Trends in Clinical and Medical Sciences

PSR Press

Original Research Article

Efficacy of packed red cell transfusion in nutritional anemia patients in a rural tertiary care centre: A cross sectional study

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Received: 12 January 2023; Accepted: 20 May 2023; Published: 24 May 2023.

Abstract: Background: Nutritional anemia is the commonest type of anemia in India, especially in rural areas. 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 to transfuse is based on an evaluation of clinical status. Patients with values above 10 gm/dl rarely require transfusion. Initially, whole blood was transfused due to the activity of 2,3 DPG. However, now it is replaced by packed red cells after the advent of proper refrigeration, component separation method, and anticoagulants, especially additive solution SAGM and polyvinyl chloride blood bags.

Aims: 1) To know the efficacy of packed red cell transfusion in symptomatic nutritional anemia patients. 2) If there is a failure of improvement following packed red cells transfusion, the underlying cause of anemia will be evaluated, which may influence the outcome of the transfusion.

Materials and Methods: The present study comprised 110 nutritional anemia patients who received packed red cell transfusion in Sri Manakula Vinayagar Medical College and Hospital. Data were collected for eight months. A thorough clinical examination and history were taken for all 110 patients, and hematological parameters were collected from the automated cell counter.

Results: In the present study, 110 patients with nutritional anemia who underwent packed red cell transfusion were taken. Out of which, 90 patients had features of only iron deficiency anemia, and 20 had features of anemia of combined deficiency (iron, vitamin B12, and folic acid). Iron deficiency anemia is more prevalent in the third and fourth decades. Anemia of combined deficiency in the sixth and seventh decade. Conclusion: Packed red cell transfusions are reserved for anemia patients whose organs (brain, heart) are being deprived of oxygen due to severe anemia and for people whose hemoglobin or hematocrit level is very low. In chronic anemia, there are increases in the content of 2,3-DPG in the red blood cells, with a shift towards the right in the hemoglobin dissociation curve in the cardiac output and respiratory rate. Hence transfusion is rarely indicated. The mean increase in Hb and PCV values in nutritional anemia patients was statistically more significant (p value<0.05). Hence Hb and PCV can be valuable tools in post-transfusion clinical assessment.

Keywords: Thyroid; Goiter; Follicular Carcinoma.

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1. Introduction

Nutritional anaemia is the most typical type of anemia in India, especially in rural areas. Generally, anemia is defined as a decrease in circulating red blood cell mass; the usual criteria being hemoglobin < 12 g/dl or hematocrit < 36% for women and Hb < 14 g/dl or hematocrit< 41% in men. It is measured by the reduction in packed red cell volume or hemoglobin concentration of blood [1]. There are various causes of anemia, the most typical being nutritional anemia due to iron, vitamin B12, and folic acid deficiency [2]. All mild degree of anaemia, and most moderate degree of anemia is treated appropriately according to the cause, and supportive measures are given. However, symptomatic severe anaemias and anaemias associated with other illness requires packed red cell transfusion to improve the patient's outcome. Symptomatic anemia, regardless of Hb concentration, in a euvolemic patient is an indication for transfusion. Symptoms of anemia include fatigue, tachycardia, tachypnea, dyspnea on exertion, postural hypotension, and impaired mentation. The transfusion trigger for anemic patients without associated medical disease is 6 gm/ dl [3–5].

Initially, whole blood was transfused, but during the last decade, the transfusion scenario has changed significantly due to the advent of component separation. Emphasis is given to specific blood components for appropriate and rational use of blood. One unit of whole blood can be separated into one unit each of packed red cells, platelets, fresh frozen plasma/ cryoprecipitate. This practice avoids wastage of collected whole blood (each component is stored at an optimum temperature for that component), allows replacement therapy administration, and avoids transfusion of unnecessary blood elements that the patient does not require. Adding additives containing sodium citrate, adenine, dextrose, and mannitol (SAGM) increases the storage period of red cells to 42 days. In the literature, few studies are carried out to know the efficacy of packed red cell transfusion in nutritional anemia patients. Hence this made us do the present study [6,7].

