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Steady state, Gender comparison of haemoglobin concentration and vital signs of children with Sickle Cell anaemia in Crises and Steady State attending UNTH Ituku-Ozalla Enugu, Nigeria.

Chinawa JM[1], Emodi I[2], Ikefuna A[3], Ocheni S[4], Uwaezuoke SN[5]

1. Lecturer Department of Paediatrics College of Medicine, University of Nigeria, Enugu Campus (UNEC), Nigeria.
2. Reader Department of Paediatrics College of Medicine, University of Nigeria, Enugu Campus (UNEC), Nigeria.
3. Senior Lecturer, Department of Paediatrics College of Medicine, University of Nigeria, Enugu Campus (UNEC), Nigeria.
4. Senior Lecturer, Department of Haematology & Immunology, College of Medicine, University of Nigeria, Enugu Campus (UNEC), Nigeria
5. Reader, Department of Paediatrics College of Medicine, University of Nigeria, Enugu Campus (UNEC), Nigeria

Abstract

Sickle Cell anaemia (SCA) is a genetic haematological disorder characterized by red blood cells that assume an abnormal, rigid, sickle shape. The current steady state haemoglobin concentration among children with sickle cell anaemia attending University of Nigeria Teaching Hospital since relocation to the present new site four years ago are not known necessitating the study. Objectives: To determine the steady state, gender comparison of haemoglobin concentration and vital signs among children with Sickle Cell anaemia in Crises and Steady State attending UNTH Ituku-0zalla Enugu. This is a prospective observational study involving 50 children with SCA in steady state, 50 in crisis and 50 with normal haemoglobin AA genotype carried out between June 2009 and October 2009. The steady state haemoglobin concentration among children with sickle cell anaemia in this environment was 7.2±1.2g/dl. The mean haemoglobin concentration among the group of subjects showed a significant gender difference (p=0.016). Females in both crises and steady state had fairly high haemoglobin concentration when compared to their male counterparts. The mean temperature, pulse and respiratory rate of sickle cell anaemia subjects in crises were 37.2±1.03oC, 101.15±19.73/mins and 34.0±3.36/mins respectively while the values for steady state and control were lower and statistically significant. The mean haemoglobin concentration of subjects in g/dl (crises 6.8+1.7 and steady state 7.2+1.2) was significantly lower than (10.8+1.2) obtained in the controls. Females with SCA had fairly high haemoglobin concentration when compared to the male counterparts.

Keywords: Sickle cell anaemia, steady state, haemoglobin concentration, crises

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Introduction

Sickle cell anaemia (SCA) is a heritable disorder characterized by red blood cells that assume an abnormal, rigid, sickle shape [1]. This disorder contributes the equivalent of 3.4% mortality in children aged under -5 worldwide [2]. Sickle cell disorders were originally found in the tropics and subtropics but are now common worldwide due to migration of people from tropical to temperate zone.[2] The prevalence of SCA in Nigeria is about 3% affecting about 20 per thousand new borns.[3] It is noted that 85% of sickle cell disorders and over 70% of all affected births occur in Africa. [4] It is also known that at least 5.2% of the world population carry a significant trait [4].

The mean value of Steady state haemoglobin concentration varies from patient to patient. It is also not known if there is any relationship between gender and haemoglobin concentration among children with SCA in this environment thus necessitating the study.

This study therefore aims at determining the levels of

haemoglobin concentration among children with sickle cell disorder in this environment when compared to those of subjects with normal haemoglobin genotype. The findings from this study will add to the increasing knowledge of this challenging disease and will help improve the management of children with this disorder especially during crises.

In addition, this study will also help in establishing baseline values of haemoglobin concentration among male and female SCA children in steady state and those in crises. This will assist the physician in suspecting an impending crises when the Haemoglobin levels in steady state are lower than normal limits.

Besides, this will also form a data base upon which further studies can be carried out.

