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Utilization of Platelet Concentrates in Patients with Thrombocytopenia – A Hospital Based Study

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Abstract: **Platelet transfusion is an effective therapy for the prevention and treatment of bleeding. The aim of the study was to determine the number of platelet transfusions that was done during the study period, to study the indications for the transfusions and evaluate its efficacy. 140 thrombocytopenic patients who received platelet transfusions were evaluated during a one-year study period. Conditions associated with the thrombocytopenia were studied and categorized. Pre and post-transfusion platelet counts were done and 24-hour corrected count increment (CCI) was calculated to check the efficacy of transfusion. Majority of the platelet recipients were transfused prophylactically when their platelet counts were >20000/µL. The most common category of diagnosis among these patients was infectious diseases. 46% of patients showed significant 24-hour CCI. The rest of patients showed no significant increment in their platelet counts after transfusion. Appropriate component therapy should be actively endorsed as it ensures optimum utilization of a scarce resource in a populous third world country like India. A Hospital Transfusion Committee would seem to be a good start to monitoring transfusion practices and steering them in the correct direction.**

Keywords: **Thrombocytopenia; platelet transfusion; platelet concentrate, corrected count increment.**

1. INTRODUCTION

Platelets, even being one of the smallest cells of the hematopoietic system, have important and well-characterized roles in hemostasis and thrombosis, the maintenance of vascular integrity and the innate immune response.[1]

Reduction in platelet number constitutes an important cause of generalized bleeding. The clinical decision regarding platelet transfusions requires consideration of several variables, including estimation of platelet count and function, cause of thrombocytopenia, the state of coagulation function, the presence or likelihood of bleeding and the hazards of transfusion.[2]

There are many indications of platelet transfusion. However, the absolute indication is severe thrombocytopenia together with clinically relevant bleeding. All the other indications are more or less relative and depend on the clinical condition of the patient.[3]

The dose and number of platelet units to be administered depends on the clinical situation of each patient.[4] It is essential to monitor the efficacy of platelet transfusion in order to guide the use of subsequent transfusions by measuring the platelet counts before and after transfusion.[5]

Though platelet transfusion is crucial in treating life threatening hemorrhage, one must keep in mind the associated hazards, which include a variety of serious or even fatal transfusion reactions, refractoriness, hemolysis from ABO-mismatched transfusions, acute lung injury and sepsis.[6]These risks, along with the difficulty and cost of producing and maintaining adequate supplies of platelets, justify the rationale of using this therapy judiciously.

2. MATERIALS AND METHODS

The present study included all admitted patients in a tertiary hospital, who had thrombocytopenia and received platelet transfusion during the study period from 1st January 2013 to 31st Decemeber 2013.

Patient information was collected from the blood bank component register and medical records of the patients who received platelet transfusion during their course of stay in the hospital. Patient details including age/sex, history, physical examination, investigations inlcuding pre and post transfusion platelet counts were noted from their medical records.

The platelet concentrates, which were used for transfusion, were prepared using platelet rich-plasma (PRP) method within 8 hours of collection of whole blood. 24 hour - CCI for each patient was calculated to assess the effectiveness of transfusion using the following formula:

$$CCI = \frac{(\text{Post} - \text{pre-transfusion count}) \times BSA}{\text{Number of platelets transfused} \times 10^{-11}}$$

3. RESULTS

The total number of patients who received transfusion of platelet concentrates in the institute was 140, out of which, 77 were males and 63 were females. The male to female ratio was 1.22. The age of the platelet transfusion recipients ranged from a day old neonate to a 75 year old.

The majority i.e. 75 out of the 140-platelet transfusion recipients was from the department of Medicine, followed by 44 patients from Pediatrics, 16 patients from Obstetrics & Gynecology, 3 patients from Surgery and 1 each from ENT and Orthopedics.

Table 1 shows the pre-transfusion platelet counts of the platelet recipients. 79 out of the 140 patients received platelet transfusions when their counts were between 21,000-50,000/µL. Table 2 shows the number of platelet units utilized by each patient.Single unit transfusions were given to 31 patients out of whom 24 were of pediatric age group. In adults, multiple transfusions at a time were much more common.

