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A Comparative Study between Fresh and Stored Platelet Concentrate after Transfusion in same ALL patients in a Tertiary Hospital

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Abstract **Original Research Article**

Background: Platelet transfusion is needed for the treatment of ALL children. Researchers have shown that transfusion of stored platelet concentrates (up to 5days) is as effective as fresh platelet concentrates (24 hours). ***Objectives:*** The present study was conducted to access the comparison between fresh and stored platelet concentrate after transfusion in same all patients in a tertiary hospital. ***Materials and methods:*** The study was a cross-sectional descriptive study which was conducted in department of Clinical Pathology, Paediatric Haemato-Oncology and transfusion Medicine BSMMU, and Department of Haematology and Paediatric Haemato-Oncology in Dhaka Medical College Hospital. Over a period of March 2010 to February 2011.The sample size was 81. A data sheet with two parts (Part A and Part B) was designed with a view to collect data from the patient to be enrolled in the study .The data were analyzed using the SPSS version 25.0. ***Results:*** Out of 81 patients fresh platelet concentrates (FPC) or day-0 platelets were transfused in 47 acute Lymphoblastic leukaemia (ALL) children. Stored platelet concentrates (day 1-5) were transfused in 34 children. In 27cases both fresh and stored platelet concentrates were transfused. Corrected count increment at 1 hour (CCI_{1h}) in FPC and SPC were 20.5 and 18.9 respectively. Mean corrected count increment at 24 hour (CCI_{24h}) FPC and SPC were 15.5 and 13.8 respectively. There were no significant differences between FPC and SPC $P>0.05$. ***Conclusions:*** It was observed that 1-5 day's stored platelet-rich-plasma platelet concentrate (PRP-PC) was as effective as fresh PC to obtain acceptable platelet increment in childhood acute lymphoblastic leukemia. Furthermore, corrected count increment and percentage platelet recovery are important tools to evaluate platelet refractoriness.

Keywords: Platelet, CCI, PPR, Transfusion, ALL.

INTRODUCTION

The value of platelet transfusion was first reported in 1910 when Duke described three patients with bleeding due to thrombocytopenia, each of whom showed improvement with transfusion of whole blood [1]. In l881-1882 Bizzozero first discovered the platelets and their involvement in haemostasis [2]. This discovery was followed by the development of techniques to prepare platelet components About 2 million PLTs are transfused per year in the United States [3], 2.9 million in Europe [4] and 40,000 in Sweden with a roughly ten-fold increase since 1984.

Though there is no statistical report found in Bangladesh, the annual report of Transfusion Medicine Department in Bangabandhu Sheikh Mujib Medical University (BSMMU) showed that 2071 platelet concentrates were supplied in the year 2010 among these 240 platelet concentrates were transfused in leukaemic patients in the day care center byAnnual report TM, 2010. The increased demand for platelet concentrates (PC) generate greater need to store viable platelets for longer periods in order to provide an acceptable component for clinical use [5]. Platelet concentrates can be prepared by centrifugation of whole blood by either platelet-rich-plasma method or the buffy-coat method. In Bangladesh platelet concentrates are obtained by platelet-rich-plasma method. Only few centers use apheresis technique. In Bangladesh at Bangabandhu Sheikh Mujib Medical University one study showed average number of platelets for all bags on day 0 was 61.6 x 10 per bag [6]. First generation storage bags made of polyvinyl chloride (PVC) plasticized with di (2 ethylhexy) phthalate had poor oxygen permeability and therefore only allow storage up to 3 days. Second-generation storage bags made of polyolefin [7] and PvC plasticised with tri (2-ethylhexyle) timellitate [8] had increased gas permeability and allowed the storage period to be extended to 5 days. New storage containers made up of plasticized with buturyl-tri-n-hexyl-citrate have been developed. Platelet transfusion is needed for the chemotherapy of acute lymphoblastic leukaemia Children. Researchers have shown that transfusion of stored platelet concentrates (up to 5days) is as effective as fresh platelet concentrates (24 hours) [9].The threshold for prophylactic transfusions can safely be set at 5 x 10/L in patients without fever or bleeding manifestations and at 10x 10^9/L in patients with such signs.For patients with coagulation disorders or anatomical lesions,or for those on heparin, the threshold should be at least 20 x 10L [10]. Platelets are transfused for therapeutic and prophylactic purposes. Therapeutic platelet transtusions are indicated for patient with active bleeding associated with thrombocytopenia although serious spontaneous hemorrhage due to thrombocytopenia is unlikely to occur at platelet counts above 10x10L by BCSH. Prophylactic platelet transfusions are indicated for the patients with bone marrow failure [11]. Among the patients receiving platelets about 40% are used by hematology/oncology patients [12]. The objective of this study is to assess the Comparison between Fresh and Stored Platelet Concentrate after Transfusion in Same ALL patients in a Tertiary Hospital.

