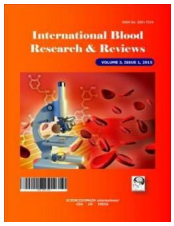

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Audit of Platelets Usage among Patients: A Descriptive Study of Various Platelet Concentrates

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Authors' contributions

This work was carried out in collaboration between all authors. Author DCS designed the study, wrote the protocol and wrote the first draft of the manuscript. Author LT managed the literature searches, analyses of the study performed the spectroscopy analysis and author PW managed the experimental process. Authors SR and RG supervised the research work. All authors read and approved the final manuscript.

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ABSTRACT

Background: Transfusion services are aimed to provide only those components which patients require and keep the rest for others. Platelet transfusion is critical due to lack of alternative; and therefore should be used rationally.
Aim: To elucidate the rational use of different platelet concentrates, its comparative efficacy in thrombocytopenia patients at our tertiary care hospital.
Materials and Methods: This prospective cross-sectional two-year study was carried out at a tertiary care hospital in India. Relevant clinical findings, pre/post transfusion platelet count along with complete haemogram and diagnosis of patients were considered in compiling the data. Quality of Platelet was maintained as per the standard protocol of American Association of Blood Bank (AABB).

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Results: Total 4157 units of platelet concentrates from recruited donors were prepared, where 3483 (83.97%) units were utilized and 674 (16.21%) were unfit for transfusion. 3483 fit Platelet concentrates were transfused to 1225 patients. Out of 3483 transfusions, 1080(31%) were therapeutic and 2403(69%) were prophylactic. In the study 3104 Random Donor Platelet (RDP) and 379 Single Donor Platelets (SDP) were transfused to 978 and 247 patients respectively. Mean absolute increase in platelet count was $4.8x10^9$/L (SD= $2.9x10^9$/L) for RDP and for SDP it was $33.2x10^9$/L (SD=$6.0x10^9$/L). Out of 3483 platelets transfusion, about 80% were found to be rational according to British Committee for Standards in Haematology (BCSH) criteria.
Conclusion: A healthy rationality of 80% was observed in the present study. Platelet concentrates should be used rationally and scientifically as per proven criteria because it has no alternative.

Keywords: Single donor platelets; buffy coat platelets; platelet rich plasma; thrombocytopenia; rationality.

1. INTRODUCTION

Half a century back, most of the blood transfused was the whole blood, after that there was a significant shift in strategy of the transfusion of allogenic blood with the concept that blood can be separated into its components, RBCs, WBCs, Platelet and Plasma [1]. Plenty of knowledge has been added recently in the field of transfusion of platelet concentrates and its application in clinical practice by various studies [2-4]. Platelet transfusion is widely employed in modern medical practice for prevention and treatment of thrombocytopenic bleeding in patients with various clinical conditions like hematological malignancies, solid tumors, major surgical bleeding, trauma etc [3,4].

Blood transfusions are frequently life-saving but it should be given only when true benefits are likely to overt side effects/ risks [5-7]. Involvement of treating physicians in this task is very essential [8]. Therefore, continued surveillance of the use of this component and re-evaluation of the aims of platelet transfusion is essential [9].

However, the main focus is on the improvement of preparation of various platelet concentrates and lengthening the storage period to provide safe product rationally [2,10,11]. The World Health Organization has developed documentation to assist developing countries in establishing transfusion guidelines [12]. In India the demand of Platelet concentrates has been increasing, especially in the endemic regions of specific parasitic infestations like Malaria and Dengue which are known to cause thrombocytopenia [13]. Emerging incidents of malignant disorders, aplastic anaemia and bone marrow depression caused by radiotherapy and chemotherapy has further augmented the demand of platelet components [14].