Aims

1. To know the efficacy of packed red cell transfusion in symptomatic nutritional anemia patients.
2. If there is failure of improvement following packed red cells transfusion the underlying cause of anemia will be evaluated, which may influence the outcome of transfusion.

2. Materials and Methods

The present study comprised of 110 nutritional anaemia patients who received packed red cell transfusion in Sri Manakula Vinayagar Medical College and Hospital. Data was collected for a period of 8 months. Data collection was started after obtaining ethical committee 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 110 patients.

Inclusion criteria - All nutritional anaemic patients receiving packed red cells.

Exclusion criteria - Surgical, obstetric, traumatic causes and paediatric patients.

Data collection tools

Pre transfusion- Clinical details and examination

-Hemoglobin percent, PCV, MCV, MCH, MCHC, RDW

-Peripheral smear

-Reticulocyte count

Post transfusion- All the pre transfusion details are collected again andcompared after 24 hours. Haemoglobin percent, PCV, Red blood cell indices were collected by running anticoagulated blood in automated haematologyanalyser. Peripheral smear is prepared by manual spreading and stained by using Leishman's stain.Reticulocytecount by using new methylene blue stain.

Statistical analysis

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

3. Results

In the present study 110 patients with nutritional anaemia who underwent packed red cell transfusion was taken. Out of which 90 patients had features of only iron deficiency anemia and 20 had features of anemia of combined deficiency (iron, vitamin B12 and folic acid). Table 1: Age distribution of nutritional anaemia

Table 1. Age distribution of nutritional anaemia

	19- 30	31-40	41-50	51-60	61-70	>70
Iron dediciencyanaemia	14	34	22	16	4	1
Dimorphic anaemia	nil	2	4	2	4	8

Iron deficiency anaemia is more prevalent in the third and fourth decade. Anaemia of combined deficiency in the sixth and seventh decade.

Table 2. Sex distribution of anaemia

	Male	Female
Iron dediciencyanaemia	24	66
Dimorphic anaemia	12	8
Total	30	70

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

Table 3. Mean increase in haematological parameters after transfusion of one unit of packed red cells in nutritional anemia patients (p value calculated by applying paired t test)

Haematological parameters	Mean increase(confidence limit)	p value
Hb	1.106(1.046-1.167)	0.0001
MCV	1.542(1.485-1.599)	0.0001
MCH	0.784(0.701-0.866)	0.0001
MCHC	0.687(0.033-1.341)	0.0004
PCV	3.555(3.353-3.757)	0.0001
Rt COUNT	-0.171 (0.298-0.024)	0.0022
RDW	0.406(0.165-0.519)	0.0001

Table 4. Mean increase in haematological parameters after transfusion of two units of packed red cells in nutritional anemia patients (p value calculated by applying paired t test)

Haematological parameters	Mean increase(confidence limit)	p value
Hb	1.766(1.559-1.971)	<0.0001
MCV	2.434(2.145-2.723)	<0.0001
MCH	1.311(1.460-1.162)	<0.0001
MCHC	1.232(0.664-1.799)	<0.0001
RDW	0.411(0.225-0.596)	<0.0001
Rt count	-0.126(0.224-0.228)	<0.0165
PCV	5.546(4.816-6.268)	<0.0001

Table 5. Mean increase in haematological parameters after transfusion of three units of packed red cells in nutritional anemia patients (p value calculated by applying paired t test)

Haematological parameters	Mean increase(confidence limit)	Pvalue
Hb	3.480(2.673-4.287)	<0.0003
MCV	5.500(4.867-6.133)	<0.0001
MCH	3.120(2.410-3.830)	<0.0003
MCHC	3.640(2.503-4.777)	<0.0009
RDW	0.020(1.009-1.049)	<0.0096
Rt count	2.440(1.777-6.657)	<0.00.35
PCV	11.144(8.484-13.804)	<0.0003

