diseases	8 (5%)

numbers and percentages for categorical variables and mean ± standard deviation and median (interquartile range) values for continuous variables. Continuous variables were examined regarding the normality assumptions using the Kolmogorov-Smirnov test, and the p-value was <0.05. Therefore, the Mann-Whitney U test, a non-parametric method, was used in pairwise group comparisons. Pearson's chi-square and Fisher's exact tests were conducted to compare categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 4,701 units of platelet suspension were transfused in our hospital over the three-year study period. Of these transfusions, 1,711 (36.40%) belonged to apheresis platelet suspensions and 2,990 (63.60%) to pooled platelet suspensions. Among the pooled platelet suspensions, 0 Rh(+) (33.42%) was the most common blood group. The least common was AB Rh(–) (0.27%); 147 (92%) of the patients were intubated, 102 (64%) of the patients had infections and patients who received platelet transfusion received an average of 3.25±3.04 (mean ± SD) blood product transfusions. Comorbidities and used medication in patients were presented in Table 1.

The most common reason for the destruction of suspensions was the expiration of the products in both groups. In the pooled platelet suspension group, 183 products were destroyed, and the destruction rate (number of products destroyed/total number of products × 100) was calculated to be 5.76%. In the apheresis platelet suspension group, the number of destroyed products was 227, and the destruction rate was 3.80%. When evaluated by year, the highest rate of platelet suspension was observed in 2021 and the lowest in 2023, while pooled platelet suspension was most performed in 2021 and least performed in 2022. The apheresis unit in our hospital was established in 2021. Therefore, apheresis platelet suspension transfu-

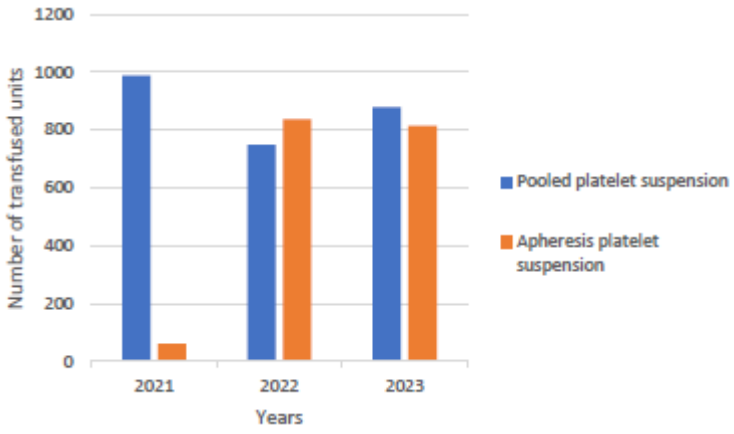

Figure 1. Number of platelet suspensions transfused by year.

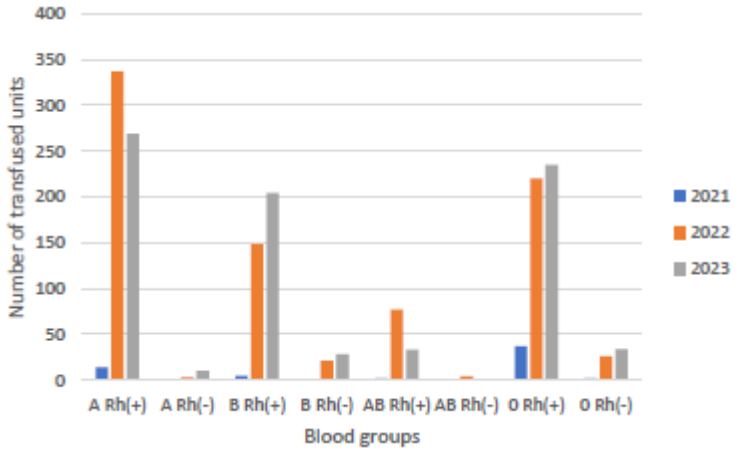

Figure 2. Number of apheresis suspensions transfused by year and blood group.