Role of Platelets in hemostasis are well established and there are increased practices to make up the threshold thrombocytic pool before going for elective surgeries which is a recommended indications in all the authenticated agencies like British Committee for Standards in Hematology (BCSH) [15] as well as American Association of Blood Bank (AABB) [16]. There are many types of platelet concentrates in use like Single Donor Platelet (SDP) and platelets obtained from blood unit i.e. commonly known as Random Donor Platelet (RDP) which are Platelet Rich Plasma (PRP) and Buffy Coat Platelet (BC-PC). These products are used with wide variations all over the world [17]. Aphaeresis is now very well practiced in western countries and it is gaining the momentum in India also [18].

There is no alternative treatment other than platelets in certain clinical settings; it is an essential therapy in some instances and very useful options in others [19]. Platelets are precious human resource and should be used rationally. With this background, the present study was designed to evaluate the appropriateness of use of platelet concentrates in our institution.

2. MATERIALS AND METHODS

The present 2 year prospective cross-sectional study was carried out from 1st January 2014 to 31st December 2015 in the Blood Bank, Department of Pathology at a tertiary care centre in Central India. Approximately four thousand plus voluntary and replacement blood donors who attended the blood bank for normal routine donation and fulfilled the standard criteria of National AIDS Control Organization [NACO guidelines 2007] were recruited for the preparation of platelet concentrates. These platelet concentrates were transfused to the

patients and appropriateness of its use in our institution was assessed.

After proper cleaning of the cubital fossa, whole blood was collected from recruited donors via cubital venipuncture through wide-bore, siliconized needles to minimize platelet and clotting factor activation and was immediately mixed with anticoagulant in 450 ml quadruple SAGM (Saline Adenine Glucose Manitol) bag/or 450 ml top and bottom SAGM bags. The collected blood units were processed for preparation of components within 6 hours without storage. From quadruple SAGM bags PRP and from Top and bottom SAGM bags BC-PC were prepared by centrifugation and separation method. Aphaeresis platelets were procured from single donor by using Aphaeresis device. In vitro platelet quality was assessed by swirling, volume, Haemoglobin (Hb %), Platelet count, White Blood Cells (WBC) count and pH of bag and parameters from our institute are compiled in the Table 1.

Units were screened for Transfusion Transmitted Infections (TTIs) i.e. Human Immunodeficiency Virus (HIV) I & II, Hepatitis B Surface Antigen (HbsAg), Hepatitis C Virus (HCV), malaria and VDRL.

Prepared platelet concentrates were either issued against the requisite/ demand or stored under the optimal liquid platelet storage temperature i.e., 22℃ with continuous gentle agitation. Storage was done for maximum 5 days and after that unit was declared and marked expired. Compatibility test was done before issuing the unit. ABO compatible platelets were issued to the patients.

For each transfusion, relevant information about the patient, type of platelet concentrate supplied, its indication and transfusion details were noted. These information were gathered from; component demand form and issue card, transfusion notes and case sheet of the patient, which included – patient's Name, Age, Sex, Clinical Diagnosis, Indication (therapeutic/ prophylactic) of Platelet transfusion, number of transfusions, Pre & Post-transfusion Platelet count, increment in platelet count after transfusion, any adverse event etc. Rationality was screened under the guidelines of BCSH 1992 as shown in Table 2. [15,20]. Wastage rate of platelet units due to various reasons were calculated in proportional percentage of total units collected and also included in statistical analysis. The data was compiled, summarized, analyzed and compared with similar studies.

Table 1. Parameters for the assessment of different platelet concentrate

S. no.	Parameter	RDP		SDP
		PRP	BC-PC	
1.	Volume	30-60 ml	40-70 ml	200-220 ml
2.	Platelet count	5- 5.5X10^{10}/unit	5-6 X10^{10}/unit	3-3.8 X10^{11}/unit
3.	Swirling	Present	Present	Present
4.	Haemoglobin	<0.2 gm/dl	<0.2 gm/dl	<0.2 gm/dl
5.	WBC	4.05 ± 0.48 × 10^7	2.08 ± 0.39 × 10^7	4.1±0.8 × 10^6
6.	ph	6.5-7.0	6.5-7.0	6.5-7.0