Materials and Methods

Study Area

This study was carried out at the University of Nigeria Teaching Hospital (UNTH) Ituku-Ozalla Enugu, Nigeria. The hospital is located about 20km from Enugu urban, along the Enugu–Port Harcourt expressway. The UNTH has a total bed space of 480 and provides specialized services in the major fields of medicine. It is a referral centre from various health centers in Enugu state and her environs. Enugu state is in the South east geographic zone of Nigeria. Enugu metropolis is located on the hills, hence the name: Enu-Ugwu (on the hill top). It lies in the rainforest zone with two major seasons (Rainy and Dry) and a temperature of about 28-33^{0}c.It has a population of 3.5 million people according to the national population census.[5] The vernacular is Igbo language though a considerable percentage of her inhabitants are able to communicate fairly well in English.

Study Population

Paediatric patients are seen at the children's outpatient clinic (CHOP), the children emergency room (CHER), the general ward, and the new born special care unit (NBSCU). The children's outpatient clinic runs every week-day and a total of 840 patients are seen monthly.

The subjects were children with SCA in crisis and steady state, aged 6 months to 18 years, who were either attending the sickle cell clinic or admitted in the children emergency room (CHER) respectively. The clinic runs on Mondays with a weekly attendance of between 15 to 20 patients. It is run by 2 consultants, 2 senior registrars, and 4 registrars. There are about seven hundred children registered at the sickle cell clinic of UNTH Enugu with an average of eight new patients a month. The control population were children who were apparently healthy with normal haemoglobin genotype (HbAA), confirmed by haemoglobin electrophoresis and who came for follow up either in the consultant clinic or CHOP (Children outpatient) . Ethical clearance for this study was obtained from the research and ethical committee of the University of Nigeria Teaching Hospital. A written consent was obtained from the parents/ caregivers of the subjects and controls after explaining to them, in detail, the objectives of the study as well as the method of specimen collection.

The inclusion criteria included those who were known to have sickle cell anaemia aged between 6 months to 18 years and steady state patients who were HbSS patients who had been apparently well for a minimum of 4 weeks before recruitment.[1] Patients excluded were those with any type of infective illness and any patient with recent blood transfusion during the preceding 3 months. The controls were patients with normal haemoglobin genotype matched for age and sex.

Children with SCA who were attending the sickle cell clinic or presented at the children emergency ward were consecutively recruited into the study. For the control group, the same method was used to recruit apparently healthy children (with HbAA genotype confirmed by haemoglobin electrophoresis) coming for follow up at the CHOP and the consultant's clinic.

Determination of Haemoglobin Concentration

Haemoglobin concentration was analyzed using automated Sysmex KX-21N model.5

Data Analysis

Data was analyzed by SPSS version 13. An initial frequency count of all variables were done. The mean, ranges and standard deviation of Haemoglobin concentration in steady state were compared with values of normal haemoglobin genotype using ANOVA test.

The relationship between gender and haemoglobin concentration were calculated usingChi-square. The level of significance was set at $P < 0.05$.

Results

Demographics

A total of 150 children aged 6 months to 18 years were recruited into the study; 100 children were subjects confirmed to have haemoglobin SS genotype: 50 were in steady state while the remaining 50 were in crises. The control group consisted of 50 children within the same age group who had haemoglobin AA genotype. As illustrated in Table 1, the mean ages of subjects in steady state (8.41yrs±4.80), in crises (8.56yrs±5.29) and control (8.39yrs±5.38) were comparable; (f= 0.018, p= 0.983).

The subjects (children with SCA) and controls were also well matched for sex; males (56%), females (44%) insteady state; males (52%) and females (48.0%) in crises (p=0.983); males (44.0%) and females (56%) in controls

(x2=0.213, p=0.644).

As shown in table II, the mean temperature, pulse rate and respiratory rate of SCA subjects in crises were 37.2±1.03oC, 101.15±19.73/mins and 34.0±3.36/mins respectively while the values for steady state and control subjects were lower. Using ANOVA test, these differences were statistically significant.