Table: 1. Pre-transfusion platelet counts

PRE-TRANSFUSION PLATELET COUNT (PER µL)	NO. OF PLATELET RECIPIENTS	%
<10000	8	5.71
11000-20000	40	28.57
21000-50000	79	56.42
51000-100000	12	8.57
>100000	1	0.71
TOTAL	**140**	**100**

Table: 2. Number of platelet units utilized

NO. OF UNITS TRANSFUSED TO AN INDIVIDUAL PATIENT	NO. OF PLATELET RECIPIENTS	TOTAL NO. OF PLATLETS UTILIZED
1	31	31
2	45	90
3	22	66
4	24	96
5	7	35
6	6	36
7	2	14
8	1	8
9	1	9
10	1	10
TOTAL	**140**	**395**

Broadly classifying the diagnoses given to the patients, the distribution of cases was as given in Table 3. Many patients had more than one diagnosis.The most common category was infectious diseases, which comprised of 76 patients. 33 patients had hematological disorders, 23 had neonatal complications and 14 had obstetric causes. The rest had other miscellaneous disorders.

Table 3.Categories of diagnosis for which platelets were utilized

DIAGNOSIS	NO. OF PLATELET RECIPIENTS	%
INFECTIOUS DISEASES	**76**	**44.44**
HEMATOLOGICAL DISORDERS	33	19.29
NEONATAL COMPLICATIONS	23	13.45
OBSTETRIC COMPLICATIONS	14	8.18
GI DISORDERS	7	4.09
CNS DISORDERS	6	3.5
LIVER DISEASE	4	2.33
LUNG DISEASE	3	1.75
SURGICAL CASES	3	1.75
PYREXIA OF UNKNOWN ORIGIN	2	1.16
TOTAL	**171**	**100**

Dengue fever was most common indication for platelet transfusion. A total of 39 cases of dengue fever was diagnosed and confirmed by serological tests. 27 out of 39 patients had pre-transfusion platelet counts between 21,000-50,000/µL, 8 patients had counts between 11,000-20,000/µL and 1 patient had a count below 10,000/µL. Only 3 patients had platelet counts above 50,000/µL.

There were 33 patients having a hematological disorder associated with thrombocytopenia. The commonest were anemia seen in 16 cases and pancytopenia seen in 13 patients. 1 case each of acute lymphoblastic leukemia, immune thrombocytopenia, Glanzmann's thrombasthenia and thalassemia major were present among the cases studied.

16 neonates required transfusion of platelet concentrates. The highest incidence of thrombocytopenia was seen in the 9 cases of preterm births that also had low birth weight. There were 4 cases of birth asphyxia, 3 cases of neonatal sepsis and 2 cases of jaundice.

15 patients out of 140 had low platelet counts during pregnancy or after delivery and required transfusion of platelets. The most common associated diagnosis among them was anemia, seen in 9 patients. There were 7 cases of pregnancy-induced hypertension, which included cases of pre-eclampsia, and eclampsia. Other diagnoses included intra-uterine death, pancytopenia, HELLP syndrome, post-partum hemorrhage and acute gastroenteritis.

Out of the 140 thrombocytopenic patients who received platelet transfusions, 40 (28.57%) cases had a history of bleeding. The most common bleeding manifestation was hematochezia seen in 10 patients. The next frequent manifestations were petechial hemorrhages and epistaxis seen in 8 patients each, followed by melena and vaginal bleeding seen in 5 patients each, and hematemesis and hematuria seen in 4 patients each. 12 out of the 40 patients had bleeding from more than one site.19 patients with bleeding had a platelet count between 21,000-50,000/µL. 11 patients had platelet counts ≤20,000/µL. The rest of the patients had counts above 50,000/µL (Table 4).