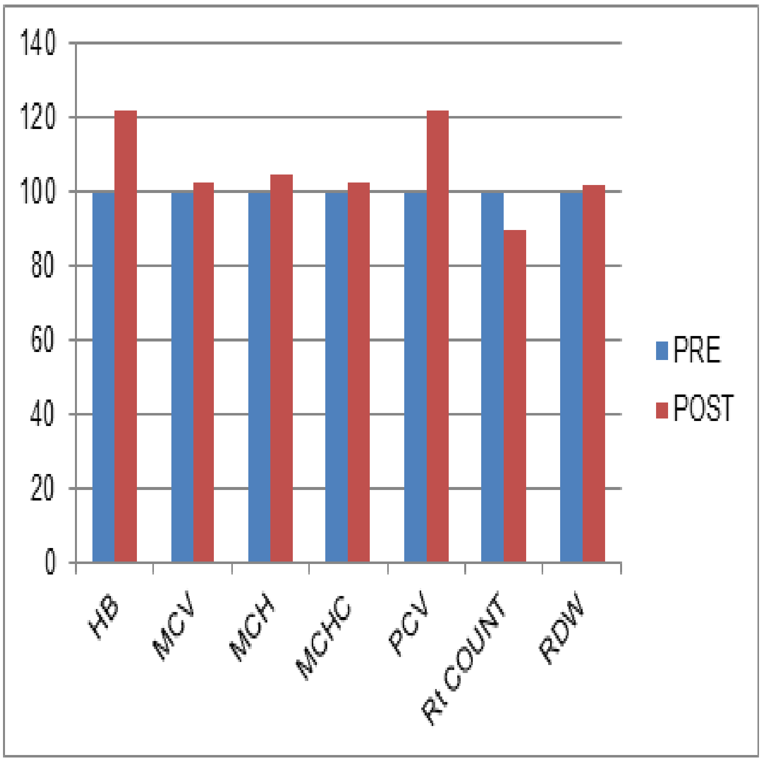

Figure 1. Percentage increase in haematological parameters after one unit of packed red cell transfusion in nutritional anemia patients

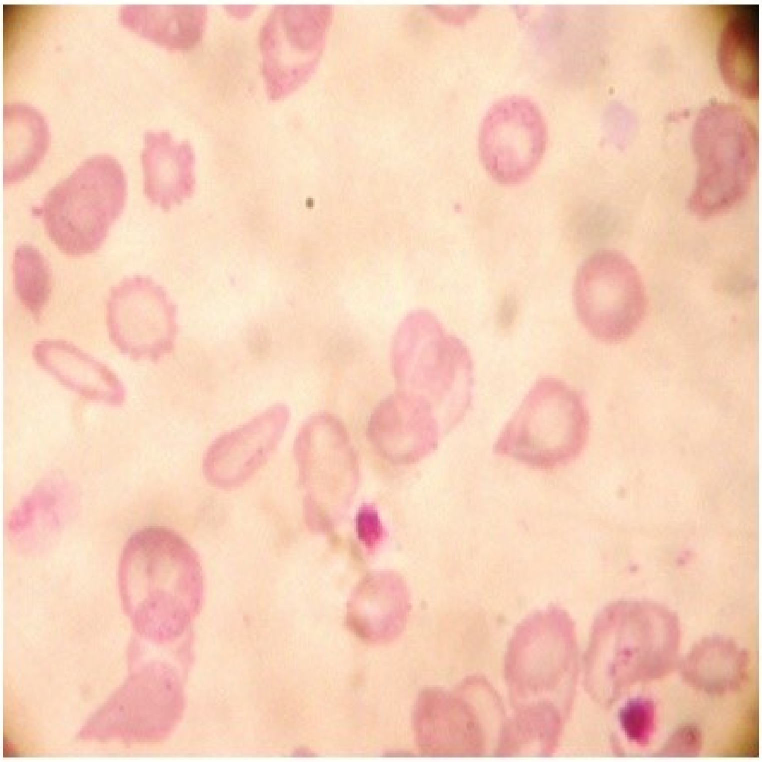

Figure 2. Iron deficiency anaemia. Microcytic hypochromic cells with pencil and teardrop cells. Leishman stain 100x

