Dose- and time-related platelet response with apheresis platelet concentrates and pooled platelets

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Article Info

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Abstract

This study was carried out to compare the post-transfusion platelet increment between the apheresis platelet concentrate (n=74) and pooled platelets (n=54). Pre- and post-transfusion platelet counts of the recipient were carried out by automated hematology analyzer. In apheresis platelet concentrate group, the mean 24 hours post-transfusion platelet increment was 47 x 10^9/L which was statistically significant ($p<0.001$). On the other hand, in pooled platelets group, the mean 24 hours post–transfusions platelet count increment was 11.0 x 10^9/L which was also statistically significant ($p<0.001$). This study concluded that the transfusion of apheresis platelet concentrate was more useful than the transfusion of pooled platelets in terms of platelet count increment and requirement of donor.

Introduction

Platelets are essential for normal hemostasis and work through a series of reaction inducing platelet adherence to vessel walls and platelet activation leading to platelet aggregation and formation of a primary hemostatic plug.[1]

Platelet can be separated by cytapheresis or by separating platelet rich plasma from a unit of whole blood within eight hour of collection and re-centrifuging to remove the majority of supernatant plasma. Platelets are suspended in a sufficient amount of plasma to ensure a pH of 6.0 or higher at the end of allowable storage time.[2]

Platelets for transfusion are collected in two ways: a) Pooled platelets: This is a two-step procedure. Firstly, one unit of platelets is produced from a unit of whole blood. Then, four-six of these units (from different donors) are 'pooled' together in a single pack to be given to a thrombocytopenic patient. b) Apheresis platelets: This has the advantage of being collected from a single donor (to reduce the risk of disease transmission). As the blood cycles through the apheresis machine, platelets are removed and all other blood constituents are returned to the donor. The amount of platelets collected with this procedure represents the equivalent of four to six units of random donor platelet.[3]

One unit of platelet concentrate (single donor platelet) by apheresis machine contains a minimum of 3 X 10^{11} platelets and is equivalent to four to six units of random donor platelets.[2] In a hemodynamically stable adult with 1.8 m^2 body surface area, each unit of random donor platelet concentration is expected to increase the platelet count by approximately 5–10 x 10^9/L and one unit of apheresis platelet increases the platelet count by 30–60 x 10^9/L that is six times more yield than random one unit platelet concentration.[4]

Platelet transfusions are indicated for the treatment of bleeding associated with decreased numbers of platelets, usually less than 50 x 10^9/L. Platelet transfusion is not indicated when the count is >100 x 10^9/L. Platelets are not effective in disorders which destroy circulating platelets, such as immune thrombocytopenic purpura.[1] Platelets are administered in adult dose equivalents which is four to six random donor platelet concentrations or one unit of apheresis platelets. Each adult therapeutic dose can be expected to raise the platelet count by approximately 20 x 10^9/L in most adult patients.[1]

Materials and Methods

This study was carried out during a period of one and half years from January, 2012 to July, 2013. A total of 148 recipients during this period were taken into consideration to compare the platelet increment between one unit apheresis platelet concentrates and one unit pooled platelets after 24 hours of transfusion. We divided the recipients equally into two groups: Group I (74 cases; 17 males and 57

females) designed for transfusing apheresis platelet concentrate and Group II (74 cases; 32 males, 42 females) for pooled platelets. The age of the recipients in Group I ranged from 2–71 years with the mean ± SD of 24.1 ± 14.3 years. In Group II, the age of the recipients ranged from 1–90 years with mean ± SD of 37.5 ± 20.3 year. The two groups were divided as per choice of the requesting physicians what type of platelets they want and the patients' relatives' desire. When a request for any type (apheresis platelet concentrate vs pooled) of platelet for a recipient was sent to this department, then the platelet count of that recipient was recorded for future comparison of post transfusion platelet count increment. Relevant history and physical examination of the donors were inquired and done. Donors with history of jaundice or suffering from medical diseases such as hypertension, diabetes mellitus, thalassaemias and malignant diseases or had history of recent surgical intervention were excluded as donor. Two milliliters blood was taken for complete blood count by automated hematology cell counter, Sysmex XT 1800i. Blood report was analyzed especially for hemoglobin concentration and platelet count. If the donor's platelet count was more than 200 X 10^9/L, then he was selected for either apheresis platelet concentrate or whole blood from where pooled platelets were prepared. Then the donors were taken into the collection room where they were positioned in lying condition for 15–20 min. Meanwhile, the apheresis machine, Cobe Spectra, made in USA was prepared and primed by anticoagulant (acid citrate dextrose) and normal saline for platelet collection. After finishing all pre-collection procedure, inlet and outlet line between the donor and apheresis machine were established, platelet apheresis was started and the time required for collection of a single donor platelet concentrate of about 230–250 mL in a platelet collection bag was about one hour. After completion of the procedure, all inlet and outlet connection between the donor and apheresis machine were disconnected and the donors were asked to take rest for 10–15 min. The collected apheresis platelet concentrate was then ready for transfusion. For pooled platelet collection, whole blood was collected from appropriate donor and platelet was separated. In this way four random platelets were collected and finally poured in a single bag which was supplied as "pooled platelets" for transfusion.

However, as per the following formula the post-transfusion corrected platelet count increment was calculated:

Post–transfusion platelet count increment=

(Post-transfusion platelet count - pre-transfusion platelet count)/(Platelets transfused x 10^{11}) x Body surface area

To find out the significance between pre- and post–transfusion platelet increment in both groups, Student's t–test was done.

