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Original Research Article

Analysis of complete blood count parameters pre and post transfusion of packed red blood: A meta-analytic study in a tertiary care hospital

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ABSTRACT

Introduction: The clinical condition of 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. 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.

Materials and Methods: The present study comprised of 140 Anaemic patients who received packed red cell transfusion. The study was analyzed for a period of one year. Haematological parameters – complete blood counts were collected by running anticoagulated blood in automated haematology analyser before and after transfusing the blood units. Peripheral smear by using Leishman's stain. Reticulocyte count by using new methylene blue.

Results: Of total 140 patients, 45(34.6%) of patients were clinically diagnosed as iron deficiency anaemia followed by 43(33.1%) anaemia of chronic disease patients, 18(13.8%) of anaemia of chronic kidney disease, 20(15%) of anaemia of liver disease, 10(7.7%) of dimorphic anaemia (anaemia of combined deficiency) and 4(3.1%) of anaemia in hypersplenism.

Iron deficiency anaemia is the most common disease group in the present study followed by anaemia of chronic disease. Anaemia is more prevalent in the female population with M:F ratio of 4:5. Particularly iron deficiency anaemia is more prevalent among females with M:F ratio of 1:3. 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.

Conclusion: From 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. After transfusion of one unit of packed red cells in chronic anaemia patients,. In all the types of anaemia studied, the mean increase in Hb and PCV values were statistically more significant (Pvalue<0.05) than other parameters. Hence Hb and PCV can be taken as valuable parameters to monitor the post transfusion outcome.

1. Background

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. Based on etiology anaemia can be classified into anaemia due to decreased production of red cells, anaemia due to increased destruction of red cells and anaemia due to acute blood loss. [1,2]

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

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transfuse is based on an evaluation of clinical status. Patients with value above 10 gm/dl rarely require transfusion.[3–5] 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).[6,7]

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. Other indications are symptomatic iron deficiency anaemia, severe anaemia in chronic kidney diseases, congestive cardiac failure patients, severe symptomatic anaemia in anaemia of chronic disease, anaemia due to chronic blood loss, certain haemolytic anaemias, anaemia associated with dialysis, anaemia of pregnancy and acute blood loss anaemia(transfused along with crystalloid or colloid).[8,9]

Previously there was a concept that whole blood or fresh blood will improve the condition because of the activity of 2,3Diphosphoglycerate, however recent studies show that transfusion of packed cells have helped in increasing hemoglobin with restoration of 2,3Diphosphoglycerate activity and thereby correcting anemia and also correction of hypoxia.[10,11]

With this background the current study will be performed to assess the effects of packed red cell transfusion in our patients by comparing pre and post transfusion hematological parameters.

2. Aim of the Study

To analyze the effect of packed red cells transfusion in anemic patients by comparing pre and post transfusion hematological work up.

3. Materials and Methods

The present study comprised of 140 cases who are diagnosed to be anaemic based on clinical as well as on laboratory date who received packed red cell transfusion in our hospital. The study was commissioned after ethical committee clearance.

3.1. Inclusion criteria

All anaemic patients receiving packed red cells.

3.2. Exclusion criteria

Surgical, obstetric, traumatic causes and paediatric patients.

3.3. Data collection tools

Pre transfusion - Clinical details and examination

1. Haemoglobin percent.
2. Peripheral smear Examination.
3. Reticulocyte count in indicated cases.

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

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.

