

## Blood transfusion in neonates- An audit study

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### Abstract

**Introduction:** Audit of blood transfusion practices is essential to monitor appropriate use of blood components. Many of the studies related to audit of blood components are based on adult population. There are very few studies addressing the audit of transfusion practices exclusively in pediatric population. Therefore present study was conducted to perform audit of transfusion practices, in order to study the appropriate and inappropriate usage of blood and its different components in neonatal population.

**Materials and Methods:** This study was carried out in a tertiary care hospital with an FDA approved blood bank for duration of two year. Total 290 neonates from birth to 28 days and who were admitted to the NICU were chosen and data obtained from cross matching, issuing of blood products to successful transfusion and any problems that might arise including but not limited to transfusion reactions.

**Results:** Out of total patients, 104 patients were transfused and 186 were not transfused. The total number of products issued from the blood bank and transfused was: PC transfused was 142 (including 13 whole blood), platelets 126 and FFP 19. The cross match to transfusion ratio was 2.42 and is within target ratio of  $\leq 2.5$ . The appropriateness of transfusions for PC and platelets was 87.5% and 78.9% respectively, is also a significantly higher number which is an indicator of optimum transfusion practice by NICU. Individual laboratory investigations had a statistically significant rise post transfusion. There was only one transfusion reaction reported which was minor allergic, non-hemolytic and non-febrile.

**Conclusions:** Both blood bank and NICU are utilizing the available resources for adequate and timely treatment of patients which leads to demonstrable betterment in the clinical outcome and are following the national and the international guidelines for transfusion.

**Keywords:** Audit, Transfusion, Blood, Neonates, Platelets, Cross match to transfusion ratio.

### Introduction

Sick neonates are one of the most heavily transfused groups of patients in modern medicine. The optimal utilization of blood and its components is of utmost importance in this age group. Clearly the administration of blood products conveys a finite risk of transfusion reactions, irregular antibodies, transmitting potentially serious infection and is not without risk and cost.<sup>1</sup> It therefore remains a continuing task to continuously improve and implement most appropriate protocols for blood product use in neonates, within the constraints of the available evidence.

Blood transfusion support is an integral part of the neonatal intensive care provided to preterm infant to reduce or prevent anaemia which is a very common problem in neonates, especially the preterm.<sup>2</sup> Exchange transfusion which is often required for the effective treatment of ABO and Rh- incompatibility is a challenge often encountered by the pathologist in the blood bank. In the first six month the antibodies of infants are immature therefore mothers' samples has to be cross matched as the infant's serum lacks the antibodies. This adds to the complications of selecting the right, cross matched blood bag to the neonates.<sup>3</sup>

In current practice most transfusion in neonates involve small volume packed cell transfusions given to the preterm infant and vary in requirement according to diagnosis. Neonates in intensive care unit (NICU) form a very sensitive patient group in the hospital and the role of blood bank to provide prompt services is of essence. A significant proportion of critical ill neonates receive blood product transfusions during their NICU stay.<sup>4</sup> There are few data on the indications for packed RBC transfusions, the cross

match to transfusion ratio (CTR) in critically ill neonates, moreover the efficacy of RBC transfusion is not clear with respect to the requirement and the expected outcome of the transfusion.

Hence the present study was carried out with objectives to study the transfusion practices for blood products in neonates to find out the practice patterns in regards to blood and blood component transfusion and the results obtained along with the complications that might arise in the process. Also this study analyze the data obtained and rank the conditions in which whole blood and blood component such as packed red cells (PC), fresh frozen plasma (FFP), platelets are required the most and correlating the above obtained data to ensure an audit cycle.

### Materials and Methods

The present prospective cross sectional study was carried out in a tertiary care hospital with an FDA approved blood bank for duration of two year. Total 290 neonates in NICU requiring transfusion of blood products were included in the study. Each year the blood bank handles and issues blood bags and products in excess of 9000 units. Analysis of transfusion of blood including whole blood, PC and blood products including FFP and platelets to neonates less than 28 days admitted to the NICU whether cross matched and transfused or not and the amount required and utilized was documented.

