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Role of Corrected Count Increment (CCI) As A Surrogate Marker for Efficacy of Platelet Concentrate Transfusions- A Hospital Based Study

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A B S T R A C T

Introduction*:** Platelet transfusion is a lifesaving procedure for thrombocytopenia, can be either prophylactic or therapeutic. Evaluation of the response to platelet transfusion by calculating Corrected count increment (CCI).The corrected count increment (CCI) is a laboratory evaluation of the effectiveness of Platelet concentrate transfusion. Corrected count increment (CCI) is the most widely used surrogate marker for evaluating refractory patient's responses to platelet component transfusions which is measured at 24 hour post transfusion.Aim and Objectives*:** 1) To study the number of platelet transfusion that was done during the study period. 2) To study the indications for the platelet concentrate transfusions in cases of thrombocytopenia. 3) To evaluate efficacy of platelet concentrate transfusion for increment of platelet count. 4) To evaluate the causes of refractoriness to platelet transfusion. ***Material and Methods*:**The present study included 100 cases having thrombocytopeniaadmittedat SMIMER hospital whoreceived platelet concentrate transfusion during the study period from 1st June 2024 to 31st November 2024.Patient information was collected from blood bank component register and from ward.Investigations including pre and post transfusion platelet counts were noted using following formula,

$$CCI = \frac{(\text{Post} - \text{pre-transfusion count}/\ \mu l) \times BSA(m^2)}{\text{Number of platelets transfused} \times 10^{-11}}$$

***Results*:** Majority of the platelet recipient were transfused prophylactically when platelet count were > 20000/ul. The most common among them is infectious causes. The most common category of diagnosis among these patients was infectious agent. ***Conclusion*:** The usage of platelet concentrates in thrombocytopenia found in the study reveals infectious cause as predominant and common finding.CCI values is found to be useful in evaluating response in cases of thrombocytopenic patients receiving platelet concentrate transfusion.It was noticed that platelet count does not increase to the expected level after platelet transfusions in certain patients due to refractoriness to the platelet transfusion (in cases of fever, sepsis etc).

Keywords: Corrected count increment (CCI), Platelet refractoriness, Thrombocytopenia, Platelet concentrate transfusion.

INTRODUCTION

Platelet transfusion is one of the most crucial therapeutic approach indicated to prevent hemorrhage in patients with thrombocytopenia or platelet function defects [1].

Platelet transfusionis used for prevention or treatment of bleeding in case of low platelet count or poor platelet function [2].

Decision regarding platelet transfusion depend on the clinical condition of the patient, the causes of thrombocytopenia, the platelet count and functional ability of the patients own platelets [2].

In many conditions, prophylactic platelet transfusions are given to nonbleeding thrombocytopenic patient to reduce the risk of hemorrhage [5].

The threshold for prophylactic platelet transfusion is 10,000/ µl [3]. In patient without fever or infections, a threshold of 5000/ µl may be sufficient to prevent spontaneous haemorrhage [3].

For invasive procedures, the usual threshold level is 50,000/ µl [3]. There are two types of platelet transfusion- Random donor platelet (RDP) and Single donor platelet (SDP) [6].

The standard dose of platelets (six units of whole blood derived RDP or one SDP) generally increase the platelet count by about 30000-40000 platelets/ µl /unit in a 70 kg adult [6].

Corrected count increment:

The corrected count increment (CCI) is a laboratory evaluation that is a measure of response to platelet transfusion that corrects the count increment after number of platelet units transfused.

CCI definition- To consider a post transfusion platelet count increment as adequate, if 24 hour post transfusion cut-off values were 5000/µl or more for CCI.

A high CCI (usually > 5000) suggests that the transfusion was effective and the platelets are functioning well.

A low CCI indicates poor response to the transfusion, which may suggest issues such as immune-mediated platelet destruction, inadequate platelet production, or issues with the platelet product itself.

Platelet refractoriness is defined as lack of response in platelet increment after two consecutive transfusions [4].

Aim and Objectives:

1. To study the number of platelet transfusions that were done during the study period.
2. To study the indications for the platelet concentrate transfusions in cases of thrombocytopenia.
3. To evaluate efficacy of platelet concentrate transfusion for increment of platelet count.
4. To evaluate the causes of refractoriness to platelet transfusion.

Material and Methods:

This prospective study included evaluation of the patients who received platelet concentration transfusion, admitted to Department of Medicine, Paediatrics and Obstetrics & Gynaecology.

Inclusion criteria: The patient (male and female) whose age is 5 to 70 year, received single donor platelet and random donor platelet.