3.4. Statistical analysis

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

4. Results & Observations

In the present study 140 patients with anaemia who underwent packed red cell transfusion were studied by using haematological parameters and subdivided into following disease groups. Out of 140 patients 45(34.6%) of patients were clinically diagnosed as iron deficiency anaemia followed by 43(33.1%) anaemia of chronic disease patients, 18(13.8%) of anaemia of chronic kidney disease, 20(15%) of anaemia of liver disease, 10(7.7%) of dimorphic anaemia and 4(3.1%) of anaemia in hypersplenism.Table 1

Iron deficiency anaemia is the most common disease group in the present study followed by anaemia of chronic disease.Table 2

Iron deficiency anaemia is more prevalent in the third and fourth decade. Anaemia of chronic disease in the fifth and sixth decade.Table 3

Anaemia is more prevalent in the female population. M:F ratio is 4:5.Table 4

Iron deficiency anaemia is more in female population. M:F ratio is 1:3.Table 5

Iron deficiency anaemia, anaemia of ACD, anaemia of CKD and Dimorphic anaemia shows desirable improvement in Hb. Anaemia of liver disease and anaemia in hypersplenism does not shows desirable improvement.

In iron deficiency anaemia, pre transfusion peripheral smear picture of all 45 patients was microcytic hypochromic. After transfusion 39 patients remains as microcytic hypochromic and 6 patients showed microcytic hypochromic with normochromic cells.

In anaemia of combined deficiency peripheral smear remains same as pre transfusion.

In anaemia of liver disease pre transfusion peripheral smear 6 patients shows predominantly macrocytic and

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	20	15
5	Dimorphic anaemia	10	7.7
6	Anaemia in hypersplenism	4	3.1

Table 2: Age distribution of anaemia based on disease group

	19- 30	31-40	41-50	51-60	61-70	71-80	>80
Iron dediciency anaemia	7	17	11	8	2	Nil	1
Anaemia of chronic disease	3	4	7	9	14	5	1
Anaemia of chronic kidney disease	1	2	4	5	4	2	Nil
Anaemia of liver disease	nil	2	5	2	4	5	Nil
Dimorphic anaemia	nil	1	2	1	1	5	Nil
Anaemia in hypersplenism	nil	1	nil	3	Nil	Nil	Nil

Table 3: Sex distribution irrespective of disease group

Sex	No. of patients	Percentage
Male	57	43.8
Female	73	56.2

Table 4: Sex distribution of anaemia based on disease group

	Male	Female
Iron dediciency anaemia	12	33
Anaemia of chronic disease	19	24
Anaemia of chronic kidney disease	10	8
Anaemia of liver disease	19	1
Dimorphic anaemia	6	4
Anaemia in hypersplenism	2	2

Table 5: Haemoglobin values compared before and after transfusion based on disease group

Clinical diagnosis	Pre transfusion HB		Post transfusion HB	
	Mean	+/- SD	Mean	+/- SD
Iron dediciency anaemia	4.8267	1.0400	6.2933	0.9638
Anaemia of chronic disease	5.4907	1.5992	7.0023	1.1581
Anaemia of chronic kidney disease	5.4667	1.2300	6.7278	1.0487
Anaemia of liver disease	5.9700	1.4712	6.5500	1.4968
Dimorphic anaemia	4.8600	1.1683	5.8300	1.1076
Anaemia in hypersplenism	4.8500	0.6351	5.2750	0.6551

Table 6: Mean increase in HB after one unit of transfusion based on disease group(P value calculated by applying paired t test)

Clinical diagnosis	Mean increase (confidence limit)	P value
Iron deficiency anaemia	1.106 (1.046-1.167)	<0.0001
Anaemia of chronic disease	0.921 (0.849-0.992)	<0.0001
Anaemia of chronic kidney disease	1.015 (0.911-1.120)	<0.0001
Anaemia of liver disease	0.614 (0.490-0.739)	<0.0001
Dimorphic anaemia	0.925 (0.866-0.984)	<0.0001
Anaemia in hypersplenism	0.367 (0.223-0.510)	<0.0082

Table 7: Mean increase in HB after two unit of transfusion based on disease group (P value calculated by applying paired t test)

Clinical diagnosis	Mean increase (confidence limit)	P value
Iron deficiency anaemia	2.092 (1.827-2.357)	<0.0001
Anaemia of chronic disease	1.857 (1.652-2.062)	<0.0001
Anaemia of chronic kidney disease	1.900 (1.000-2.800)	<0.0042
Anaemia of liver disease	0.500 (0.252-0.748)	<0.0131

