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Original Research Article

Critical Evaluation of Haematological Parameters Before and After Transfusion of Packed Red Cells

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Abstract

Context: Anaemia is defined as reduction below normal limits of the total circulating red cell mass. It is measured by the reduction in packed red cell volume or reduction in haemoglobin concentration of blood. Blood transfusion will be helpful in the correction of anemia.

Aims: This study is aimed at evaluating the effect of packed red cells transfusion in anemic patients by comparing pre and post transfusion hematological work up .

Methods and Material: The present study was done in the department of pathology comprised of 130 anaemic patients who received packed red cell transfusion in Sri Manakula Vinayagar Medical College and Hospital. Data was collected from September 2012 to May 2014. Haematological parameters were collected by automated haematology analyser. Peripheral smear and reticulocyte smear were made.

Statistical Analysis used: Mean, standard deviation was done using Epi Info software. P value was calculated using paired test. Microsoft word and Excel have been used to generate graphs, tables etc.

Results: Out of 130 patients, 45 (34.6%) were iron deficiency anaemia followed by 43 (33.1%) anaemia of chronic disease, 18 (13.8%) anaemia of chronic kidney disease, 10 (7.7%) anaemia of liver disease, 10 (7.7%) dimorphic anaemia and 4 (3.1%) anaemia in hypersplenism. After one unit of packed red cell transfusion the mean increase in Hb in IDA was 1.106gm/dl, in anaemia of ACD was 0.922gm/dl, in anaemia of CKD was 1.015gm/dl, in anaemia of liver disease was 0.614gm/dl, in anaemia of combined deficiency was 0.925gm/dl and in hypersplenism was 0.367 gm/dl.

Conclusions: Desirable improvement was seen in most of the patients with respect to all haematological parameters and clinical outcome.

Keywords: Packed Red Cells; Anaemia; Indications for Transfusion.

Introduction

Packed cell volume or hematocrit is the volume occupied by the red cells when a sample of anticoagulated blood is centrifuged. It indicates relative propotion of red cells to plasma [1]. Red cells are filled with a red coloured molecule called hemoglobin. This hemoglobin combines with oxygen and delivers it to the tissues. This affinity of hemoglobin for oxygen depends on 2,3 Diphosphoglycerate [1]. Anaemia is defined as reduction below normal limits of the total circulating red cell mass [2]. Patients with hemoglobin below 6 gm/dl usually require

transfusion therapy. In stabilized patients with hemoglobin values between 6 and 10 gm/dl, the decision whether to transfuse is based on an evaluation of clinical status. Patients with value above 10 gm/dl rarely require transfusion [3-14]. Initially whole blood was transfused but now it is replaced by packed red cells after the advent of proper refrigeration, component separation method (platelet rich plasma method and buffy coat method)and anticoagulants especially additive solution SAGM (saline adenine dextrose and mannitol) and polyvinylchloride (PVC) blood bags such as di-2-ethylhexylphthalate(DEHP) and tri-2-ethylhexyl trimellitate (TEHTM) [15]. Packed cells are particularly valuable in treating patients whose blood volumes are normal and corrects the anemia without increasing blood volume, thereby preventing circulatory overload [16]. Other indications are symptomatic iron deficiency anaemia, severe anaemia in chronic kidney diseases, Previously there was a concept that whole blood or fresh blood will improve the condition because of the activity of 2,3 Diphosphoglycerate, however recent studies show that transfusion of packed cells have helped in increasing hemoglobin with restoration of 2,3 Diphosphoglycerate activity and thereby correcting anemia and also correction of hypoxia [17]. In literature search no studies are available in establishing the changes and improvement in haematological parameters like Hb, MCV, MCH, MCHC, RDW, PCV, reticulocytic count and peripheral smear study in pre and post packed cell cell transfusion of anemic patients. Hence this prompted us to do the current study aimed at evaluating critically the effect of packed red cells transfusion in anemic patients by comparing pre and post transfusion hematological work up.