Table 2. Recommendations for the rational use use of platelet concentrates

1. Prophylactic causes		
Code	**Platelet count**	**Additional features/ Clinical assessments**
1A.	Less than 10x10^9/L	Without additional risk factors
1B.	Less than 20x10^9/L	With additional risk factors (Fever, Sepsis, Concurrent use of Antibiotics, on chemo-/radio therapy or other abnormalities of haemostasis)
1C.	Less than 50x10^9/L	If patient is undergoing minor invasive procedure, epidural anesthesia, gastroscopy and biopsy, insersion of indwelling lines, transbronchial biopsy, liver biopsy etc.
1D.	Less than 100x10^9/L	If patients are undergoing major surgical procedures (especially on critical site as Brain etc.)
1E.	Less than 100x10^9/L	If Patient undergoing massive Transfusion.
2. Therapeutic cause		
In Patients with bleeds from oral cavity, mucous membranes or any other site with platelet dysfunction irrespective of platelet counts		

3. RESULTS

During study period 31,852 Blood units were collected and 66,949 units of different components were Prepared in which 4157 (6.2%) were platelet concentrates. Platelet concentrates prepared were comprised of PRP 2858 (68.75%), BC-PC 920 (22.13%) and SDP 379 (9.11%).

Out of the 4157 prepared platelet units, 3483 (83.8%) were fit units and 674 (16.2%) were unutilized and/or discarded due to various reasons such as expire date units 542 (13%), infected blood components 129 (3.1%), loss of swirling 1(.024%), pH inadequacy 1(.024%) and leakage 1(.024%). Among 129 TTIs reactive units, 108 (83.72%) were HbsAg reactive, 11(8.53%) were VDRL reactive, 6 (4.65%) were HCV reactive, 3 (2.33%) were HIV reactive and 1 (0.77%) was Malaria Parasite positive. Distribution of utilized units for different platelet concentrates are represented in Fig. 1.

The total of 3483 units fit for transfusion was given to 1225 patients during the study period. The overall average was 2.84 transfusions per patient. For PRP it was 3.28 (2358 transfusions to 717 patients), for BC-PC it was 2.85 (746 transfusion to 261 patients) and for SDP it was 1.53 (379 units transfusion to 247 patients).

Male verses Female ratio of the transfused patients in the study was 1.9:1. Age of the patients ranged from 06 months to 78 years, with the mean age of 27 years. Age group wise distribution of specific platelet components are illustrated in Fig. 2.

A total of 3483 platelets transfusion, of which 2403 (69%) were prophylactic and 1080 (31%) were for therapeutic indications. Department wise of distribution of specific platelet components are summarised in Fig. 3.

Out of total 3483 transfusions performed in the present study, 2786 (80%) transfusions were found appropriate (rational) as per guidelines of BCSH criteria and 697 (20%) transfusions fell into the category of irrational demand/ transfusion. Rational transfusions for PRP, BC-PC and SDP in the present study were 1816 (77.01%), 645 (86.46%) and 325 (85.75%) respectively.

Mean pre and post transfusion Platelets count and its absolute increase along with standard deviation in different platelet concentrates are illustrated in Table 3.

Adverse events of platelets transfusion in the study was reported in 63/3483 (1.8%) patients while for PRP it was 52 (2.2%), BC-PC 7(1%) and SDP 4(1%).