METHODOLOGY

The study was a cross-sectional descriptive study which was conducted in department of Clinical Pathology, Paediatric Haemato-Oncology and transfusion Medicine BSMMU, and Department of Haematology and Paediatric Haemato-Oncology in Dhaka Medical College Hospital. Over a period of March 2010 to February 2011. Children up to 18 years of age with acute lymphoblastic leukaemia that had indications for platelet transfusion were included in the study and patients who were not willing to participate were excluded from the study. A data sheet with two parts (Part A and Part B) was designed with a view to collect data from the patients to be enrolled in the study. Relevant transfusion history, hematological history, clinical examination and absolute diagnosis had been recorded in a predetermined data sheet (Part A).Part B was to record subsequent laboratory investigation. As per inclusion criteria the paients were enrolled in this study. The aims and objecives of the study was explained to each patient or their guardians. The written consent was taken from all of them. For each patient data concerning age, sex, blood group, haematological history, transfusion history, clinical findings, drug history and all other information related to study given by the patients or their guardians were carefully noted. All the information was recorded in data collection sheet. Patients who were transfused with fresh platelet concentrates, platelet count was done before transfusion, at 1 hour and after 24 hours of transfusion. Same procedute was done in patients who were transfused with stored platelet concentrates (1 day's, 2 day's 3 day's, 4 day's or 5 day's). It was a convenient type of sampling and the sample size was 81. The detail of the study was explained to each eligible respondent and consent was taken. After collection, the data were checked and cleaned, followed by editing, compiling, coding and categorizing according to the objectives and variable to detect errors and to maintain consistency, relevancy and quality control. Collected data were edited and analyzed according to the objectives and variables by IBM software- Statistical package for Social Science (SPSS 25) version. Ethical clearance was taken from the IRB of the institution.

RESULT

Table 1: Demographic characteristics of the study population

Age (in years)	**n=81**	**%**
1-5	37	45.68
6-10	28	34.56
12-15	16	19.75
Mean ±SD	27.0 ± 10.54	
Range (Min-Max)	(1-15)	
Sex		
Male	47	58.0
Female	34	41.97
Blood group		
A positive	20	24.69
B positive	29	35.80
O positive	25	30.86
AB positive	5	6.17
A negative	1	1.23
O negative	1	1.23

Table shows Distribution of study subjects according to age, sex and blood group (n=81). Age ranged from 1 to 15 years with mean ± SD was 27 ± 10.24. Among them 47 were found male and 34 female. Regarding the blood group it was observed that most of the subjects had B positive (+ve) 29 (35.80%), followed by O positive (+ve) 25(30.86), A positive (+ve) 20 (24.69%) and 5 (66.17%) had AB positive (+ve). Each one O-ve) (1.23%), A (-ve) (1.23%), cases were also found. The age, sex and blood group distribution of study subjects are given in the Table 1.

