

Some Hematological and Biochemical Changes Associated with Blood Transfusion in Sickle Cell Anaemia Patients

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Abstract

Objective(s): The present study was designed to provide additional information on some hematological and biochemical changes associated with blood transfusion in sickle cell anemia (SCA) patients.

Materials and methods: A total of 86 subjects (aged between 20 and 40 years) were randomly studied. Among these were 30 multi-transfused SCA (≥ 3 units of blood per year), 30 rarely transfused SCA (<3 units of blood per year) and 26 apparently healthy individuals. The blood samples collected in EDTA were used for packed cell volume, haemoglobin concentration, total white blood cell count, and platelet count using Sysmex[®], Automated Hematology analyser where the blood samples collected in the anticoagulant free vacutainers were used for total bilirubin, aspartate amino transferase, alanine amino transferase using Beckman's autoanalyser. Statistical analysis was done using the student's t-test. $P < 0.05$ was considered significant.

Results: The PCV and HB concentration were significantly lower in both multi and rarely blood transfused subjects when compared with controls ($P = 0.001$) whereas the WBC, PLT, total bilirubin, AST and ALT were significantly higher in both multi and rarely blood transfused subjects when compared with controls ($P = 0.001$).

Conclusion: This study revealed a mild elevation of the liver function tests of the sickle cell anemia patients which are indicative of an increased red cell splenic sequestration and haemolysis regardless of blood transfusion.

Keywords: Blood transfusion; Immune response; Haemolysis; Sickle cell anaemia

Introduction

Sickle cell anaemia is an inherited single-gene autosomal recessive disorder caused by the 'sickle' gene, which affects haemoglobin structure [1]. SCA has its origins in sub-Saharan Africa and the Middle East [2,3]. Owing to population migration, SCA is now of increasing importance worldwide and there are increasing numbers of affected individuals globally [4-7].

The pathophysiology of SCA is a consequence of polymerization of the abnormal haemoglobin in low-oxygen conditions, which leads to the formation of rigid and fragile sickle-shaped red cells [8]. Other complications of SCA include stroke, pulmonary hypertension, renal dysfunction, retinal disease, leg ulcers and avascular necrosis (which commonly affect the femoral head and may necessitate hip replacement) [8,9].

Blood transfusion is indicated for SCA patients with acute anemia [10]. Acute anemia may be attributable to transient red cell aplasia, acute splenic sequestration or the increased haemolysis and volume expansion encountered in SCA [11]. There is no absolute level at which blood transfusion should be undertaken and the decision must be

made in conjunction with clinical findings, but haemoglobin under 6 g/dl or a fall of over 2 g/dl from baseline is often used as a guide [11,12].

Alloimmunisation (the formation of antibodies to red cell antigens) is common in SCA, occurring in 18-36% of patients [11-12]. It is clinically important as it can lead to delayed haemolytic transfusion reactions which render patients untransfusable [12]. The risk of alloimmunisation is significantly reduced by giving red cells matched for the ABO, D, C, E and Kell antigens; this should be standard practice for patients with SCA [10-11]. The present study was designed to provide additional information on some hematological and biochemical changes associated with blood transfusion in sickle cell anaemia patients in Benin City, Nigeria.

Materials and Methods

Before the commencement of the cross sectional study, ethical approval was obtained from UBTH Ethical Review Committee. A total of 86 subjects (aged between 20 and 40 years) were randomly studied. Among these were 30 multi-transfused SCA (≥ 3 unit of blood per year), 30 rarely transfused SCA (<3 unit of blood per year) and 26 apparently healthy individuals. Informed consent was obtained from all subjects before the commencement of the study.

Eight milliliters volume of venous blood sample were collected from the ante-cubital vein of the subjects using standard laboratory collection technique and shared equally into ethylene diamine tetra acetic acid (EDTA) vacutainers and an anticoagulant free vacutainers, subsequently centrifuged at 750 xg for 15 minutes to obtain serum. The blood samples collected in EDTA were used for packed cell volume, hemoglobin concentration, total white blood cell count and platelet count using Sysmex® Automated Hematology Analyzer as previously described by Ehiaghe et al. [13] whereas the blood samples collected in the anticoagulant free vacutainers were used for total bilirubin, aspartate amino transferase, alanine amino transferase using Beckman's Autoanalyser as previously described by Adedapo et al. [14].

Data analysis

Student's t- test was used to compare independent variables. The probability values less than 0.05 were considered significant. The statistical analysis were done using SPSS version 20.0.

Results

Table 1 shows the mean ± (SD) values of packed cell volume, haemoglobin concentration, white blood cell count, platelet counts, total bilirubin, aspartate amino transferase and alanine amino transferase for the multi blood transfused subjects and controls (Table 1).

Parameters	Multi-transfused N=30	Control N =26	P value
PCV (%)	24.2 ± 2.2	38.1 ± 3.8	P=0.001
Hb (g/dl)	7.1 ± 1.4	12.8 ± 2.4	P=0.001
WBC (x 10 ⁹ /l)	13.8 ± 5.0	4.6 ± 2.0	P=0.001
PLT (x10 ⁹ /l)	387.5 ± 105.4	235.9 ± 23.6	P=0.001
TB (mg/dl)	2.6 ± 2.3	0.8 ± 0.3	P=0.001
AST (iu/l)	18.4 ± 12.8	8.8 ± 3.7	P=0.001
ALT (iu/l)	16.1 ± 3.4	6.9 ± 2.6	P=0.001

Table 1: Comparison of the mean (± SD) some hematological and biochemical parameters of multi blood transfused and controls subjects. Keys: N: Number of subjects; PCV: Packed Cell Volume; Hb: Haemoglobin Concentration; WBC: White Blood Cell Count; PLT: Platelet Count; TB: Total Bilirubin; AST: Aspartate Amino Transferase; ALT: Alanine Amino Transferase; SD: Standard Deviation

The packed cell volume and haemoglobin concentration were significantly lower in the multi blood transfused subjects when compared with controls (P=0.001) respectively. Whereas the white blood cell count, platelet count, total bilirubin, aspartate amino transferase and alanine amino were significantly higher in multi blood transfused subjects when compared with controls (P=0.001) respectively.