Table: 4. Pre-transfusion platelet counts in patients with bleeding

PLATELET COUNT (per µL) IN BLEEDING PATIENTS	NO. OF PLATELET RECIPIENTS	%
≤5000	3	7.5
6000-10000	2	5
11000-20000	11	27.5
21000-50000	19	47.5
51000-100000	4	10
>100000	1	2.5
TOTAL	**40**	**100**

119 patients out of the 140-platelet transfusion recipients showed an increment in the post-transfusion platelet count. 21 patients showed no increment or further decrease in their platelet counts.49 out of the 119 patients who showed post-

transfusion increments in their platelet counts had 24-hour CCI above 10,000/µL. 6 patients showed CCI between 7500-10,000/µL. The rest 64 patients showed CCI below 7500/µL (Table 5).

Table 5.24-hours corrected count increment after platelet transfusion

24-HOUR CCI (per µL)	NO. OF PLATELET RECIPIENTS	%
<5000	45	37.81
5000-7500	19	15.96
7500-10000	6	5.04
>10000	49	41.17
TOTAL	**119**	**100**

4. DISCUSSION

This study was conducted to study the utilization of platelet components by a hospital with an attached blood bank. There were a total of 140 patients who had thrombocytopenia and utilized platelet concentrates during the study period. 55% of them were males and 45% were females. The male to female ratio was 1.22. The age range of the patients was wide and varied from a 1 day old baby to a 75 years. The mean age was 37.5 years.

In a 4-month study conducted in 6 hospitals in Eastern Ontario, Canada, a total of 4801 units of platelet concentrates were transfused on 687 occasions to 303 patients. The cardiovascular service utilized the highest number of platelets, aorto-coronary bypass being the most common procedure. The oncology department used the next highest proportion of platelet units, for transfusion to leukemic patients with thrombocytopenia.[7]Gaur *et al.* evaluated the utilization of blood and blood components at the blood bank of a tertiary health center and concluded that the most common indication was thrombocytopenia due to leukemia, followed by thrombocytopenia at the time of surgery.[8] In the present study, the most common indication for platelet transfusion was thrombocytopenia associated with infectious diseases. The different specialities that utilized platelets in decreasing order of frequency were Medicine (53.57%), Pediatrics (31.42%), Obstetrics & Gynecology (11.42%), Surgery (2.14%), Orthopedics (0.71%) and ENT (0.71%). The total number of platelet concentrate units utilized by the patients was 395. Majority of them received multiple transfusions at a time. Single unit transfusion was given mainly in the pediatric age group.

Patients with acute febrile illnesses in a tropical country like India usually have an infectious etiology and may have associated thrombocytopenia. Naik *et al.* studied 109 patients with fever and observed platelet counts between 50,000-100,000/µL (62 patients), 20,000-50,000/µL (28 patients) and below 20,000/µL (19 patients). Septicemia was the leading cause of fever-associated thrombocytopenia and in a significant number of cases lead to various bleeding manifestations.[9]In the present study, 94 patients had fever as one of the presenting complaints. More than half (54%) of the patients who utilized platelets were suffering from an infectious disease. The most common infectious disease was dengue fever seen in 39 patients. Other infections noted were malaria, typhoid, rickettsial fever, HIV, hepatitis B and tuberculosis. Bacterial sepsis was seen in 7 cases. 13 patients had splenomegaly which could be a cause of abnormal pooling of platelets, thereby reducing their counts in peripheral blood. 40 patients had bleeding from one or more site. The commonest bleeding manifestions were hematochezia, epistaxis and petechiae.

Most common hematological disorders associated with the thrombocytopenia in these patients were anemia and pancytopenia with one confirmed case of megaloblastic anemia. Varying degrees of thrombocytopenia may be observed with either folate or vitamin B_{12} deficiency. The pathophysiologic mechanism is ineffective production of platelets along with other cell lines.[10]Platelet transfusion is a cornerstone of treatment in many malignant hematological disorders. Most commonly, platelets are administered prophylactically, with the aim of maintaining the patient's platelet count >20000/µL.[11] A single caes of ALL in a 16 year old boy was present in the study whose pre-transfusion platelet count was 5000/µL.One case each of ITP and Glanzmann's thrombasthenia was also seen.

