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Original Research Article

Haematological Parameters in Adult Individuals with Sickle Cell Anaemia in Steady State, Visiting a Tertiary Hospital in North West Nigeria

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Abstract: ***Background*:** A large number of patients with sickle cell anaemia are in steady state as a result of high level of fetal haemoglobin (HbfF). However, few of those with low HbfF levels usually have bone pain crisis intermittently. Considering the delicate nature of these patients, it is therefore imperative to carry out this study. ***Aim of the Study*:** The aim of this study is to determine the haematological parameters in adult with sickle cell anaemia in steady state visiting a tertiary hospital (Ahmadu Bello University Teaching Hospital) Zaria, Kaduna, Nigeria, with a view to providing a predictive data of SCA patients haematological parameters, as well as contribute to effective management of the disease. ***Materials and Method*:** This cross-sectional study was conducted in a tertiary hospital. Sixty (60) participants consisting of thirty (30) individuals with HbSS in steady state and thirty (30) apparently healthy HbAA controls were enrolled into the study. ***Result*:** The study revealed significantly higher mean white blood cell (WBC) and platelets count in the subjects with p value of < 0.005 but significantly lower mean haemoglobin and haematocrit (P< 0.005). ***Conclusion*:** Considering the role of leukocytosis and thrombocytosis in vaso-occlusion, it is therefore advisable to monitor patients with sickle cell anaemia closely and get them prevented from triggering factors to crisis as much as possible.

Keywords: Haematological Parameters, Steady State, Sickle Cell Anaemia (SCA).

INTRODUCTION

Sickle cell anaemia (SCA) is a common haematological disorder affecting millions of people worldwide [1]. Each year in Africa, about 300, 000 infants are born with the disease contributing to 70% of the world's annual figure [2]. Nigeria has the largest population of people with SCD, with about 150,000 births annually [3]. It is currently estimated that about 25% of adult Nigerians have sickle cell trait and 1 to 3% have sickle cell disease [3]. The disease condition is associated with various complications affecting both hematological and biochemical parameters, which clinically present with episodes of pain and increased vulnerability to infections [4]. White cells and platelets play a vital role in the pathophysiology of the disease; the two are linked with many clinical manifestations in SCA [4]. These include but not limited to severe bone pain crisis, stroke and acute chest syndrome. Activated white cells/platelets adhere to and activate endothelial cells; at the same time, activated platelets release pro-inflammatory molecules like TNF, ET-1 and IL-8 contributing to vaso-occlusion and endothelial damage [5]. Therefore, the importance of laboratory reference values for individuals with HbSS cannot be underestimated [5]. Most time, many patients with sickle cell anaemia are in good health for the most part of their life and attaining a steady state level of fitness. The importance of early recognition and subsequent clinical and haematological assessment of the disease are considerably helped by familiarity with the patient's steady state parameters [1]. Steady state in sickle cell anaemia is defined as a period in which there is absence of acute painful episodes for the past four weeks, no history of transfusion in the past three months and no history of conjoined disease such as infections in the previous four weeks [2].

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Aim

The current study aimed at determining the hematological parameters in adults with sickle cell anaemia visiting Ahmadu Bello University Teaching Hospital Zaria, Kaduna State Nigeria, as well as healthy controls in the same hospital with a view to providing a predictive data of SCA patients' hematological parameters, as well as contribute to improvement in managing the disease by identifying the steady state parameters of those patients in this locality.

MATERIALS AND METHODS

Study Area and Population

The study was carried out in the Haematology Department, Ahmadu Bello University Teaching Hospital Zaria, Kaduna State Nigeria. Sixty (60) participants consisting of 30 individuals with SCA patients in steady state (study group) and thirty (30) apparently healthy HbAA controls were enrolled into the study.

Study Period

The study was carried out with in the period of five months, from January 2023 to May 2023.

Study Design

The study was cross sectional comprising of two arms. The first arm consisted of adult individuals with HbSS in steady state (study group). The second arm consisted of apparently healthy individuals with HbAA phenotype.

Inclusion Criteria

- Individuals who granted their written consent
- Age between 18-60
- Confirmed HbSS individuals in steady state (diagnosed by cellulose acetate electrophoresis at pH 8.6)
- HbAA controls (confirmed by cellulose acetate electrophoresis at pH 8.6).

Exclusion Criteria

- Confirmed Hb phenotype AS, AC and CC individuals
- Individuals with history of acute or chronic illness like asthma, diabetes and hypertension
- HbSS patients in crisis
- Individuals who rejected a written consent

Participant's Informed Consent

Written informed consent was obtained from the literate participants while the non-literate participants thumb printed the consent form after a detailed explanation of the nature and benefits of the study. The participatory need of the non-English speaking participants was addressed by the use of interpreter.