Materials and Methods

The present study is a cross sectional study comprised of 130 anaemic patients who received packed red cell transfusion in our hospital. Data was collected from September 2012 to May 2014. Data collection was started after obtaining ethical committe clearance. Before collecting the blood samples his or her consent and co-operation was ensured. A thorough clinical examination and history was taken for all 130 patients .

Inclusion Criteria

All anaemic patients receiving packed red cells.

Exclusion Criteria

Surgical, obstetric, traumatic causes and paediatric patients.

Data Collection Tools

Pre transfusion - Clinical details and examination

- Haemoglobin percent, PCV, MCV,MCH, MCHC, RDW
- Peripheral smear
- Reticulocyte count

Post transfusion - All the pre transfusion details are collected again and compared after 24 hours.

Haemoglobin percent, PCV, Red blood cell indices were collected by running anticoagulated blood in automated haematology analyser. Peripheral smear is prepared by manual spreading and stained by using Leishman's stain. Reticulocyte count by using new methylene blue stain.

Statistical analysis

Mean, standard deviation was done using Epi Info software. P value was calculated using paired test. Microsoft word and Excel have been used to generate graphs, tables etc.

Results

In the present study 130 patients with anaemia who underwent packed red cell transfusion were studied by using haematological parameters and subdivided into following disease groups. Out of 130 patients 45 (34.6%) were clinically diagnosed as iron deficiency anaemia followed by 43 (33.1%) as anaemia of chronic disease, 18 (13.8%) as anaemia of chronic kidney disease, 10 (7.7%) as anaemia of liver disease, 10 (7.7%) as dimorphic anaemia and 4 (3.1%) as anaemia in hypersplenism.

Iron deficiency anaemia was the most common disease group and it was common in female population, M:F ratio was 1:3. in this study followed by anaemia of chronic disease were shown in (Table 1 & 2). As a whole anaemia was more prevalent in the female population. M:F ratio was 4:5 (Figure 1). In this present study number of transfusions and mean value of haematological parameters were calculated using paired t test in which all the haematological parameters except reticulocyte count showed the mean increase and the other haematological parameters were statistically significant except RDW were shown in (Table 3 & 4). Iron deficiency anaemia, anaemia of ACD, anaemia of CKD and Dimorphic anaemia showed desirable improvement in all the parameters except reticulocyte count. Anaemia of liver disease and anemia in hypersplenism did not show desirable improvement. P value was significant in all disease groups in comparison with pre and post transfusion (Table 5 & 6).

In 45 patients of iron deficiency anaemia, pre transfusion peripheral smear picture of all 45 patients was microcytic hypochromic. After transfusion 39 patients remained as microcytic hypochromic and 6 patients showed microcytic hypochromic with normocytes (Figure 2). Most of the patients received 2 units of blood transfusions

Table 1: Types of disease group studied

S. No.	Type of disease group studied	No of patients	Percentage
1	Iron deficiency anemia	45	34.6
2	Anaemia of chronic disease	43	33.1
3	Anaemia of chronic kidney disease	18	13.8
4	Anaemia of liver disease	10	7.7
5	Dimorphic anaemia	10	7.7
6	Anaemia in hypersplenism	4	3.1
	Total	130	100

Total number of patients were 130.

Table 2: Sex distribution of anaemia based on disease group

Disease group	Male	Female
Iron dediciencyanaemia	12	33
Anaemia of chronic disease	18	25
Anaemia of chronic kidney disease	10	8
Anaemia of liver disease	9	1
Dimorphic anaemia	6	4
Anaemia in hypersplenism	2	2
Total	57	73

Table 3: Number of transfusion based on disease group

Disease group	No of transfusion			
	1	2	3	4
Iron deficiency anaemia	31	13	1	Nil
Anaemia of chronic disease	24	14	4	1
Anaemia of chronic kidney disease	13	5	nil	Nil
Anaemia of liver disease	7	3	nil	Nil
Dimorphic anaemia	8	2	nil	Nil
Anaemia in hypersplenism	3	1	nil	Nil
Total	86	38	5	1