Exclusion criteria: Loss to follow-up at 24 hours post-transfusion, Patient having a failure of the platelet product to be completely transfused, Pregnant female, Repeated admission of the same patient.

We studied 100 cases having thrombocytopenia, for the duration of 6 months in blood bank of SMIMER Hospital. Demographic and other basic characteristics like age, gender, blood group, height, weight, and diagnosis were noted.

Platelet units were prepared as per the standard operating procedures (SOP) of the department.

Investigations including pre and post transfusion platelet counts were noted from their medical records. Two ml of the patient's blood was collected in EDTA tubes at two different times, one sample before the transfusion and the other sample was collected at 24 hours post-transfusion. Platelet counting was done by an automated cell counter. The main outcomes measured are corrected count increment (CCI).

Efficacy of platelet transfusion were evaluated by 24 hour - CCI for each patient. 24 hour - CCI was calculated to assess the effectiveness of transfusion using the following formula:

$$CCI = \frac{(\text{Post} - \text{pre-transfusion count}/\ \mu l) \times \text{BSA}(m^2)}{\text{Number of platelets transfused} \times 10^{-11}}$$

Where,

BSA was estimated calculated using the **Mosteller formula**,

Body surface area(m^2): √Height(cm) x weight(kg)/3600
PI=Post transfusion platelet count- Pre transfusion platelet count
Platelet dose (10^{-9})- Desired platelet increment x blood volume (L) x F^-
Where F^- = .67, which represent a correction factor for splenic pooling.

RESULTS

Total number of patient who received transfusion of platelet concentration in the institute was 100, out of which, 55 were male and 45 were female.

The majority patient is from department of Medicine (43), followed by Paediatric (30), followed by Obstetrics and Gynaecology (17).

The age of the platelet transfusion recipient ranged from 5 to 70 year old.

Table 1: Number of cases according to department

Department	Number of cases
Medicine	43
Paediatrics	30
Obs-Gynec	17
From outside Hospital	10
Total	100 cases

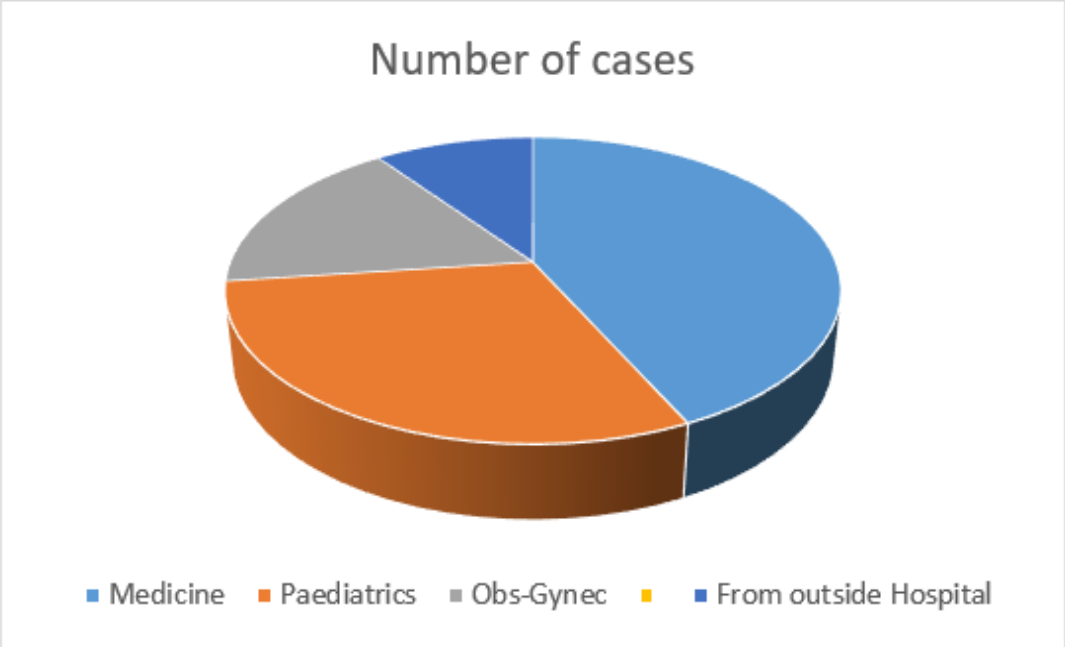

Table 2: Pretransfusion platelet counts

Pre-transfusion platelet count (per µl)	No. of platelet recipients	%
<10000	8	8%
11000-20000	25	26%
21000-50000	58	58%
51000-100000	7	7%
>100000	1	1%
Total	100	100%

Table-2 shows pre-transfusion counts of the platelet recipients, 58out 100 patients received platelet transfusion when their count were between 21000-50000/µl.