sion in 2021 is lower than pooled platelet suspension transfusion (Figure 1). The use of apheresis platelet suspension was observed to increase over the years. Throughout the three years, the highest percentage of platelet suspension transfusions was seen in the blood group A Rh(+) (36.23%) and the lowest rate in the blood group AB Rh(–) (0.29%) (Figure 2). In the pooled platelet suspension group, the highest number of platelet suspensions belonged to the blood group 0 Rh(+) (36.09%) and the lowest number to the blood group AB Rh(–) (0.26%) (Figure 3).

Among the 160 patients evaluated in the internal medicine intensive care unit, 53.7% of the total platelet suspension transfusions were administered to male patients. The mean age of patients who underwent platelet suspension was 54.35 years. The mean platelet count change in one suspension unit was 18.77 in the pooled platelet suspension group and 22.67 in the apheresis platelet suspension group (Table 2). No adverse events or transfusion reactions were observed in either group.

As shown in Table 2, the platelet count change showed a significant difference between the groups (p=0.048), significantly higher in the apheresis platelet suspension group. However, when the platelet count change was evaluated according to age (p=0.977) and gender (p=0.501), no significant difference was observed between the groups.

DISCUSSION

The utilisation of blood product separation and platelet suspension transfusion commenced in the 1950s.[9] Pooled platelet suspension was obtained by combining four to six units of these products. In the following years, apheresis platelet suspension emerged as an alternative. However, there is still no consensus on whether pooled or apheresis platelet suspension will be more beneficial in patients, and both suspension methods are used at varying rates. There is a growing trend in our hospital toward the use of apheresis platelet suspension. According to our study, among the patients in the internal medicine

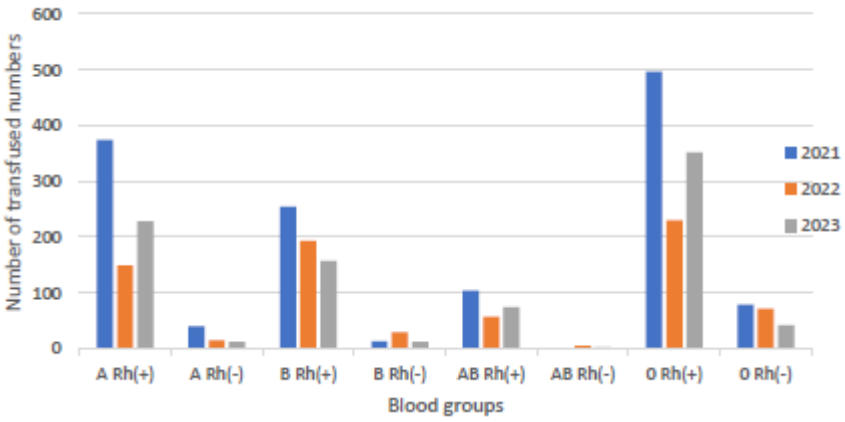

Figure 3. Number of pooled suspensions used by year and blood group.

Table 2. Comparison of the sociodemographic and clinical characteristics of the groups

Variables	Total group (n: 160)	Pooled platelet group (n: 80)	Apheresis platelet group (n: 80)	*P*-value
Age (years) mean±SD	54.35±23.98	54.65±25.86	54.05±22.27	0.977[a]
Gender n (%)				0.501[b]
Female	74 (46.3)	40 (50.0)	34 (42.5)	
Male	86 (53.7)	40 (50.0)	46 (57.5)	
Blood groups n (%)				
0 (–)	4 (2.5)	4 (5.0)	0	
0 (+)	52 (32.5)	24 (30.0)	28 (35.0)	
A (+)	52 (32.5)	12 (15.0)	40 (50.0)	
AB (–)	2 (1.3)	2 (2.5)	0	
AB (+)	12 (7.5)	8 (10.0)	4 (5.0)	
B (–)	4 (2.5)	4 (5.0)	0	
B (+)	34 (21.3)	26 (32.5)	8 (10.0)	
Platelet count change				0.048[a]
mean±SD	20.72±13.16	18.77±13.55	22.67±12.61	
median (IQR)	16.0 (16.00)	14.50 (14.75)	20.0 (16.75)	