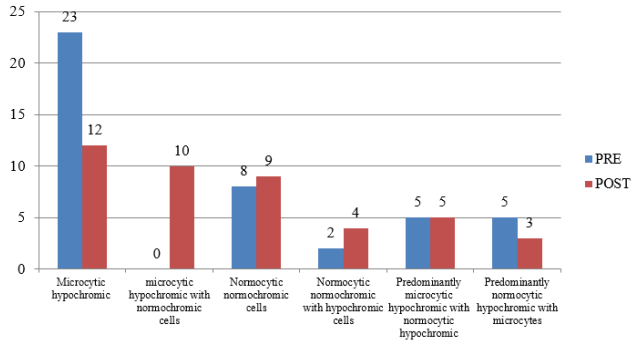

Fig. 1: Comparison of pre and post transfusion peripheral smear patterns in anaemia of chronic disease

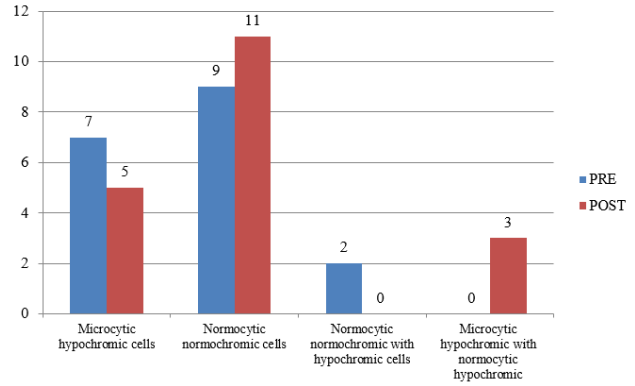

Fig. 2: Comparison of pre and post transfusion peripheral smear patterns in anaemia of chronic renal disease

microcytic cells, remains same after transfusion.4 patients show predominantly microcytic hypochromic with macrocytes.

In anaemia in hypersplenism, peripheral smear remains same as pre transfusion.

5. 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. [1,2,6]

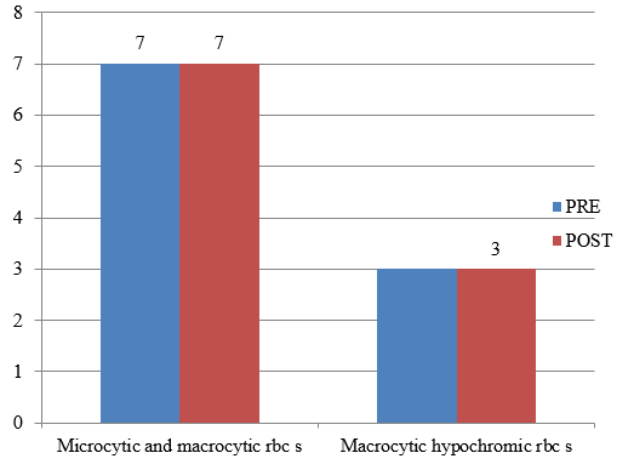

Fig. 3: Comparison of pre and post transfusion peripheral smear patterns in dimorphic anaemia (anaemia of combined deficiency)

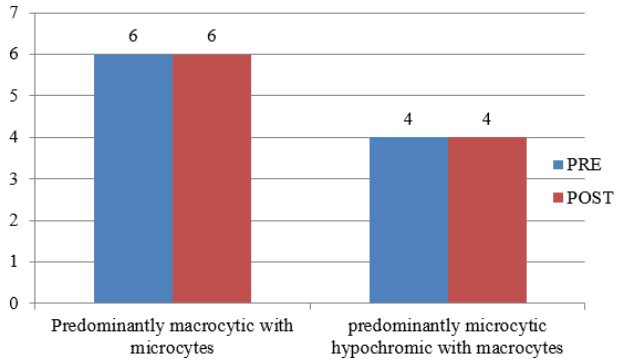

Fig. 4: Comparison of pre and post transfusion peripheral smear patterns in anaemia of liver disease