Table 4: Mean increase in haematological parameters after one unit of transfusion irrespective of disease group (p value calculated by applying paired t test)

Haematological parameters	Mean increase (confidence limit)	+/-SD	p value
Hb	0.958 (0.908-1.008)	0.233	<0.0001
MCV	1.371 (1.295-1.446)	0.351	<0.0001
MCH	0.763 (0.718-0.808)	0.210	<0.0001
MCHC	0.689 (0.374-1.004)	1.451	<0.0015
RDW	1.486 (1.258-4.230)	12.797	<0.2846
Rt count	-0.106 (0.172-0.040)	0.308	<0.0020
PCV	3.144 (1.258-4.230)	0.832	<0.0001

All haematological parameters except reticulocyte count showed mean increase and haematological parameters were statistically significant except RDW

Table 5: Mean increase in Hb after one unit of transfusion based on disease group (p value calculated by applying paired t test)

Clinical diagnosis	No of patients	Mean increase(confidence limit)	p value
Iron deficiency anaemia	31	1.106 (1.046-1.167)	<0.0001
Anaemia of chronic disease	24	0.921 (0.849-0.992)	<0.0001
Anaemia of CKD	13	1.015 (0.911-1.120)	<0.0001
Anaemia of liver disease	7	0.614 (0.490-0.739)	<0.0001
Dimorphic anaemia	8	0.925 (0.866-0.984)	<0.0001
Anaemia in hypersplenism	3	0.367 (0.223-0.510)	<0.0082
Total	86		

Table 6: Comparison of parameters in pre and post transfusions

Clinical diagnosis	Hb		MCV		MCH		MCHC		RDW		PCV		p-value
Comparison in pre and post transfusion	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	0.0001
Iron deficiency anaemia	5.026	6.132	58.032	59.574	17.316	18.100	26.710	27.397	17.794	18.200	15.971	19.526	0.0004
Anaemia of chronic disease	6.388	7.308	67.296	68.939	23.208	23.992	29.429	30.274	15.246	20.258	20.238	23.383	0.0004
Anaemia of CKD	5.885	6.900	67.308	68.800	23.531	24.423	29.564	30.667	14.754	14.608	18.733	22.109	0.0003
Anaemia of liver disease	6.457	7.071	76.014	76.929	25.629	26.171	30.829	31.471	17.500	17.943	20.371	22.400	0.0002

The mean increase of all parameters observed were statistically significant.

Table 7: Comparison of haematological parameters in dimorphic anaemia

Haematological parameters (mean)	Present study	Seunget al study
Hb	4.86	3.3
PCV	15.16	12.5
MCV, MCH	88.55, 30.65	86.2, 22.8
RDW	19.77	22.2
Reticulocyte count	0.56	0.59
Peripheral smear	Microcytic and macrocytic cells(7), macrocytic hypochromic cells(3).	NHA with hypersegmented neutrophils
Bone marrow	Erythroid hyperplasia with micronormoblastic and megaloblastic maturation Myelopoiesis and megakaryopoiesiswere also affected in 6 patients, and they showed peripheral pancytopenia picture. Perl s stain showed decreased iron stores.	Dyserythropoiesiswithmegaloblastic maturation and decreased amounts of hemosiderin particles, sideroblasts.