Table 2 shows the mean ± (SD) values of packed cell volume, hemoglobin concentration, white blood cell count, platelet counts, total bilirubin, aspartate amino transferase and alanine amino transferase for the rarely blood transfused subjects and controls. The packed cell volume and hemoglobin concentration were significantly

lower in the rarely blood transfused subjects when compared with controls (P=0.001) while the white blood cell count, platelet count, total bilirubin, aspartate amino transferase and alanine amino were significantly higher in rarely blood transfused subjects when compared with controls (P=0.001), respectively (Table 2).

Parameters	Rarely Transfused N=30	Control N=26	P value
PCV (%)	22.4 ± 4.8	38.1 ± 3.8	P=0.001
Hb (g/dl)	7.1 ± 1.5	12.8 ± 2.4	P=0.001
WBC (x 10 ⁹ /l)	14.1 ± 7.9	4.6 ± 2.0	P=0.001
PLT (x 10 ⁹ /l)	530.6 ± 99.9	235.9 ± 23.6	P=0.001
Tb (mg/dl)	1.6 ± 1.3	0.8 ± 0.3	P=0.001
AST (iu/l)	15.7 ± 13.7	8.8 ± 3.7	P=0.001
ALT (iu/l)	13.9 ± 1.6	6.9 ± 2.6	P=0.001

Table 2: Comparison of the mean (± SD) some hematological and biochemical parameters of rarely blood transfused and controls subjects.

Table 3 shows the mean ± (SD) values of packed cell volume, hemoglobin concentration, white blood cell count, platelet counts, total bilirubin, aspartate amino transferase and alanine amino transferase for the multi-transfused subjects and rarely transfused subjects (Table 3).

Parameters	Multi-Transfused N=30	Rarely Transfused N=30	P value
PCV (%)	24.2 ± 2.2	22.3 ± 4.8	P=0.06
Hb (g/dl)	7.1 ± 1.4	7.0 ± 1.5	P=0.88
WBC (x 10 ⁹ /l)	13.8 ± 5.0	14.1 ± 7.9	P=0.87
PLT (x 10 ⁹ /l)	387.5 ± 105.4	530.6 ± 99.9	P=0.001
Tb (mg/dl)	2.6 ± 2.3	1.6 ± 1.3	P=0.08
AST (iu/l)	18.4 ± 12.8	15.7 ± 13.7	P=0.06
ALT (iu/l)	16.1 ± 3.4	13.9 ± 1.6	P=0.10

Table 3: Comparison of the mean (± SD) some hematological and biochemical parameters of multi-transfused and rarely blood transfused subjects.

The mean packed cell volume, hemoglobin concentration, white blood cell count, total bilirubin, aspartate amino transferase and alanine amino transferase of the multi blood transfused subjects shows no significant differences when compared with controls (P>0.05) while the mean platelet count were significantly higher in the rarely blood transfused subjects when compared with the multi blood transfused subjects (P=0.001).

Discussion

This study revealed that sickle cell anaemia patients irrespective of the number of blood transfused had a significantly lowered packed cell

volume and haemoglobin level when compared with the control subjects; this could be attributed to the persistent haemolytic episodes associated with sickle cell anaemia. The significantly higher white cell count observed in the SCA patient as compared to the control subjects might be due to immunological responses to recurrent bacterial infections which corroborates with the report of Ahmed et al. [15], who reported an increased incidence of bacterial infection amongst SCA patients on blood transfusion. Acute anaemia may be also attributable to transient red cell aplasia, acute splenic sequestration, increased haemolysis and volume expansion encountered in SCA [11]. The significantly higher platelet count observed in the multi and rarely blood transfused subjects when compared with controls could be due to autosplenectomy which is consistent with the report of Ahmed et al. and Onwukeme et al. [15-16].

The total bilirubin, aspartate amino transferase and alanine amino were significantly higher in multi and rarely blood transfused subjects when compared with controls. This mild elevation of the liver function tests might be due to transient red cell aplasia and increased haemolysis which are common in SCA patients. It has been reported that the mild elevation of liver function tests encountered in SCA patients are attributed to transient red cell aplasia, acute splenic sequestration, increased haemolysis and volume expansion which are associated with sickle cell disease [10,11,17]. It has been observed that liver enzymes activities are elevated in SCA patient on blood transfusion [18-21].

Conclusion

This study revealed a mild elevation of the liver function tests of the sickle cell anaemia patients which are indicative of an increased red cell splenic sequestration and haemolysis regardless of blood transfusion. The molecular mechanism needs further investigation.

Authors' Contributions

This work was carried out in collaboration between all authors. Authors Augustina II, Alfred EF, and Marcellinus NU designed the study and performed the statistical analysis. Author Alfred EF conducted and managed the laboratory analysis. All authors read and approved the final manuscript.

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