The cross-match to transfusion ratio (CTR) calculated from the above data. Birth history, other contributory history, pre transfusion clinical data and laboratory investigations were noted and clinical diagnosis was done.

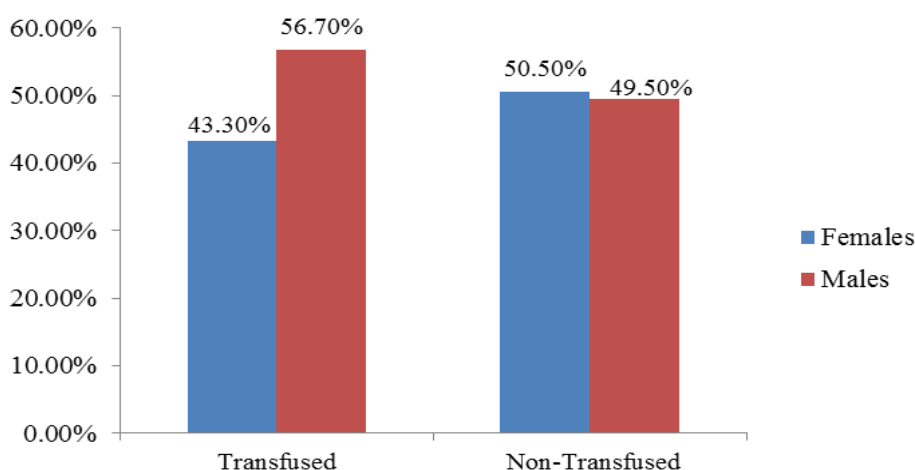
Blood group of the mother and the neonate and cross matching with the mothers sample were done. Also the various conditions where blood products were required and the quantity utilized outlining a pattern in which neonates are in need of blood products were studied. Any adverse transfusion reactions and irregularities in cross matching amounting to irregular antibodies and other abnormalities were documented. The pre versus post transfusion laboratory parameters including hemoglobin, platelet count, hematocrit, serum bilirubin documentation were done to determine the outcome of the required transfusion thus achieving a clinical correlation of the effect of blood transfusion.

All the data collected was analyzed and an audit cycle established reflecting whether there exists an optimal and

effective utilization of blood and blood components in the neonates.

**Results**

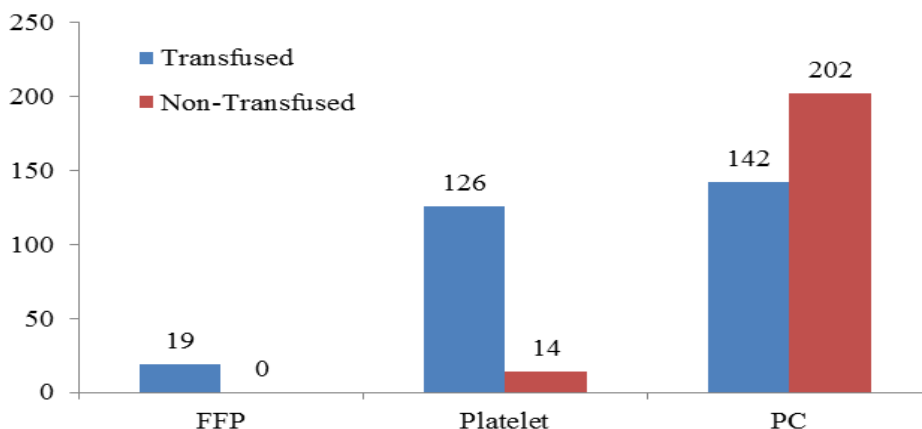
The total 290 neonates were enrolled in the study, among them 151(52.1%) were males and 139(47.9%) were females showing a slight male predominance but not statistically significant (p=0.287). Out of the total neonates, 47(16%) were preterm and 243(84%) were term neonates. Among total neonates, 104 neonates were transfused with a single or multiple blood products whereas 186 were not transfused any product at all from the blood bank. The sex distribution among cases with and without transfusion was shown in Fig. 1.