Table 2: Distribution of the study subjects according to fresh platelet concentrates (FPC) and stored platelet concentrates (SPC) transfusion (n-81)

Type of Platelet concentrates (PC)	Day of storage	n=81	%
Fresh PC(day-0) n=47	Day-0	47	58.0
Stored PC (day 1-5) n=34	Day-1	07	08.6
	Day-2	10	12.3
	Day-3	09	11.1
	Day-4	06	07.4
	Day-5	02	02.5

Table 2 shows Distribution of the study subjects according to fresh platelet concentrates (FPC) and stored platelet concentrates (SPC) transfusion. It was observed that fresh platelet concentrates (FPC) or day-0 platelets were transfused in 47 acute Lymphoblastic leukaemia (ALL) children (58%) and one day's (Day-1) stored platelet concentrates (SPC) were transfused in 7 (8.6%), Day-2 in 10(12.3%), Day-3 in 9 (11.1%),Day-4 in 6 (7.4%) and Day-5 in 2 (2.5%) acute lymphoblastic leukaemia children. Stored platelet concentrates (day 1-5) were transfused in 34 children. In 27cases both fresh and stored platelet concentrates were transfused. According to transfusion of fresh or stored platelet concentrates n= (54+27) =81. These are shown in Table 2.

Table-3: Distribution of study subjects according to number of units of platelet concentrate (PC) transfused (n=81)

Unit of PC	Number of patients	No. of pt. transfused FPC	No. of pt. transfused SPC	%
1	27	17	10	33.3
2	40	24	16	49.4
3	13	06	07	16.0
4	01	00	01	01.3
Total	81	47	34	
Mean ± SD	1.8±07			
Range (Min-Max)	(0.7-1.8)			

It was observed that 2 units of platelet concentrate (PC) were transfuse in 40 (49%) ALL children, among them fresh platelet concentrates (FPC) were transfused in 24 children, whereas stored platelet concentrates (SPC) were transfused in 16 children. 27 ALL children were transfused with I unit of PC; FPC and SPC were 17 and 10 respectively. 13 ALL children were transfused 3 units of PC, FPC and SPC were transfused in 6 and 7 spectively.4 units SPC were transfused in 1 child. 17+ 48+18 =83 units FPC (Day-0) was transfused in 17+24+6=47 children and 10+32+21+67 unit of SPC were transfused in 34 ALL children. Total 85+65=150 units of PCs were transfused in 8l ALL children. These are shown in table 3.

Table 4: PPR and CCI status of the study patients after one hour and 24 hours According to pre-transfusion platelet count (n-81)

		After 1 hour		After 24 hour	
No of patients	Pre-PLT($x10^9$)	PPR_{1h} (Mean ±SD)	CCI_{1h} (Mean ± SD)	PPR_{24h} (Mean ±SD)	CCI_{24h} (Mean ±SD)
18	0-5	47.3 ± 22.6	18.8 ± 9.0	36.4 ± 18.9	14.6 ±7.6
24	6-10	53.8 ± 25.3	21.9 ± 11.2	39.7 ± 24.3	15.8 ± 9.3
24	11-20	47.6 ± 23	20.0 ± 9.2	35.2 ± 20.2	14.2 ±8.1
15	>20	48.3 ± 16.4	18.7 ± 6.2	32.8 ±17.7	12.9 ± 6.2

Table shows that 18 ALL children were transfused PC when their pre-transfusion platelet count was 0-5 $x10^9$/L, Mean ± SD were CCI_{1h} l8.8 ± 9.0 and CCI_{24h} 14.6±7.6. In 24 children pre- transfusion PLT were 6-10$x10^9$/L; mean ±SD were CCI_{1h} 21.9±11.2 and CCI_{24h} 15.8±9.3. Another 24 children's pre-transfusion

PLT 11 -20x10^9/L; and mean ±SD CCI_{1h} 20.0± 9.2 and CCI_{24h} 14.2 ± 8.1. 15 children were transfused when their pre-transfusion PLT count CCI and PPR after 1 hour and 24 hours are presented in the Table 4.