SD: standard deviation, IQR: interquartile range. [a] Mann-Whitney U test, [b] Pearson chi-square test.

intensive care unit, the rate of apheresis platelet suspension transfusions was 36.40%, and that of pooled platelet suspension transfusions was 63.60%. A 2015 study conducted in the USA reported that 93.9% of the platelet suspension transfusions belonged to apheresis suspensions, and the remaining portion consisted of pooled platelet suspensions separated from whole blood.[10]

Several factors influence the supply of pooled and apheresis platelet suspensions in healthcare institutions. These factors include expenses, difficulty in finding donors, and the absence of apheresis units in every centre. Physicians' preference for apheresis or pooled platelet suspension is affected by the expected numerical increase in platelet count, the risk of contagious infection or unwanted reactions, such as febrile reactions, and the possibility of forming alloantibodies. Furthermore, physicians may be limited to pooled platelet suspension due to the lack of an apheresis unit in certain healthcare centres.

Our study found that apheresis platelet suspension transfusion increased platelet count more than pooled platelet transfusion among the patients in the internal medicine intensive care unit (p=0.048). Similarly, Rahman *et al.*[11] found that the increase in platelet count after apheresis platelet suspension transfusion was higher than pooled platelet transfusion. In another study, Agarwal *et al.*[12] determined that apheresis platelet suspension increased blood pressure more than pooled platelet suspension. The authors also noted that the apheresis suspension was of better quality according to criteria such as the pH of the platelet suspension and the number of platelets per unit in the suspension. Furthermore, in our study, the lower destruction rate in apheresis platelet suspension showed that this method produced more efficient results.

Ness *et al.*[13] stated that apheresis platelet suspension increased platelet value more but was not preferred due to its higher cost. Upon performing a cost analysis at our hospital, we similarly found that apheresis platelet suspension was more expensive than pooled apheresis suspension.

One of the most critical factors in platelet suspension preferences is the reactions resulting from the transfused product. However, in our study, no reaction developed in either group. Additionally, one of the risks of platelet transfusion is the risk of infection. The risk of infection is higher in hospitalised patients and patients who receive platelet transfusions than those who do not.[14] In our study, no platelet transfusion-related infection developed in either group.

The data included in this paper was sourced exclusively from a single centre. To enhance the efficacy of our study, it would be advantageous to incorporate data from many centres and include pediatric patients. In addition, conducting a comparison of the increase in platelet count according to patient diagnoses will yield more comprehensive data.

CONCLUSIONS

Platelet suspension is a blood product commonly used in healthcare. It is an indispensable blood product with no substitute; therefore, its use is of vital importance. According to our study, apheresis platelet suspension transfusion increased the platelet count more. However, it is a more expensive product. We consider that the use of apheresis platelet suspension in healthcare centres where there is no difficulty in finding a donor, and there are no financial constraints will improve the platelet levels of patients better.

Conflict of Interest

The author(s) declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

Ethical Approval

The Medical Ethics Committee of Harran University, Şanlıurfa, Turkey, approved the study protocol (decision number: HRÜ/23.23.21, date: 11.12.2023).

Authors' Contribution

Study Conception: İHD., EC., İI.; Study Design: İHD., EC.; Literature Review: İHD.; Critical Review: İHD.; Data Collection and/or Processing: EC.; Analysis and/or Data Interpretation: İHD., EC.; Manuscript preparing: İHD., EC.