**Fig. 1: Sex distribution among cases with and without transfusion**

The grand total of all the products requested was 503 while the total products actually transfused to patients was 287. The total number of products category wise was 142 PC including 13 whole blood, 126 platelets and 19 FFP. In the neonate who were either transfused or non transfused PC remind the highest requested component from the blood bank, followed by platelets and lastly FFP being the least

requested product (Fig. 2).PC, platelets and FFP were ordered whether single or multiple times, or along with other components. In cases of multiple transfusion of a particular component, platelets were at the top of list with 36 instances followed by PC and FFP.



**Fig. 2: Distribution in transfused and non-transfused**

Out of the total 104 transfusions, 94 received PC (90.8%), out of these 43 patients were exclusively given PC while 53 were given PC along with either platelets or FFP or both. Out of total transfusions, 57 received platelets (54.8%), out of these 8 neonates received exclusive platelets whereas 49 cases received platelets along with PC. Only 11 patients (10.5%) received FFP amongst which only 2 received them exclusively rest 9 received FFP along with PC.

Out of 104 transfusions, 54 (51.92%) were single transfusions while 50 (48.8%) were multiple transfusion. To sum up and distribution of the issue of various components across various groups and combinations were shown in table 1. Amongst the combination of product requested or transfused, PC + Platelets was the most ordered combination followed by PC+ FFP, all the three components together were requested in only 8 instances, (Table 1).

**Table 1: Distribution of blood components**

Components Transfused		No. of patients
Exclusive PC		56
Exclusive Platelets		8
Exclusive FFP		2
Multiple PC		33
Multiple Platelets		36
Multiple FFP		12
Others	PC+ Platelet	43
	PC+FFP	12
	PC +FFP +Platelet	8

The request for PC was 344 out of which 142 units were utilized, this helped us calculate the cross match to transfusion ratio (CTR) which was found to be 2.42. This falls under the optimum range and is an indicator of

optimum utilization of blood. Table 2 show the distribution of cases according to diagnosis in transfused and non-transfused group.

**Table 2: Diagnosis among transfused and non-transfused cases**

Diagnosis	Groups		Total
	Transfused	Non-Transfused	
Infectious	52 (50.0%)	41 (22.0%)	93 (32.1%)
Hyperbilirubinemia	13 (12.5%)	75 (40.3%)	88 (30.3%)
Preterm	3 (2.9%)	44 (23.7%)	47 (16.2%)
RDS	16 (15.4%)	12 (6.5%)	28 (9.7%)
Birth Asphyxia	9 (8.7%)	8 (4.3%)	17 (5.9%)
Heart disease	5 (4.8%)	4 (2.2%)	9 (3.1%)
Others	6 (5.8%)	2 (1.5%)	8 (2.8%)
Total	104 (100%)	186 (100%)	290 (100%)

The total prevalence of blood group in the mothers that were studied reveals O positive as the most frequent blood group (30.3%) followed by B positive (24.5%), A positive (21.7%) and AB positive (11%). The Rh- negative groups were O negative (4.5%), B negative (2.8%), A negative (2.8%) and AB negative (0.7%) in decreasing order of prevalence. In the neonates studied there were equal number

of O positive and A positive (30.1%) followed by B positive (26.3%) and AB positive (9.7%) while the Rh- negative blood groups were O negative (2.8%) followed by A negative (1%) and B negative (0.3%). Table 3 shows the distribution of mothers and neonates according to blood group in transfused and non-transfused group.