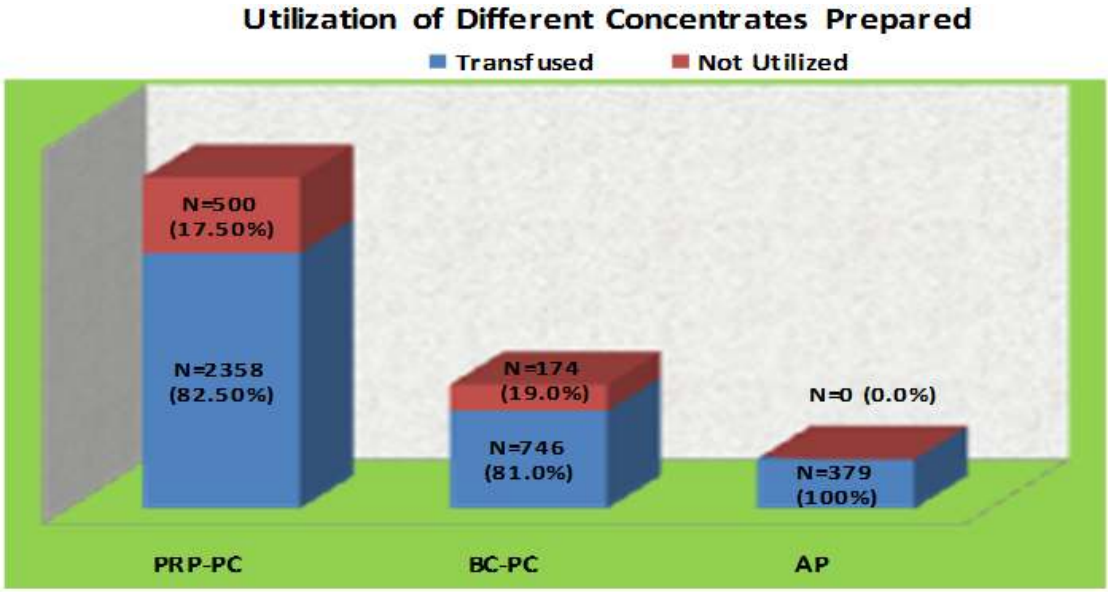

Fig. 1. Utilization of different prepared platelets units

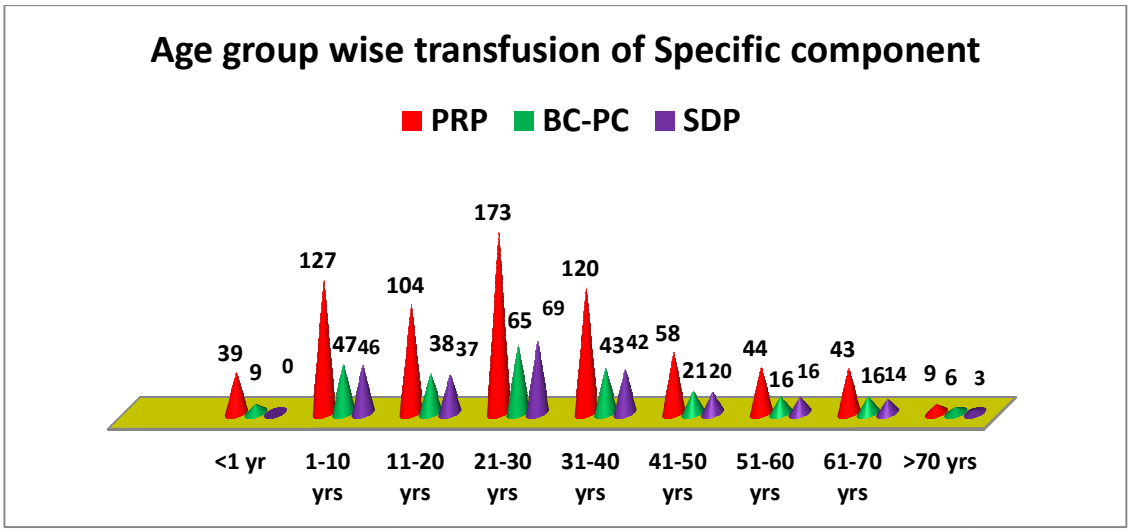

Fig. 2. Patient distribution by age groups

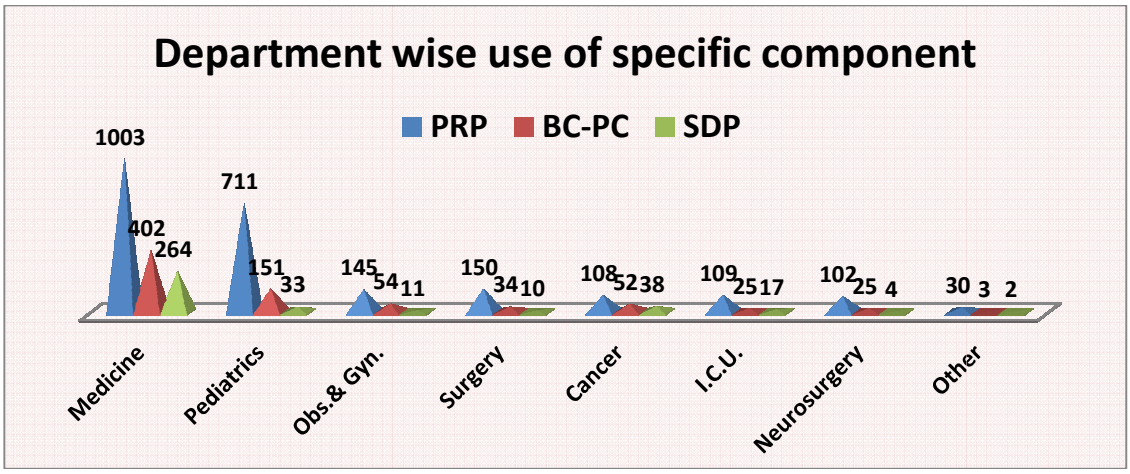

Fig. 3. Distribution of platelet transfusion by medical services in Gajra Raja Medical College, Gwalior

Table 3. Mean and range of pre and post transfusion platelet counts and its absolute increase in RDP (PRP+BC-PC) and SDP

S. no	Concentrate	Platelet count	Mean ($x10^9$ /L)	Standard deviation ($x10^9$ /L)	Range ($x10^9$ /L)
1	RDP (PRP+BC-PC)	Pre-transfusion	19.1	11.3	2- 59
		Post transfusion	23.9	14.1	8-60
		Absolute increase	4.8	2.9	0.2-9
2	SDP	Per-transfusion	22.3	12.9	6-80
		Post transfusion	55.5	12.4	35-110
		Absolute increase	33.2	6.0	16-50

4. DISCUSSION

Blood Banking is a rapidly progressing branch of medical science which is expanding itself to the new horizon of development. At the same time it needs to be monitored and audited periodically for proper utilization of the resources.

In the present study, most commonly preferred platelet concentrate was PRP (68.75%) followed by BC-PC (22.13%) and SDP (9.11%), it is comparable with study of Saluja K, et al. [20] and Chaurasia et al. [21] (Table no. 4). Transfusion of RDP which include both PRP and BC-PC were far more in the study of Saluja K, et al. [20] (97.92%) and Chaurasia R, et al. [21] (93.88%) than in the present study (90.88%). Despite of a better component, SDP is less commonly preferred because of unavailability of facilities and unawareness.

In the present study Total Wastage Rate of platelet components was 16.21% which is comparable with the study of Rafat MF et al. [22] (16%) While higher rate was observed by Saluja K, et al. [23] (29.11%) and lower wastage rate reported by Ryan A, et al. [23] (02.81%). Higher utilization of platelet components in western countries as shown in the study of Ryan A, et al. [23] was due to the efficient training schedule and strict follow up of Blood Banking Manual.

In the present study, TTI Reactive units were 3.16% which was much higher than the studies of Bobde et al. [24] (1.03%) and Saluja K, et al. 2007(1.19%). It was due the higher prevalence of HbsAg (3.51%) among blood donors in this region as reported by Sharma DC et al. [25].