REFERENCES

1. Vatansever S, Barısık V, Omer Z, Can H. Usage of platelet suspensions. Smyrna Tıp Dergisi. 2012;3:48-53.
2. Salvadori U, Minelli C, Graziotin B, Gentilini I. Single-donor platelet apheresis: observational comparison of the new Haemonetics Universal Platelet protocol with the previous Concentrated Single Donor Platelet protocol. Blood Transfus. 2014 Apr;12(2):220-5. doi: 10.2450/2013.0119-13.
3. Pietersz RNI. Pooled platelet concentrates: an alternative to single donor apheresis platelets? Transfus Apher Sci. 2009 Oct;41(2):115-9. doi: 10.1016/j.transci.2009.07.003.
4. Fontana S, Kellerb P, Taleghanib MB. Platelet recruitment during multiple donor platelet apheresis differs between cell separators. Transfus Med Hemother. 2011;38(3):195-8. doi: 10.1159/000328634.
5. Mowat Y, Hoad V, Haire B, Masser B, Kaldor J, Heywood A, Thorpe R, McManus H, McGregor S. Prevalence of blood donation eligibility in Australia: A population survey. Transfusion. 2023 Aug;63(8):1519-27. doi: 10.1111/trf.17474.
6. Snyder EL, Elfath MD, Taylor H, Taylor H, Rugg N, Greenwalt TJ, Baril L, Whitley P, Brantigan B, Story K. Collection of two units of leukoreduced RBCs from a single donation with a portable multiple-component collection system. Transfusion. 2003 Dec;43(12):1695-705. doi: 10.1111/j.0041-1132.2003.00603.x.
7. Wollersheim J, Dautzenberg M, van de Griendt A, Sybesma B. Donor selection criteria to maximize double platelet components (DPP) by platelet apheresis. Transfus Apher Sci. 2006 Apr;34(2):179-86. doi: 10.1016/j.transci.2005.12.004.
8. Stroncek DF, Rebulla P. Platelet transfusions. Lancet. 2007 Aug 4;370(9585):427-38. doi: 10.1016/S0140-6736(07)61198-2.
9. Katus MC, Szczepiorkowski ZM, Dumont LJ, Dunbar NM. Safety of platelet transfusion: past, present and future. Vox Sang. 2014 Aug;107(2):103-13. doi: 10.1111/vox.12146.
10. Ellingson KD, Sapiano MRP, Haass KA, Savinkina AA, Baker ML, Chung KW, Henry RA, Berger JJ, Kuehnert MJ, Basavaraju SV. Continued decline in blood collection and transfusion in the United States-2015. Transfusion. 2017 Jun;57 Suppl 2(Suppl 2):1588-98. doi: 10.1111/trf.14165.
11. Rahman MM, Khan L, Saha D. Dose-and time-related platelet response with apheresis platelet concentrates and pooled platelets. Bangabandhu Sheikh Mujib Medical University Journal. 2017 Feb 25;10(1):44-7. doi: 10.3329/bsmmuj.v10i1.31667.
12. Agarwal P, Jain A, Elhence P, Verma A. Are buffy-coat pooled platelet concentrates an effective alternative to apheresis platelet concentrates? An in vitro Analysis at a tertiary care center in Northern India. Int J Appl Basic Med Res. 2023 Jul-Sep;13(3):175-9. doi: 10.4103/ijabmr.ijabmr_73_23.
13. Ness PM, Campbell-Lee SA. Single donor versus pooled random donor platelet concentrates. Curr Opin Hematol. 2001 Nov;8(6):392-6. doi: 10.1097/00062752-200111000-00013.
14. Aubron, C, Flint AW, Bailey M, Pilcher D, Cheng AC, Hegarty C, Martinelli A, Reade MC, Bello-

mo R, McQuilten Z. Is platelet transfusion associated with hospital-acquired infections in critically ill patients? Crit Care. 2017 Jan 6;21(1):2. doi: 10.1186/s13054-016-1593-x.