Table I

Distribution of disease pattern received platelets transfusion

	Apheresis platelet therapy	Pooled platelet therapy
Disease	Cases (n=74)	Cases (n=74)
Dengue fever	29	34
Aplastic anemia	26	10
Solid cancer	8	24
Immune thrombocytopenic purpura	6	-
Non-Hodgkins lymphoma	2	-
Acute myeloid leukemia (AML)	2	4
Acute lymphoblastic leukemia (ALL)	1	2

Results

Disease patterns of both apheresis platelet concentrate and pooled platelets groups are shown in Table I. Most of the apheresis platelet concentrates were transfused in dengue fever followed by aplastic anemia and solid cancer.

Both apheresis platelet concentrate and pooled platelets issued to the recipients were group specific. Among 148 cases, blood group B positive was 58 (45.3%) cases, O positive cases 39 (30.5%) cases, A positive 20 (15.6%) cases, nine (7.0%) cases belongs to AB positive and two (1.6%) cases B negative.

Platelet count was done for comparing the platelet increment 24 hours after transfusion in both Group I and Group II. In case of apheresis platelet concentrate therapy, the pre-transfusion platelet count ranged from 2–60 x 10^9/L and mean ± SD was 14.9 ± 10.4 x 10^9/L. After transfusion of one unit apheresis platelet concentrate, the platelet increment ranged from 10–120 X 10^9/L and mean ± SD was 61.9 ± 20.8 x 10^9/L. Therefore, platelet increment after 24 hours of one unit apheresis platelet concentrate therapy was 47 x 10^9/L and the p value was 0.001 which was statistically significant. In case of pooled platelet therapy, the pre-transfusion platelet count ranged from 3–66 x 10^9/L and mean ± SD was 14.6 ± 12.2 x 10^9/L. After transfusion of one unit pooled platelets, the platelet count ranged from 6–189 x 10^9/L and mean ± SD was 25.6 ± 16.0 x 10^9/L. One unit pooled therapy incremented 11.0 x 10^9/L platelet and the p value was 0.001 which was statistically significant. Table II compares the platelet increment between post–transfusion platelet increment with apheresis platelet concentrate and pooled platelets.

Table II

Platelet count after transfusion

	Platelet count (x 10^9/L)		Post-transfusion corrected platelet count increment (x 10^9/L)
	Pre-transfusion	Post-transfusion	
Apheresis platelet concentrates therapy	14.9 ± 10.4	61.9 ± 20.8	5.6
Pooled platelet therapy	14.4 ± 12.2	25.6 ± 15.9	1.4

The post-transfusion corrected platelet count increment was 5.6 x 10^9/L 24 hours after transfusion of one unit apheresis platelet concentrate and in case of pooled platelets therapy it was 1.4 x 10^9/L, assuming the average body surface area of the studied recipients was 1.8 m^2.

Discussion

Appropriate use of platelet transfusion can reduce the volume of red blood cells transfused. When a platelet transfusion is considered, the quality of endogenous platelets should be taken into account as well as patient's platelet count. Platelet transfusion may be indicated despite an apparently normal platelet count if there is known or suspected platelet dysfunction e.g. in a patient taking platelet inhibitor such as clopidogrel.[5, 6]

In this study, most of the apheresis platelet concentrates were transfused in dengue fever followed by aplastic anemia. Other conditions where apheresis platelets were transfused were solid cancer, immune thrombocytopenic purpura and hematological malignancies. The findings of Banu and Hossain[2] showed the transfusion of apheresis platelet concentrates in the following diseases as dengue fever, aplastic anemia, solid cancer, disseminated intravascular coagulation, hematological malignancies and chemotherapy-induced thrombocytopenia. This difference may be due to diverse disease pattern found in this geographical area. Pooled platelets transfusion were also given mainly to patients with dengue fever (45.9%) followed by solid cancers (32.5%) and other malignant and non-malignant hematological disorders (21.6%). In a study conducted by Saluja et al, 39.1% pooled platelets were used in patients with adult and pediatric hemato–oncology.[7]

After 24 hours of transfusion of apheresis platelet concentrates, the mean platelet count was 61.9 x 10^9/L whereas the pre–transfusion mean platelet count was 14.9 x 10^9/L. So, the platelet count increment in Group I was 47.0 x 10^9/L. This findings correlate with the findings of Banu and Hossain.[3] Platelet count increment was not observed in patients suffered from immune thrombocytopenic purpura in this study. This finding correlates with findings of Avery and Avery.[8]

In Group II where pooled platelets was used for platelet count increment, the pre–transfusion mean platelet count was 14.6 x 10^9/L and range 3–66 x 10^9/L whereas the post–transfusion mean platelet count was 25.6 x 10^9/L and range 6–189 x 10^9/L. So, the platelets count increment in Group II 11 x 10^9/L which is almost similar to the findings of Plaza.[9]

In this study, corrected count increment was determined to observe the platelet refractoriness. With apheresis platelet concentrate therapy corrected count increment (5.6 x 10^9/L) indicates the absence of platelet refractoriness as corrected count increment higher than 4.5 x 10^9/L from a sample drawn 8–24 hours after transfusion is considered acceptable.[10]

Conclusion

Transfusion of apheresis platelet concentrate was more useful than the transfusion of pooled platelets in terms of platelet count increment and requirement of donor.

Conflict of interest

No conflict of interest.

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