Sample Collection

3 ml of venous blood samples was collected from each participant after informed consent. This was done from an intravenous access (the antecubital vein was mostly used) and under aseptic conditions with the use of disposable syringe. The blood was dispensed into ethylene diamine tetra acetic acid (EDTA) anticoagulated containers.

Sample Analysis

The sample was used for full blood count using the automated Sysmex autoanalyzer machine. The remaining blood in the EDTA bottle was used for haemoglobin electrophoresis test to confirm the Hb phenotypes of all the participants.

Ethical Consideration

Ethical approval for this study was obtained from the Health Research Ethics Committee (HREC) of ABUTH Zaria prior to the commencement of the study and conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

Data analysis was done using the Statistical Package for Social Sciences (SPSS) version 23.0 which is a software package used for the analysis of statistical data. The results obtained were presented using tables and figures. Continuous variables were presented as means and standard deviation (SD), or median with interquartile range (IQR) where appropriate, while categorical variables were presented as percentages. Comparison of means was carried out using the student's t-test.

RESULTS

Table 1 shows the socio demographic characteristics of subjects and controls. The median and interquartile age for the subjects and controls were 24 [15], and 27 [12], years respectively, with no significant difference. There was a significant sex difference between the subjects and controls. Subjects were predominantly females (80%) while majority of control participants were males (60%). The majority of the subjects and controls were unmarried. Only 10 (33.3%) of the subjects and 7 (22.3%) of the control group were married respectively. There was no ethnic difference between the subjects and the controls as Hausa was the predominant ethnic group among the subjects (80%) and controls (73.3%). The majority of the subjects were students and traders while most of the controls were students.

Figure 1 shows the age distribution of subjects and controls.

Table 1: Sociodemographic characteristics of subjects and controls

Variables	SS, n =30	AA, n= 30
	Freq. (%)	Freq. (%)
Age (years)	24.0(15.0)*	27.0(12.0)*
Min., Max. (age range)	18, 50	20, 47
Sex		
Male	6(20.0)	18(60.0)
Female	24(80.0)	12(40.0)
Marital Status		
Single	20(66.7)	23(76.7)
Married	10(33.3)	7(23.3)
Ethnic Group		
Hausa	24(80.0)	22(73.3)
Fulani	0	3(10.0)
Yoruba	4(13.3)	3(10.0)
Nupe	2(6.7)	2(6.7)
Occupational Status		
Student	12(40.0	17(56.7)
Trader	12(40.0)	5(16.7)
civil servant	3(10.0)	8(26.7)
house wife	3(10.0)	0

*Median (Interquartile range)

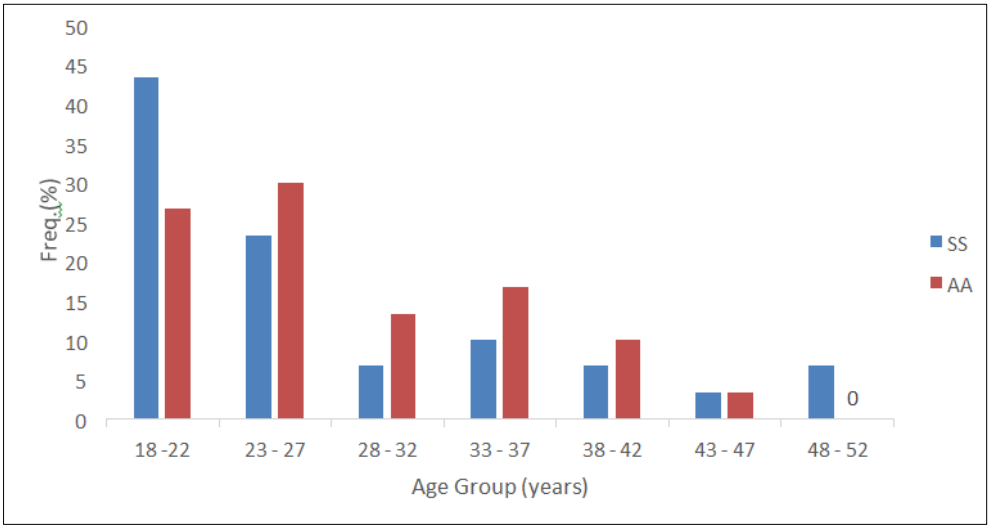

Figure 1: Age distribution of subjects and controls

Table 2 shows the mean value of haemoglobin (Hb), haematocrit (HCT), white blood cell (WBC) and Platelet (PLT) count for subjects and controls.

The mean Hb and HCT were significantly lower in the subjects when compared with controls (*P < 0.001*).

The mean ±SD WBC count was significantly higher in the subjects (12.93 ±3.14x109/L) when compared with controls (5.57 ±1.73x109/L); (*P*< 0.001).