Table 3: Number of platelet unit utilized

No. of units transfused to an individual patient	No. of platelet recipients	Total no. of platelets utilized
01	15	15
02	13	26
03	12	36
04	30	120
05	9	45
06	20	120
07	1	7
Total		369

Table 4: Number of cases of different diagnosis having thrombocytopenia

Sr No	Diagnosis	Number of cases	Percentage of cases
1	Systemic Lupus Erythematous	**2**	**2%**
2	Dengue	**23**	**23%**
3	Immune thrombocytopenic purpura	**2**	**2%**
4	Gestational thrombocytopenia	**8**	**8%**
5	HELLP syndrome	**10**	**10%**
6	Aplastic anaemia	**1**	**1%**
7	Sickle cell disease	**10**	**10%**
8	Disseminated intravascular coagulation	**3**	**3%**
9	Chronic kidney disease	**10**	**10%**
10	Tuberculosis	**8**	**8%**
11	Malaria	**21**	**21%**
12	Plasma cell disorder	**2**	**2%**
13	Acute leukaemia	**5**	**12%**

Dengue fever was most common indication for platelet transfusion. A total of 23 cases of dengue fever was diagnosed and confirmed serological test.

Table 5: Pre-transfusion platelet count in dengue patient

Platelet count/µl	No of patient
> 50000	2
21000-50000	16
11000-20000	4
<1000	1
Total	23

Table 5 shows pre-transfusion platelet count in dengue patient, 16 out 23 patients had pre-transfusion counts between 21000-50000/ µl, 4 patients had counts between11,000-20000/µl and 1 Patient had a count below 10000/ µl, Only 2 Patients had platelet counts above 50000/ µl.

70 patients out of the 100 patients transfusion recipients showed an increment in post transfusion platelet count.18 Patients showed no increment or furthur decrease in their platelet counts.

Table 6: 24 Hours CCI after platelet transfusion

24 hour CCI (per microlitre)	No of Platelet Recepient	%
<5000	18	18%
5000-7500	28	27%
7500-10000	19	19%
>10000	35	35%
Total		100%

DISCUSSION

Thrombocytopenia is defined as platelet count less than 1,50,000. Majority transfusion give prophylactically [3].Study reveals that the need for platelet concentration is highest for infectious disease like dengue followed by malaria followed by haematological malignancy etc [1].

It is essential to monitor the efficacy of platelet transfusions in order to guide the use of subsequent transfusions by measuring the platelet counts before and after transfusion [1].

The post-transfusion platelet count plays a key role in the assessment of a patient's response to platelet transfusion, and it is affected by pre transfusion platelet count, dose, and viability of platelet administered [8].

Cross matched-compatible platelet concentration improve the mean corrected count increments (CCI) than cross matched incompatible and [7].

The corrected count increment (CCI) formula is the standard used to assess response to platelet transfusion and determine platelet recovery and platelet survival, as well as to diagnose a refractory state.

Platelet refractoriness is the term given to a consistent failure to achieve an appropriate platelet count increment following platelet transfusion [2].

A single donor platelet (SDP) concentrate was expected to raise platelet count by 30,000-60,000 /µl, while random donor platelets increased the platelet count by 5,000-10,000 /µl in an average-sized adult.

While post-transfusion platelet increments at 24 hours were significantly higher with SDP transfusion as compared to transfusions with RDP [2].

Male sex was associated with a lower response to platelet transfusion than female.The corrected count increment (CCI) is a useful tool in monitoring platelet transfusion effectiveness but, it has limitations related to individual patient factors, platelet quality, storage, immune responses, and the inherent variability of platelet dynamics.

CONCLUSION

- Platelet transfusion was found to beimportant prophylactic and therapeutic procedure in managing thrombocytopenic patient.
- It was found that platelet count does not increase to the expected level after platelet transfusions in certain patients due to refractoriness to the platelet transfusion (in cases of fever, sepsis etc).
- According to logistic terms, SDP is better than RDP when considering the number of donors exposed to patients.
- Unsuccessful CCI at 24 hours is attributed to non-immunological clinical factors like sepsis, splenomegaly.
- Identifying these underlying causes and treating them has helped in getting a better response to platelet transfusion in patient requiring platelet transfusion.

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