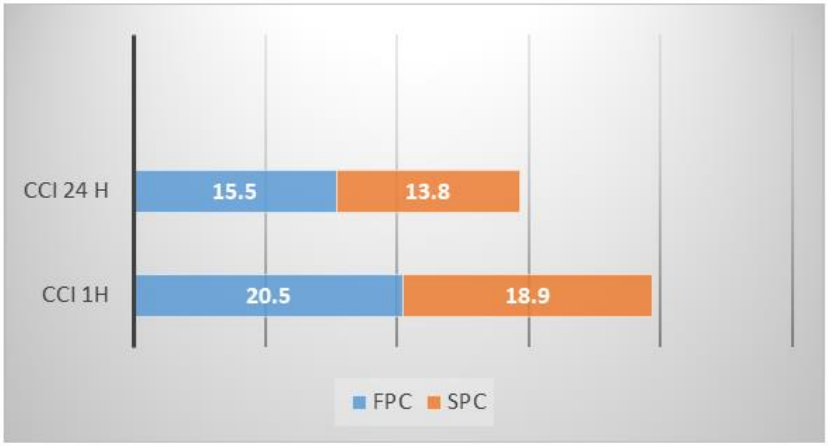

Figure-1: Comparison between fresh platelet concentrates and stored platelet concentrate after transfusion ALL children on the basis of corrected count increment at 1hour and 24 hour (n=81)

Figure shows that, corrected count increment at 1 hour (CCI_{1h}) in FPC and SPC were 20.5 and 18.9 respectively. Mean corrected count increment at 24 hour (CCI_{24h}) FPC and SPC were 15.5 and 13.8 respectively. There were no significant differences between FPC and SPC P>0.05.

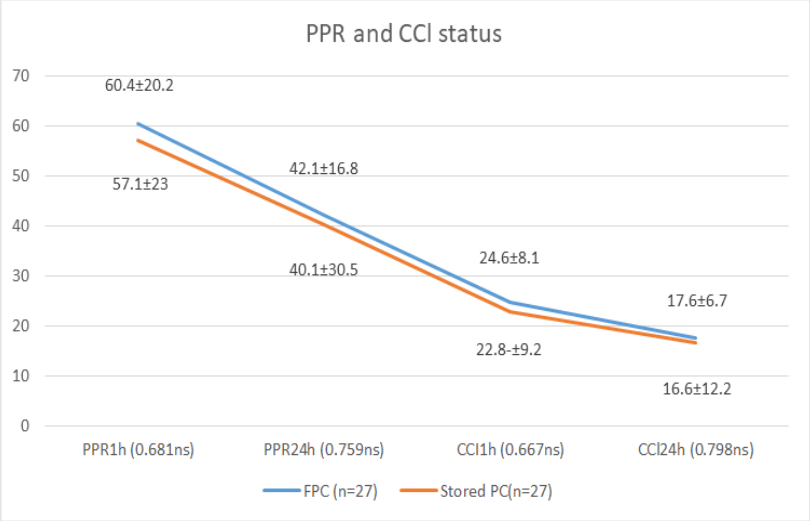

Figure II: PPR and CCl status after one hour and after 24 hours between fresh PC and different days of stored PC in same ALL children (n=27)

PPR_{1h} = percent platelet recovery after l hour, PPR24h percent platelet recovery after 24 hour, CCI_{1h} =Corrected count increment after 1 hour, CCI_{24h}=Corrected count increment after 24 hour, 27 ALL children were transfused both fresh platelet concentrates (FPC) and different day's stored platelet concentrates (SPC). The mean (±SD) PPR_{1h} and PPR_{24h} in cases of FPC were 60.4±20.2, 42.1±16.8; CC_{1h} and CCI_{24h} were 24.6±8.1 and 17.6±6.7 respectively. In cases of stored platelet (SPC) the values of PPR at 1 hour and 24 hours are 57.1±23 and 40.1±30.5 respectively. CCI_{1h} and CCI_{24h} in cases of (SPC) 22.8±9.2 and 16.6±l2.2.In comparison to FPC with SPC P values were more than 0.05 which were statistically not significant.

DISCUSSION

This cross-sectional study was conducted in the Department of Clinical Pathology, Paediatric Haemato-Oncology and transfusion Medicine BSMMU, and Department of Haematology and Paediatric Haemato-Oncology in Dhaka Medical College Hospital. Over a period of March 2010 to February 2011. A total of 81 children with acute lymphoblastic leukaemia were enrolled in this study. These 81 patients were assessed before and after transfusion of platelet concentrate (PC) to evaluate platelet increment.