Table III shows that subjects with normal haemogobin AA had a significantly higher haemoglobin concentration (10.8±1.2); P=0.000, than sickle cell patients who were either in steady state or in crises. However there was no significant difference between the haemoglobin concentration of sickle cell patients in steady state and those in crises. In Table IV, Male children with normal HbAA genotype had higher haemoglobin concentration than their female counterparts and was statistically significant. (p=0.016)

Females in both crises and steady state had fairly high haemoglobin concentration when compared with their male counterparts, though not statistically significant.

Table I. Demographic characteristics of SCA subjects and control

Age in years	Steady state n(%)	Crises state n (%)	Control n(%)
<3	5 (10)	4 (8)	6
3-5	6 (12)	6(12)	7
6-8	9(18)	11(22)	10
9-11	9(18)	7(14)	8
12-14	13(26)	12	10
>_ 15	8(16)	10(20)	9(18)

p=0.983 f=0.018

Table 2. *Comparison of vital signs between subjects and control.*

	Steady state	crises	control	f	P
Temperature	*36.7*±0.47	37.2±1.03	36.3±0.47	5.68	0.001*
Pulse rate	97.03±13.80	101.15±19.73	4.88	86.5±12.08	0.001*
Respiratory rate	33.3±2.52	34.0±3.36	28.0±3.74	3.11	0.05*

**Difference is significant(p<0.05)*

Table 3. *Comparison of haemoglobin concentration(g/dl) among children with sickle cell anaemia in steady state, crises and normal haemoglobin genotype.*

	Steady state patients (n = 50)	Crises state patients (n = 50)	Normal Hb AA patients (n = 50)	f	P
Mean Hb (g/dl)	7.2 ± 1.2	6.8 ± 1.7	10.8 ± 1.2	121.4	0.000*
Range (g/dl)	5.0-10.1	2.3-10.0	8.2-14		

Table 4. *Gender comparison of the mean values of patients' haemoglobin concentration in steady state, crises and HBAA.*

	Male Mean Hb(g/dl)	Female Mean Hb(g/dl)	t	P
Steady state	7.2±1.3 (n=28).	7.3± 1.3 n=22	0.357	0.361*
Crises State	6.8±1.6 (n=26)	6.8±1.8 (n=24)	0.055	0.458*
Normal	11.3±1.3	10.7±1.2	2.201	0.016*

**Difference is significant (p<0.05)*

Discussion

This study reveals that the mean heamoglobin concentration among children with SCA in this environment is 7.2±1.2g/dl. This is similar to the value obtained by Kaine et al [1] in the same health facility several years ago which was 7.8±0.8g/dl. The findings of Imoru [7] and colleagues in Zaria, northern Nigeria (7.4±1.0g/dl) are also comparable to the value in this study. Patients, both in steady state and crises, have significantly lower haemoglobin concentration when compared to con-

trols. This may be due to premature haemolysis and reduced red blood cell lifespan in the subjects [8,9].

Females in crises and also in steady state had fairly high haemoglobin concentration when compared with their male counterparts. This finding has been attributed to a transcription factor for haemoglobin F which has been linked to X chromosome.[10] This transcription factor enhances production of variable levels of HbF through globin gene modification and transcription factor programming.[10].

It is however striking to note that some children with SCA in steady state have relatively high haemoglobin concentration. This observation has been explained by high levels of fetal haemoglobin (HbF) as found by Ibia.[11] It is noted that red blood cells which contain HbF, in addition to HbS, are less susceptible to haemolysis than the cells without HbF.[11].