**Table 3: Mothers and neonates blood group distribution**

Blood group	Mothers		Neonates	
	Transfused	Non-Transfused	Transfused	Non-Transfused
A negative	3 (2.9%)	5 (2.7%)	2 (1.9%)	1 (0.5%)
A positive	25 (24.0%)	38 (20.4%)	29 (27.9%)	56 (30.1%)
AB negative	1 (1.0%)	1 (0.5%)	-	-
AB positive	7 (6.7%)	25 (13.4%)	10 (9.6%)	18 (9.7%)
B negative	2 (1.9%)	6 (3.2%)	0 (0.0%)	1 (0.5%)
B positive	27 (26.0%)	44 (23.7%)	31 (29.8%)	49 (26.3%)
O negative	3 (2.9%)	10 (5.4%)	1 (1.0%)	7 (3.8%)

O positive	31 (29.8%)	57 (30.6%)	31 (29.8%)	54 (29.0%)
Mothers not available	5 (4.8%)	0 (0.0%)	-	-
Total	104 (100%)	186 (100%)	104 (100%)	186 (100%)

The appropriateness of transfusion for packed red cells was observed to be 87.5% which is an indicator of optimum utilization of blood. For platelets the appropriateness of

utilization was 78.9% which is an excellent number in comparison to other studies. The appropriateness of transfusion was statistically significant as shown in Fig. 3.

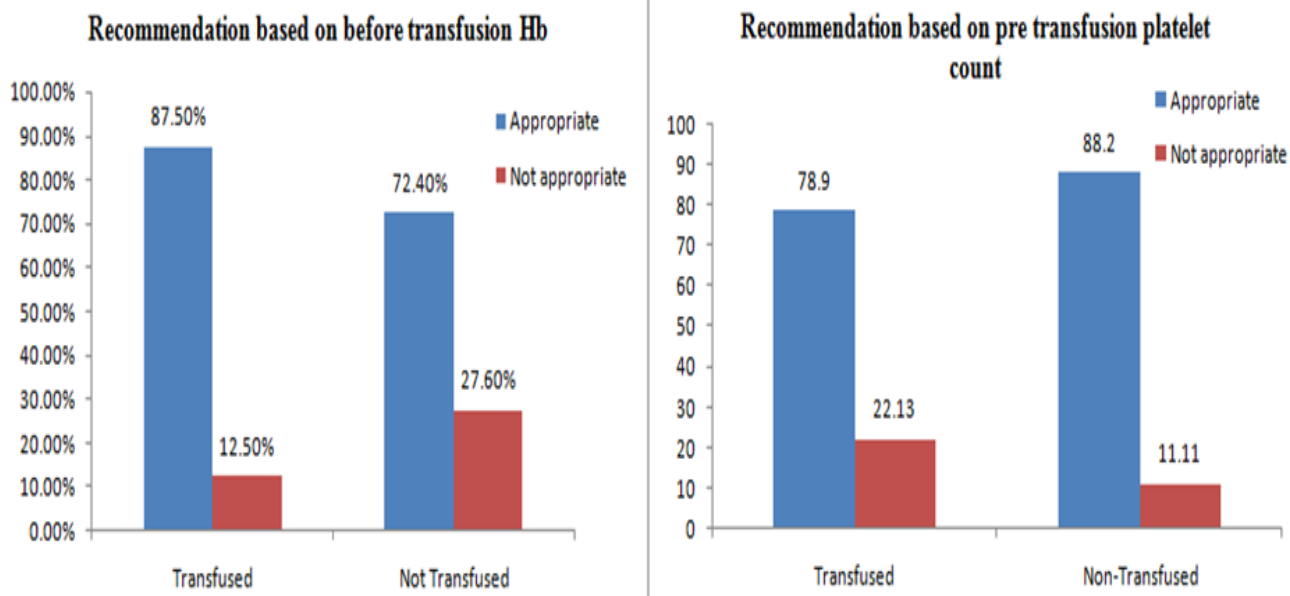


Fig. 3: Appropriateness of PC and platelet transfusion

Comparison of values of hemoglobin, hematocrit, platelet count, direct and total bilirubin was measured and compared pre and post transfusion, (Table 4). There was statistically significant improvement in all the parameters

after transfusion which highlights the positive outcome of the transfusions that were carried out.