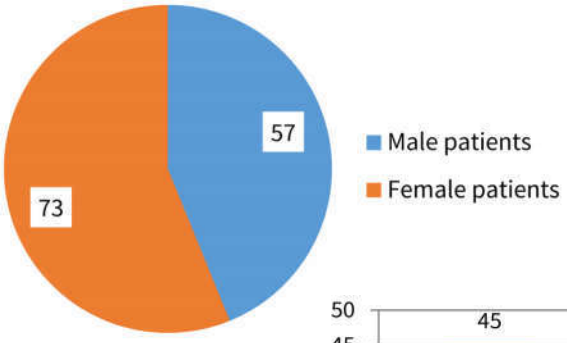

Fig. 1: Sex distribution irrespective of disease group

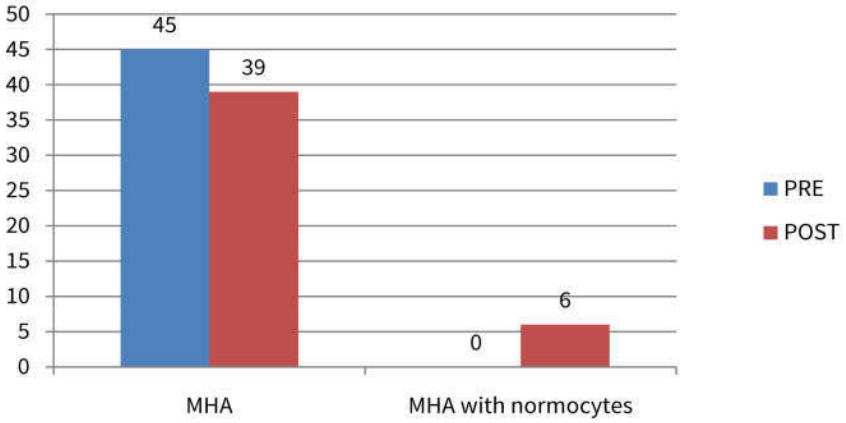

Fig. 2: Comparison of pre and post transfusion peripheral smear patterns in IDA

and the changes were statistically significant in all the haematological parameters.

Discussion

Packed red cell transfusion plays an important role in treatment of symptomatic anaemia patients, in order to improve the clinical status. Previous literature discusses the improvememnt of survival, mortality and morbidity through transfusion in various clinical types of anemia. The present study discusses the improvement of various hematological parameters and thereby improvement of survival indirectly, in comparison with literature.

In the present study 130 patients with anaemia who underwent packed red cell transfusion were reviewed by using haematological parameters and subdivided into following disease groups. Out of 130 patients 45 (34.6%) were clinically diagnosed as iron deficiency anaemia (IDA) followed by 43 (33.1%) as anaemia of chronic disease (ACD), 18 (13.8%) as anaemia of chronic kidney disease (CKD), 10 (7.7%) as anaemia of liver disease, 10 (7.7%) as dimorphic anaemia and 4 (3.1%) as anaemia in hypersplenism.

Iron deficiency anaemia was more prevalent in the age group of 31-40, followed by age group of 41- 50. Anaemia of chronic disease was more in the age group of 61-70 followed by 51-60. Anaemia of chronic kidney disease was equally distributed in the age group of 41-70. Anaemia of liver disease was more in the age group of 41-50. Dimorphic anaemia was more prevalent in the age group of 71-80.

In this study anaemia was more prevalent among the females (56.2%) followed by males (43.8%). Particularly iron deficiency anaemia was more prevalent among females (72.34%). Anaemia of chronic disease and anaemia of CKD and dimorphic anaemia had almost equal sex distribution. Anaemia of liver disease was more prevalent among males (90%). According to WHO Global Database on Anaemia Bruno et. al. worldwide prevalence of anaemia in non pregnant women is (30.2%) and number of women affected in million is 468.4 [18].

In this study increased iron loss was due to menstrual bleed and hook worm infestations. 13(27.65%) female patients had clinical documentation of menorrhagia due to various gynecological reasons. Shersten et. al. [19] observed that menstruating women lose from 0.6 to 2.5 percent more per day [19]. Haas et al observed that iron deficiency anaemia was associated with reduced workload [20] It is concurrent with the current study.

Improvement in hemoglobin concentration observed 24hours after transfusion of one unit of packed red cells is 1gm/dl [21]. One unit of packed red cells should raise the haemoglobin of an average adult by 1gm/dl and haematocrit by 3%.