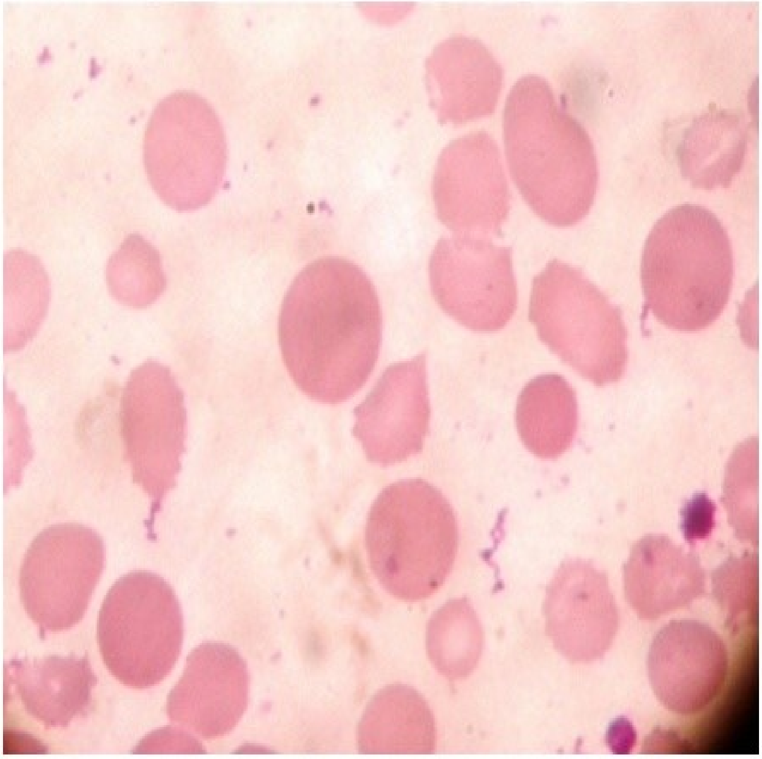

Figure 3. Dimorphic anaemia (anaemia of combined deficiency) Predominantly macrocytes with microcytes. leishman stain 100x.

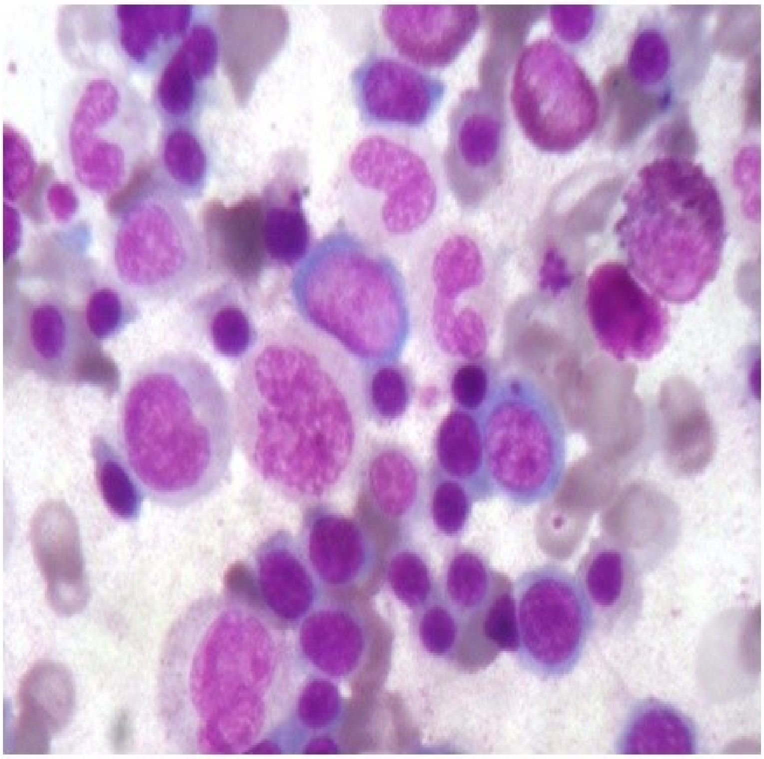

Figure 4. Bone marrow of dimorphic anaemia (anaemia of combined deficiency) Megaloblasts with open sievelike chromatin, increased N/C ratio and micronormoblasts. Leishman. 100 x.