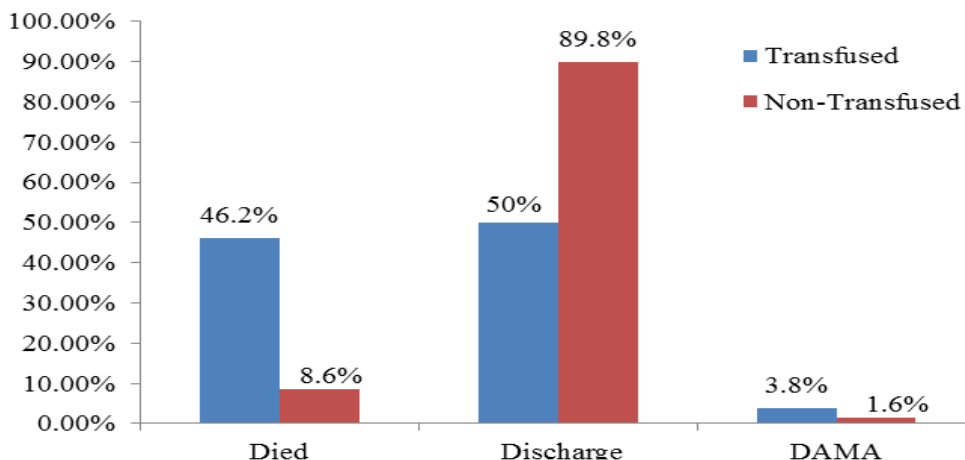
Table 4: Comparison of pre and post transfusion parameters

Parameters	Before/After Transfusion	Mean±SD	P value
Hb	Before	10.55±3.26	1.43E-13
	After	11.96±2.82	
Hematocrit	Before	31.49±10.69	4.57E-10
	After	35.56±8.90	
Platelet	Before	89384.62±73959.49	6.35E-10
	After	125786.52±133501.23	
Direct Bilirubin	Before	3.79±2.87	0.03268
	After	3.78±2.99	
Total Bilirubin	Before	10.19±7.79	0.00218
	After	3.17±3.13	

Note- All variables failed normality test. Hence Mann-Whitney test applied

There were 7 instances of Rh incompatibility 2.4 %, all of them required transfusion. There were 43 instances of ABO (14.8%) incompatibility out of which 5 required exchange transfusion. The outcomes of patients who were transfused or not transfused was noted and depicted in Fig.

4. The mortality in the patients that were transfused was much higher (43.2%) than those who did not receive any transfusion at all (8.6%). There was only one minor transfusion reaction (0.37%) reported in the duration of study period which was an allergic and non-hemolytic reaction.



**Fig. 4: Outcomes in transfused and non-transfused neonates**

### Discussion

The availability of blood and blood component as compared to earlier times have become easier and the advances in technology have made it easier to collect, store, separate and dispense blood. Wastage of whole blood and blood component are on the rise globally as a result of increase availability. Audit can help to curb this wastage to an extent and save a lot of expenses of the hospital as well as maintain an economy and optimum utilization of blood banking services. Regular audit can provide us with a timely trend of the pattern of utilization of the blood in a specific time period and can help the blood bank identify the need of changes in the inventory. This data can be utilized to outline policies of usage, frequency of blood donation camps to be arranged and number of components to be prepared from collected blood. Audit also help us to prevent undue over utilization of blood, wastage and reduced the number of inappropriate transfusion. Inappropriate transfusion exposes the patient being transfused to multiple donors and in turn to a variety of antigens and also the risk of transfusion transmitted diseases. Most of the audit done earlier include the overall some of the population of patients across all age groups and specialties.

But this was a specific study targeted towards neonates in the specialty of NICU; hence the sample size was smaller as compared to various other studies.<sup>5,6</sup> A lot of guidelines and previous studies<sup>5,6</sup> have taken into account neonates, but under 4 months and not under age group of 28 days as included in present study. There was only a minimal variation when it comes to the distribution of sex of patients admitted in NICU. But, there does exist a male predominance when it comes to the severity and mortality of diseases. The rate of transfusions, complications and death has been reported to higher in males than females in the neonatal population.