Most low platelet counts observed in pregnant ladies are due to normal physiologic changes, whereas some disorders associated with thrombocytopenia occur with higher frequency, such as pre-eclampsia, HELLP, acute fatty liver of pregnancy, DIC, TTP and HUS.[12] In this study, among the 15 patients who utilized platelets during or after pregnancy, 9 had anemia and 7 had PIH which included 2 cases of pre-eclampsia. HELLP syndrome was observed in 1 patient.

Gupta *et al.* analyzed thrombocytopenia in 146 neonates admitted in neonatal intensive care unit. Their study showed that babies with low birth weight (LBW) and intrauterine growth retardation (IUGR) showed significantly low platelet counts

due to their limited ability to compensate for accelerated destruction of platelets. However, they concluded that factors such as LBW, IUGR and maternal hypertenstion were not independently responsible for thrombocytopenia. These conditions associated with sepsis, GI problems and hypoxia together necessitate platelet transfusions in these babies.[13]9 out of 16 neonates, who received platelet transfusions in the present study, were both preterm and low birth weight, out of which 1 baby had associated meconium aspiration with septicemia and 1 baby had respiratory distress. 2 other neonates were septicemic and 5 had birth asphyxia.

Definitive studies (e.g. well-designed, prospective, randomized clinical trials) are not available either historically or at present to support evidence-based decisions regarding a trigger level of platelet count that indicates prophylactic platelet transfusion. Instead, retrospective reviews and anecdotal reports provide observational data to assist in best guess clinical practices. Reasonable clinical practice, until more definitive data become available, is to transfuse enough platelets per each transfusion to maintain the blood platelet count >10,000/μL in stable non-bleeding patients, >20,000/μL in unstable non-bleeding patients, and >50,000/μL in bleeding patients or in those undergoing invasive procedures.[14]In the present study 100 out of 140 patients who received platelet transfusion were transfused prophylactically. No definitive trigger value of platelet count for prophylactic transfusion was observed. Only 37% of those who received prophylactic platelet transfusions had a platelet count less than 20,000/μL. Rest of the prophylactic platelet transfusions were given to patients with platelet count >20,000/μL. No uniform guidelines for prophylactic transfusion therapy were hence found to be followed.

The 24-hour CCI was calculated in each case and a total of 119 patients showed post-transfusion increments in platelet counts. However, in 84 cases, there was either no increment or the increment was not significant. A number of clinical factors such as fever, infection and the administration of certain drugs my reduce the effectiveness of platelet transfusion.[15]In the present study, 57/84 platelet recipients who had reduced 24-hour CCI had fever associated with the thrombocytopenia. 44/84 patients had an infectious disease. All 9 preterm/LBW babies and 5 neonates who suffered from birth asphyxia also showed no significant increase in their 24-hour CCI.

5. CONCLUSION

The observations of this study provide information on platelet concentrate usage in our hospital. It was seen that although many patients genuinely required platelet transfusion therapy for various causes of thrombocytopenia, others were transfused with platelets prophylactically and no definitive trigger value of platelet count for prophylactic transfusion was observed.

Blood transfusion has come a long way from early 20th century when it was a cumbersome and risky procedure. Currently transfusion medicine is a specialty in its own right. The emphasis has shifted from the use of whole blood to component therapy, as blood is a scarce and precious resource. The demand for blood far exceeds supply, especially in the densely populated third world countries where ignorance and superstition mitigate against voluntary blood donation. Inappropriate ordering and use of blood aggravate these increased requirements and additionally expose the patients to unnecessary hazards of transfusion. Most of the hospitals in India function without a hospital transfusion committee, which is supposed to review each blood transfusion, its indications and appropriateness.

In conclusion, component therapy, including platelet therapy, should be actively endorsed as it ensures optimum utilization of a scarce resource in a country like ours. Additional studies are advisable regarding the availability of this facility by government health providers. Directives encouraging all blood banks in such setups to prepare components on a regular basis and regular CME programs to encourage component use by the physicians, surgeons and specialists would go a long way in reaching the goal of optimum and rational use of donated blood.

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