Most prevalent TTI in the present study was HbsAg (83%) which is comparable with the studies of Bobde et al. (75.90%) [24], Leena et al. (52.13%) [26] and Agrawal V.P. et al. (70.54%). [27] In our study, prevalence of HCV reactive rate was 4.54% which is similar to the study of Bobde et al. [24] (5.55%). Prevalence of HIV in the present study was 2.30% whereas higher prevalence was reported by Bobde et al. [24] (20.81%), Leena et al. [26] (20.21%) and Agrawal VP, et al. [27] (17.64%). This difference might be due to the proper counseling of blood donors at our centre.

The VDRL reactive units in the present study was 8.46% which is similar to the study of Leena et al. [26] (7.45%) while no case was detected in the studies of Bobde et al. [24] and Agrawal V. P. et al. [27]. In our study incidence of Malaria was 0.83% while no unit was discarded due to Malaria in the study of Bobde et al. [24] and Agrawal V.P, et al. [27]. Higher incidence (9.61%) of discarded units due to Malaria was reported by Leena et al. [26] may be due to be Malaria being endemic in their region.

In the present study, therapeutic versus prophylactic platelet transfusion ratio was 31: 69 which is comparable with the study of Buhrkuhl D.C, et al. [28] (23:77), Davidson A, [29] (27:73) and Qureshi H, et al. [30] (45:55), while the reverse ratio was found in study of Chaurasia R. et al. [21] (65:35), as their study was limited to the dengue patients only.

Our maximum patients were below 40 years of age (74%) while in other studies they were above 40 years; from England by T. J Cobain et al. (56%) [31], Bortken Raven B. A, et al. (71%) [32], Apuca Susan M. et al. (57%) [33] and demographical studies of United states (69%), Australia (73.0%) and Denmark (90%) [31]. This distinction could be due to demographic variances and death rate in population composition as younger age group is higher in India.

The Male/ female ratio in the present study showed male dominance (65%) which is comparable with the study of Moses M, et al. [34] (61%), multinational study of T. J. Cobain et al. [31] United states- 58%, England- 66%, Australia- 62% and Denmark- 62% and Apuca Susan M, et al. [33] (54%) from India.

Transfusion reactions reported in the study was 1.8%. These were febrile non-hemolytic transfusion reaction (FNHTR) due to platelets and leukocytes and allergic reactions due to foreign plasma proteins and were managed symptomatically.

Rationality of platelet transfusion in the present study was 80% which is comparable with the studies from India and other developed countries; Minal Wade et al. [35] (93%), Saluja K. et al. [20] (88%), Charelwood R. [36] (87%) [36], Thomson A et al. [37] (81%), Hui C.H, et al. [38] (79%) and Clinical Audit of platelet use in Victorian and Tasmanian hospitals by Department of Health & Human Services [39] (74%). While from Nigeria, Arewa O. P. [40] reported rationality 20% which may be because of health services being under developed in the country and lack of a clear policy on blood component transfusion. Indian results are comparable with the developed countries because of NACO has launched a national programme to develop and strengthen blood transfusion services for ensuring the safe supply of blood and it's components even to the last person living in the remote area of the country.

In our institute we are conducting regular awareness programme and training sessions for the consultants, residents and supporting staff regarding the rational use of blood products which are reflected in the results of present study.

5. CONCLUSIONS

We observed that in our institute, RDP is preferred over SDP concentrate though SDP is an ideal concentrate for prophylactic as well as therapeutic use and it also prevents multiple immunological exposures to the patient. A better rationality (80%) according to BCSH criteria in the present study is due to coordinated and updated approach for the transfusion of platelet concentrates. Platelet concentrates should be used rationally and scientifically as per proven criteria because it has no alternative.

CONSENT

The author(s) declare that permission from the ethical committee of the institute has been obtained to access the patient's files and hospital/ lab records. The written informed consent from the patient/donor has also been taken.

ETHICAL APPROVAL

All author(s) hereby declare that all procedures have been examined and approved by the appropriate ethics committee of Gajra Raja Medical College, Gwalior, India and research has therefore been performed in accordance with the ethical standards laid down in the 1964 declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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