The grand total of the entire component required from the NICU was 503 inclusive of all the products including PC, Platelets and FFP. Out of which PC had the highest request (344 patients) followed by platelets (140 patients) and FFP (19 patients). Various other studies had similar finding with respect to pediatric patient except for FFP.<sup>6,7</sup>

The overall instance of single transfusion of a blood product was 52% which was less than found in Deb et al study<sup>8</sup> while instances of multiple transfusions were 48 % and it is comparable with the study done by Marti-Carvajal et al.<sup>5</sup>

The cross match to transfusion ratio is an excellent numerical which reflects the efficiency of coordination between the blood banking service and the various clinical departments of the hospital. The present audit study reveals that the cross match to transfusion ratio which was calculated as 2.41 is within the target ratio of  $\leq 2.5$ . This substantiates that there is indeed an optimum utilization of PC in the NICU; this finding was comparable with previous studies.<sup>9,10</sup> Measuring the appropriateness of transfusions involves major constituents of performing an audit. This gives us a measure of the exact instances and percentage of whether the transfusions were given in accordance with the guidelines for transfusion or not. In current study, the appropriateness of transfusions for PC and platelets was 87.5% and 78.9% respectively which was a significantly higher number and is an indicator of optimum transfusion practice by the NICU. Also, our values of appropriateness/inappropriateness fall within the range as compared to found in various literatures<sup>6,7,11</sup>

Individual laboratory investigations which includes hemoglobin, hematocrit, platelet count and bilirubin levels, all had a statistically significant rise after post transfusion indicative of achieving the desirable effect and fulfillment of the purpose for which the transfusions were carried out, be it correction of anemia, thrombocytopenia or reducing bilirubin levels to prevent kernicterus by means of exchange transfusion. There was only one (0.34%) transfusion reaction reported which was a minor allergic, non-hemolytic and non-febrile and is less than reported in various studies.<sup>12,13</sup> There were 7 instances of Rh incompatibility (2.4%); all of them required transfusion with whole blood which was comparable with the study done by Narang et al.<sup>14</sup> There were 43 instances of ABO (14.8%) incompatibility out of which 5 required exchange transfusion with whole blood and this was compared with the study done by Yigit et al.<sup>15</sup>

Out of the 69 patients who have received PC in spite of not falling in the recommended guidelines, there were 28 deaths (40.57%) this high number can be attributed to the severe degree of illness including sepsis, respiratory distress syndrome (RDS) and birth asphyxia which are associated with high rates of mortality. Most of the neonates which were included in this category did not survive even after transfusion was carried out. Thus we can conclude that these patients who fell under the not needing transfusion category according to the transfusion guidelines ideally cannot be considered as inappropriate. This is because the cross match requests were honored and PC units were issued all the times, but due to associated severity of illness and mortality of the conditions for which requests were made resulted in death even though PC was issued. The mortality in patients who were transfused platelets was 36.84% whereas the death in patients who did not receive platelets was 17.02%. These findings of mortality are consistent with the findings of other authors.<sup>16-18</sup> Thus the rate of mortality in patients who require transfusion will always be higher as compared to those who do not require transfusion.

### Conclusion

The symbiotic relationship between the blood bank and NICU is highlighted in this study. Both the blood bank and NICU are utilizing the available resources for adequate and timely treatment of patients which leads to demonstrable betterment in the clinical outcome and are following the national and the international guidelines for transfusion.

This audit study can be used as a basis for further studies in other tertiary hospitals to establish the Indian data on the same. Such promising figures show adherence to the acceptable national and international guidelines for blood transfusion. It also provides an important tool for the future studies regarding the transfusion practices in an institute at a given point in time and contributes towards the data which can be utilized by transfusion committee to revise and update their transfusion guidelines from time to time.

**Conflict of Interest:** None.

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**How to cite this article:** Butale PR, Kove B, Jibhakate S, Blood transfusion in neonates- An audit study, *J Diagn Pathol Oncol* 2019;4(1):16-21