There was also a significantly higher mean platelet count in the subjects when compared with controls; (*P*< 0.001).

The mean ±SD reticulocyte was significantly higher in the subjects when compared with the controls; (P< 0.001).

Table 2: The mean haematological parameters of subjects and controls

Haematological Parameters	SS	AA		
	Mean ±SD	Mean ±SD	t-test	P-value
Hb (g/dL)	8.37 ±1.77	16.03 ±2.71	-12.981	<0.0001
HCT (%)	23.57 ±5.60	41.93 ±5.36	-12.971	<0.0001
WBC ($x10^9$/L)	12.93 ±3.14	5.57 ±1.73	11.240	<0.0001

Haematological Parameters	SS	AA		
	Mean ±SD	Mean ±SD	t-test	P-value
MCV (fl)	86.73 ±10.19	82.60 ±8.11	1.735	0.088
MCH (pg)	31.16 ±4.68	31.89 ±3.88	-0.658	0.513
MCHC (g/dL)	35.05(1.57)	41.55(10.35)	550.000	0.139*α
Reticulocyte (%)	8.11 ±3.16	2.00 ±0.46	10.499	<0.0001
PLT (x10^9/L)	406.33 ±139.48	268.00 ±85.18	4.636	<0.0001

α: Independent Sample t-test, *Mann-Whitney test, Median (Interquartile Range)

MCV: Mean Corpuscular Volume; **MCH**: Mean Corpuscular Haemoglobin; **MCHC**: Mean Corpuscular Haemoglobin Concentration

DISCUSSIONS

This is a cross sectional study of patients with sickle cell anaemia visiting the Haematology Department of Ahmadu Bello University Teaching Hospital Zaria, Kaduna, Nigeria. 60 participants were studied, 30 sickle cell and 30 healthy controls. The median age of the subjects was comparable to that obtained by Ebele *et al*., [6], and Ugwu *et al*., [7], who performed their studies in Lagos and Ebonyi States respectively. This indicates that the subjects were older than the presumed age (paediatric age group) of death. This may be due to introduction of public health measures such as penicillin prophylaxis, vaccinations and hydroxyurea that contributed to an impressive decline in SCA-related childhood mortality [8].

On the evaluation of the proportion of some haematological parameters, the study revealed significant difference in the mean Hb, HCT, WBC and PLT of SCA subjects when compared with HbAA controls. ($P < 0.0001$). The haemolysis that occurs in some SCA individuals even in the steady state probably accounted for the reduction of haemoglobin and haematocrit in this study when compared with apparently healthy HbAA controls. This is due to chronic destruction of sickled red cells which have shortened lifespan [9]. However, the values found in this study were higher than those observed among Gabonese SCA subjects in a study conducted by Mombo, *et al*., [10], in rural area of eastern Gabon. The difference could be due to nutritional deficiency and high prevalence of infectious disease like malaria and hook worm infestations in the rural areas.

Mean WBC count of SCA individuals in this study was found to be significantly higher than HbAA controls. Studies by Mombo *et al*., [10], in Eastern Gabon, Kosiyo *et al*., [11], in Western Kenya, and Ugwu *et al*., [7], in Ebonyi State Nigeria all revealed similar findings. This could be attributed to the underlying subclinical infections and sterile inflammation in SCA group. Mombo *et al*., [10], observed even higher values of WBC, likely because of the high prevalence of infections in rural areas.

The finding of increased platelet count in this work is in keeping with the studies of Akinbami *et al*., [12], Kusfa *et al*., [13], and Antwi *et al*., [14], where all reported an increase in platelet count when SCA individuals were compared with HbAA controls. The increase in platelet count could be due to functional asplenia with a reduction in platelet pooling by the spleen. This is a condition where the spleen is physically present but non-functional due to repeated, early-life vaso-occlusive infarctions, leading to splenic fibrosis [13].

There was a significant increase in the mean reticulocyte of subjects when compared with that of controls in this study (Table 2). This is not surprising as reticulocyte count is a marker of compensatory erythropoietic response to haemolysis. This finding is similar to Moreira *et al*., [15], and Mikobi *et al*., [16]. They both demonstrated a significant increase in the mean reticulocyte in SCA subjects when compared to the HbAA control group. Reticulocytosis in SCA is attributable to the chronic haemolytic state leading to bone marrow expansion. Functional asplenia also contributes to the reticulocytosis, as the spleen is a site for terminal maturation of erythrocytes [9].

CONCLUSION

In order to prevent severe manifestations of SCA as a result of abnormal level of these parameters, it is of paramount importance that monitoring of these haematological parameters be done every so often. It is also necessary for the managing physicians to be aware of these haematological changes so as to avoid confusing the steady state status with infection, especially the high white cell count.

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Conflicts of Interest: There are no conflicts of interest.

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