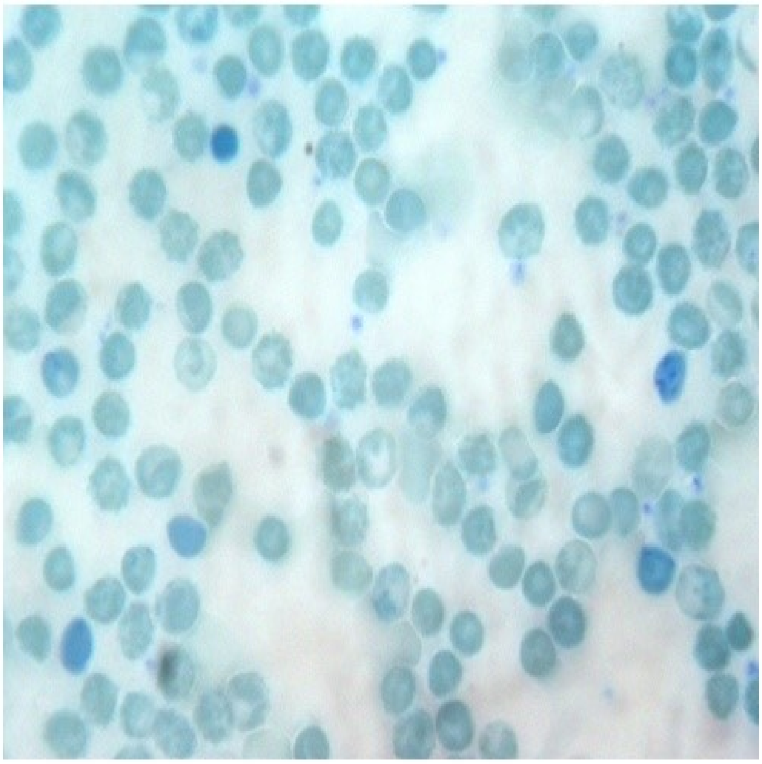

Figure 5. Increased reticulocyte count. New methylene blue. 100x.