Melanie et. al. observed that one unit of transfused RBCs is expected to increase the Hb level of 1 to 1.5 gm/Dl and haematocrit level of 3 to 5 percent in normal adult [21]. The present study correlates with these studies. The mean pre transfusion Hb of all 45 iron deficiency anaemia patients was 4.82. This haemoglobin value falls under the grade of severe symptomatic anaemia according to WHO grades of anaemia. Blood transfusion of patients with chronic stable anemia is probably unjustifiable if the hemoglobin level is above 7 g per 100 ml unless the patient is elderly or severe cardiac or pulmonary disease is present. This present study also satisfies the above criteria.

Ravi observed that RDW increases after transfusion [22]. Similar results were obtained in this study also. The mean pretransfusion value of RDW in IDA patients was 17.79, post transfusion value was 18.2. The mean increase was 0.40. Already there will be moderate to severe anisocytosis due to microcytes, further addition of normocytic cells will increase the variations in red cell size thereby increasing the RDW. There was mild decrease in reticulocyte count after transfusion.

Cooper et. al. compared liberal and conservative transfusion approaches in 45 patients with an acute myocardial infarction. The primary outcome measure of in-hospital death, recurrent MI or worsening of congestive cardiac failure occurred in eight patients in the liberal group and three in the conservative arm (38% vs. 13%) [23]. Michael et al observed red blood cell transfusion at Hb concentrations < 8 g/dl decreased the risk of mortality whereas transfusion at Hb concentrations >11 g/dL was associated with a higher mortality, supporting a more conservative transfusion strategy. Some of the above studies of Hebert et al, Wu et al and Sabatine et al observed that transfusion of packed cells improves the patient outcome [26]. Singla et. al. [27] observed that packed cell transfusion was associated with worse clinical outcomes. Above study also observed that restrictive blood transfusion was better than liberal transfusion. In the present study also restrictive strategy was followed and the mean pre transfusion Hb was below 6gm/ dl.

Among the 98 anaemic patients in the study of Arun et. al. 59 patients had a moderate degree of anaemia, 21 patients had severe anaemia and 18 patients had mild anaemia. Based on the evaluation of the type of anaemia, 59 patients were found to have NNA, 14 had MHA and 25 had the features of both NNA and MHA [28]. Haematlogical values of the present study correlate with Arun et. al. [24].

The current study with dimorphic blood picture correlates with the study done by seung et. al. [25] (Table 7).

From the present study we understand that packed red cell transfusion plays an important role by improving both the Hb values and patient clinical condition. Packed red

cell transfusion was more valuable especially in volume overload and high output failure conditions. The disease groups such as iron deficiency anaemia, anaemia of chronic disease, anaemia of combined deficiency respond similar to reference vaues. Anaemia of chronic liver disease and anaemia in hypersplenism do not respond upto target level. Hence restricted strategy of blood transfusion plays an pivotal role in anemic patients with other risk factors.

Conclusion

Desirable improvement was seen in most of the patients with respect to all haematological parameters and clinical outcome. Only a few patients in certain disease group such as anaemia of liver disease failed to improve, the underlying causes for failure being hypersplenism, haemodilution and bleeding tendencies.

With this background the present study concludes that before planning transfusion in anaemic patients, accurate clinical assessment and work up for type of anaemia is essential. Assessment of symptoms immediately after transfusion along with post-transfusion Hb levels should be done after transfusion of one unit of packed red cells in chronic anaemia patients to evaluate the response.

It is also important that, in cases of anaemia of chronic disease and critically ill patients, a restrictive statergy of blood transfusion must be followed in order to avoid unnecessary transfusion and its complications. Packed cell transfusion is of immense use in volume overload and in fluid restriction patients. Packed red cells improve tissue oxygenation, reduce cardiac workload and improve patient outcome.

In all the types of anaemia studied, the mean increase in Hb and PCV values were statistically more significant (p value<0.05). Hence Hb and PCV can be taken as valuable parameters to monitor the post transfusion outcome.

Key Messages

Most of the patients are receiving unnecessary blood transfusion without any clinical and hematogical improvent to emphasis the effect of blood tansfusion in anemic patients and its outcome which aids a tool to prevent unwanted trasfusions and also helps in preventing its complications and replacing the whole blood transfusion to packed cells.

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