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 140 patients 45 (34.6%) of patients were clinically diagnosed as iron deficiency anaemia followed by 43 (33.1%) anaemia of chronic disease patients, 18(13.8%) of anaemia of chronic kidney disease, 20(15%) of anaemia of liver disease, 10(7.7%) of dimorphic anaemia and 4 (3.1%) of anaemia in hypersplenism. [7,9]

Iron deficiency anaemia is more prevalent in the age group of 31-40, followed by age group of 41- 50. Anaemia of chronic disease is more in the age group of 61-70

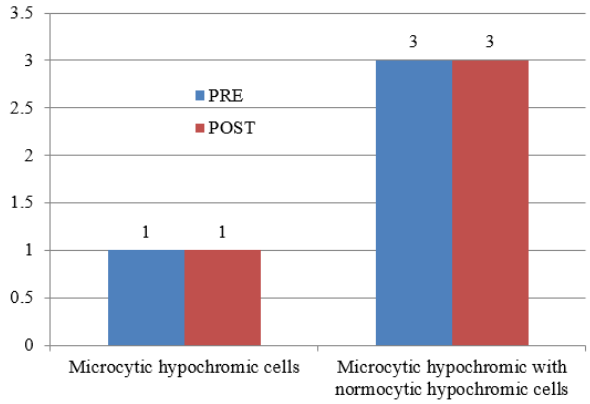

Fig. 5: Comparison of pre and post transfusion peripheral smear patterns in anaemia in hypersplenism

followed by 51-60. Anaemia of chronic kidney disease is equally distributed in the age group of 41-70. Anaemia of liver disease is more in the age group of 41-50. Dimorphic anaemia is more prevalent in the age group of 71-80.[10,11]

In this study anaemia was more prevalent among the females 56.2% followed by males 43.8%, particularly iron deficiency anaemia is more prevalent among females with 72.34%. Anaemia of chronic disease and anaemia of chronic kidney and dimorphic anaemia have almost equal sex distribution. Anaemia of liver disease is more prevalent among males with 90%. According to WHO Global Database on Anaemia Bruno de Benoist et al worldwide prevalence of anaemia in non pregnant women is 30.2% and number of women affected in million is 468.4.[12]

5.1. Iron deficiency anaemia

In this study iron deficiency anaemia is more prevalent than other anaemias. Also it is the most common anaemia in the female of reproductive age group. The reasons are negative iron balance, increased iron loss and increased iron requirement. Negative iron balance is due to decreased iron intake because of nutritional deficiencies, poor socioeconomic status. The increased prevalence of iron deficiency among the economically deprived people in developing countries is explained in part by the fact that heme iron is less abundant in their diets and women are usually smaller and consume less food and their requirements are greater, so their daily iron intake may be marginal.[13]

Improvement in hemoglobin concentration could be observed 24hour after transfusion of one unit of packed red cells is 1gm/dl. Sally A, Campbell-L et al says that one unit of packed red cells should raise the haemoglobin of an average adult by 1gm/dl and haematocrit by 3%.[14]

In the present study the mean increase in Hb after transfusion was 0.97gm/dl(P value-0.01) and PCV of 3(P value-0.02). There is desirable increase and patient condition also improved with concurrent iron, vitamin B12 and folic acid therapy which is appreciated one week after administration of therapy by monitoring the reticulocyte count in younger age group. But in the older patients 5 in no, degree of improvement after initiation of therapy was low as the marrow response was poor. Packed red cell transfusion is not always necessary in anaemia of combined deficiency, but its of valuable in severe grade anaemia and in symptomatic anaemia patients.

6. Conclusion

From 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. After transfusion of one unit of packed red cells in chronic anaemia patients, assessment of symptoms immediately after transfusion and post-transfusion Hb levels should be done.

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.

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

7. Source of Funding

None.

8. Conflicts of Interest

None.

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