4. Discussion

Iron deficiency anaemia is more prevalent than other anaemias. In this study, 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 and poor socioeconomic status. The increased prevalence of iron deficiency among 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 [7]. In this study26 (28%) of female patients had a clinical history of menorrhagia. According to Sherstenet al [8], menstruating women lose from 0.6 to 2.5 percent more per day, and an average (60-kg) woman might lose an extra 10 mg of iron per menstruation cycle, but the loss could be more than 42 mg per cycle depending on how heavily she menstruates [8]. In this study, 22(23.40%) patients were positive for stool ova/cyst. 8(8.51) patients are positive for stool occult blood. Hookworm infestations are common in our area. Worms attach to the upper small intestine and suck blood. The amount of blood lost is proportional to the number of worms harbored, which can be estimated by the fecal excretion of hookworm eggs [7]. Stool positive for occult blood is a sign of gastrointestinal bleeding [7]. Out of 8 patients positive for occult stool blood, four were later diagnosed with GI malignancy, one with diverticulum, and three with gastritis. In this study, the increased requirement was due to repeated pregnancies with fewer inter-birth intervals. Haas et al. observe that nutritionalanaemia is associated with reduced workload [9], and Verdon et al [10] says unexplained fatigue is the common complaint in IDA [10]. In this study also, 61.7% of patients experienced fatigue and inability to work. The other complaints commonly seen in this study were irritability, palpitations, dizziness, and breathlessness. Each unit of packed red cells contains approximately 200 mg of iron and will raise the hemoglobin by about one g/dl [11,12]. The transfusion trigger for anemic patients without associated medical disease is 6 gm/ dl [13]. Gould et al. say that patients with heart, lung, and cerebrovascular disease need transfusion between 7-8 gm/dl, and most renal dialysis patients can tolerate 6 gm/dl of Hb. Healthy individuals could tolerate Hb levels as low as five g/dl with minimal effects [14]. Patients with severe nutritional anemia (Hb <6.5 g/dl) by WHO (World Health Organization) and NCI (National Cancer Institute) criteria require transfusion [15] Improvement in hemoglobin concentration could be observed 24 hours after transfusion of one unit of packed red cells is 1gm/dl [16]. Sally, Campbell et al. say that one unit of packed red cells should raise the hemoglobin of an average adult by 1gm/dl and hematocrit by 3% [17]. In the present study, out of 90 IDA patients, 66 patients received one unit of packed red cells whose mean pre-transfusion Hb value was 5.02 gm/dl and after transfusion of one unit of packed red cellwas 6.13 gm/dl (value measured after 24hours) with a mean increase of 1.10 gm/dl(Pvalue-0.01). The mean increase in PCV was 3.55(Pvalue-0.01). PCV values also increase appropriately, according to the references. Similar findings were observed in Melaine et al. study also. The other red cell indices such as MCV, MCH, and MCHC, also increase correspondingly with a mean increase of 1.542, 0.784, 0.687. The mean pre-transfusion reticulocyte count is 1.55, and post-transfusion reticulocyte count is 1.38. Pretransfusion peripheral smear was microcytic hypochromic anaemia; 78 patients showed no change after transfusion, but 12 patients showed microcytic hypochromic with normochromic cells. This dimorphic appearance was due to adding normocytic cells to already present microcytes. Mostly this dimorphic picture was found in patients with more than one transfusion, where more normocytes get transfused, and an increased number of normocytes appear in peripheral blood along with microcytic hypochromic cells. In the onset of iron deficiency, the newest red cells produced will be microcytes (due to poor hemoglobinization of the cells). There will be a tiny "tail" of microcytic cells, and the RDW is slightly increased. The MCV is slightly decreased, but the difference at this stage is least measurable. As iron deficiency persists, this "tail" and the RDW gets larger, the Hb also falls, and the MCV falls. When all the cells are microcytic, the RDW decreases. The MCV is now at its lowest (around 55 fl). The RDW (and Hb) once again increases after commencing treatment with iron. The "tail" is marginally minor, and the MCV is marginally higher. Only when most cells are normocytic again does the RDW start to decrease [18]. In the present study in moderate anaemia patients, hypochromia was noted, and as the severity of anaemia increases, the hypochromia becomesmore severe, and a more significant percentage of erythrocytes were affected. When hypochromia is extreme, most red blood cells appear as tiny microcytes and an average number of poikilocytes, exceptionally tear drop and pencil-shaped cells, were also found. At this extreme stage of severe anaemia RDW value decreases as more cells were uniformly microcytic. Dimorphic anemia has microcytic and macrocytic cells. This is due to combined iron, folic acid, and vitamin B12 deficiency. These patients respond well to iron, folic acid, and vitamin B12. In combined deficiency patients with a severe grade of anaemia, high output failure symptoms are treated by packed red cell transfusion. Most of these patients are in the age group of 6 th and seventh decade of life. In the present study, PS also showed hyper-segmented neutrophils, anisopoikilocytosis, and howell-Jolly bodies in 3 patients and Cabot rings in 2 patients. Pancytopenia is found in 6 patients. The present study's haematological parameters correlate with Seung et al. study except for MCH, which is much decreased in Seung's study. Trowell et al says that the dual deficiency group might be classified as 1) Iron deficiency anaemia complicated by nutritional macrocytic anaemia. 2) Nutritional macrocytic anaemia complicated by iron deficiency.3) A new clinical entity. Since the peripheral blood, more particularly the blood smear shows two aspects, the bone marrow shows different types of erythropoiesis, and two factors have been detected in its etiology and in its treatment, it is thought that the term "dimorphic anaemia" may commented [19] 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 a desirable increase and patient condition also improved with concurrent iron, vitamin B12 and folic acid therapy, which is appreciated one week after therapy administration by monitoring the reticulocyte count in the younger age group. But in the older patients, 5 in number, 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 it is of value in severe grade anaemia and symptomatic anaemia patients.

5. Conclusion

Packed red cell transfusions are reserved in anaemia patients whose organs (brain, heart) are being deprived of oxygen as a result of severe anemia and to people whose hemoglobin or hematocrit level is very low. In chronic anaemia there are increases in the content of 2,3-DPG in the red blood cells, with a shift towards the right in the Hb dissociation curve, in the cardiac output and respiratory rate. Hence transfusion is rarely indicated. In nutritional anaemia patients, 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 tool sin post transfusion clinical assessment.

Author Contributions: All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

Conflicts of Interest: "The authors declare that they do not have any competing interests."

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