The resent conducted study shows Among 81 study subjects 47 were found male and 34 female.

Regarding the blood group it was observed that most of the subjects had B positive (+ve) 29 (35.80%), followed by O positive (+ve) 25(30.86), A positive (+ve) 20 (24.69%) and 5 (66.17%) had AB positive (+ve). Each one O-ve) (1.23%), A (-ve) (1.23%), cases were also found. Fresh platelet concentrates (FPC) or day-0 platelets were transtused in 47 acute lymphoblastic leukaemia (ALL) children (58%) and 34 (42%) children were transfused with stored platelet concentrates SPC (day1-5). One day's (Day-1) stored platelet concentrates (SPC) were transfused in 7 (8.6%), Day-2 in 10(12.3%), Day-3 in 9 (11.1%), Day-4 in 6 (7.4%) and Day-5 in 2 (2.5%) acute lymphoblastic leukaemia children. In 27 cases both fresh platelet concentrates platelet concentrates (SPC) were transfused. Total 150 units PC were transfused in 81 cases.

Peter-Salonen K *et al*., conducted a similar FPC and 63 SPC 31 thrombocytopenic patients, where 105 PC were transfused, 70 % FPC and study 20% SPC [13]. In another study, Lazarus H M *et al*., enrolled 15 multi thrombocytopenic patients to evaluate the effectiveness of PC stored for 72 ours [14].

In this study total 150 units of PC were transfused. 18 ALL children were transfused PC when their pre-transfusion platelet count was 0-5 $x10^9$/L, Mean ± SD were CCI_{1h} l8.8 ± 9.0 and CCI_{24h} 14.6±7.6. In 24 children pre- transfusion PLT were 6-10$x10^9$/L; mean ±SD were CCI_{1h} 21.9±11.2 and CCI_{24h} 15.8±9.3. Another 24 children's pre-transfusion PLT 11 - 20$x10^9$/L; and mean ±SD CCI_{lh} 20.0± 9.2 and CCI_{24h} 14.2 ± 8.1. In a study with AML patients, they transfused 2-4 days SPC and percentage platelet recovery at hour (42±9.9) was values were apart from the recommended lower limits of AABB and BCSH (BCSH,PPR 003), Furthermore, here were no significant differences between P values of FPC and SPC (P>0.05). 27 ALL children were transfused both fresh platelet concentrates (FPC) and different day's stored platelet concentrates (SPC). The mean (±SD) PPR_{1h} and PPR_{24h} in cases of FPC were 60.4±20.2, 42.1±16.8; CC_{lh} and CCI_{24h} were 24.6±8.1 and 17.6±6.7 respectively. In cases of stored platelet (SPC) the values of PPR at 1 hour and 24 hours are 57.1±23 and 40.1±30.5 respectively. CCI_{1h} and CCI_{24h} in cases of (SPC) 22.8±9.2 and 16.6±l2.2.In comparison to FPC with SPC P values were more than 0.05 which were statistically not significant. Though Lazarus (1982 [14]) found poorer increment; these data are in accordance with that of Shanwell [15]. The incremental transfusion data obtained thus reflected that there were no changes due to the Storage duration up to 5 days of storage.

Overall, effectiveness of platelet transfusion is determined by the lower limit of CCI or PPR as the recommendations of AABB and BCSH. The recommended limit of corrected count increment is 7.5 $x10^9$/L at 1 hour or PPR 30%. After 24 lower hours; the values should be 4.5 $x10^9$/L and 20% respectively.

From the current study it was observed that 1-5 day's stored platelet-rich-plasma platelet concentrate (PRP-PC) was as effective as fresh PC to obtain acceptable platelet increment in childhood acute lymphoblastic leukemia.

RECOMMENDATION

This study can serve as a pilot to a much larger research that can provide a nationwide picture to ensure better management and adherence.

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DECLARATION

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