The present study also shows that children with SCA in steady state and in crises had a significant higher pulse rate when compared to their control. This agrees with the findings of Covitz et al who noted increased pulse rate among sickle cell anaemia patients when compared to normal subjects.[12] This could be a compensatory response to the chronic anaemia, which increases cardiac output. The significantly increased temperatures among the subjects when compared to controls suggest SCA as an inflammatory disease which causes a release of cytokines and tumour necrotic factor (TNF) which may alter the body's thermostat [13].

Furthermore, Alexandra and colleagues[14] also noted that in SCA, there are endothelial activation and subclinical microvascular occlusions which trigger the release of interleukin 6 (1L-6), alpha-2-microglobullin, and acute phase proteins which can cause a rise in body temperature. Sickle cell anaemia patients had significantly higher respiratory rate when compared to controls, findings similarly documented by Blumgart et al.[15] as well as Duke and colleagues.[16] This increased respiratory rate in the subjects may be an effect of hypoxic drive which is secondary to the chronic hypoxia which results from chronic anaemic state. It may also be due to decreased pliability of the lungs from repeated vaso-occlusion thus leading to infarction of the lungs. This reduced pliability may also be due to microthrombotic phenomenon in the lungs.

Males presenting in crises were more than females (though not statistically significant).

Sweitzer.[17] noted that there is a change in the Endothelial B receptor (ETBR) during crises. This receptor is important in the body's internal ability to control pain by releasing endorphins. Males have less receptor when compared to females. More males presented to the clinics than females (though not statistically significant). The importance attached to male children in this environment may also be a contributory factor .The findings in this present study confirm the common knowledge that children with sickle cell anaemia both in steady state and crisis have less hemoglobin concentration when compared to subjects with normal haemoglobin genotype.

Recommendations

It is recommended that children with sickle cell anaemia attending UNTH Ituku- Ozalla should not receive indiscriminate transfusion because they can still go on with their normal lives even with haemogliobin concentration of 7.2±1.2g/dl. Gender difference should also be noted when assessing the haemoglobin concentration of children with sickle cell anaemia in steady state and crises..

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Authors' contribution

All the authors made substantial intellectual contributions to this study. CJM was involved in the conception, design, and data collection, interpretation of results, preparation of the manuscript, revision of the article at various stages and preparation of the final draft. Other authors made substantial contributions in the design, data collection, and interpretation of the results, preparation of the manuscript, revision and preparation of the final draft.

References

1. Quirolo K, Vichinsky E. Haemoglobin disorders. In: Behrmen RE, Kliegman EM, Jenson HB (eds). Nelson Text Book of Paediatrics. 17th ed. Philadephia. Saunders Company 2004; 1623-1634.

2. Livingstone FB. Abnormal haemoglobins in human populations. Chicago.Aldine 1975; 25: 1-12.
3. Araba AB. A Survey of haematological variable in 600 healthy Nigerians. Nig Med J 1976; 6:49-53.
4. Bernadette M, Matthew D. Global epidemiology of haemoglobin disorder and derived service indicators. WHO 2008; 86: 480-497.
5. Roberts S, Kenneth A, Henry M. Measurement of coagulation factors. In: Manrc S, Robert P, Patrick C (eds). Haematology In anaemia. Circulation 1969; 39: 503-515
6. Juwah A, Nlemedim C,Kaine W.Types of Anaemeic crises in Paediatric Patients with Sickle Cell Anaemia seen in Enugu.Arch Dis Child 2004; 89: 572-575
7. Imoro M,Kabiru S,Shehu A,Umar A.Haematological values in Nigeria Children with steady state homozygous sickle cell disease.Int J Academic Research 2011; 3: 2.
8. Anna M, Halina K, Violetta, D, Piekarska A, Joanna M, Piotr R et al.Platelet count, mean platelet volume and thrombo- cytopoeitic indices in healthy women and men. Thrombosis Reasearch 2006; 118: 199-204.
9. Favaloro EJ, Sottani S, Mcdonald J, Grezchnik E, Easton L. Cross laboratory audit of normal reference ranges and assessment of Blood group,gender on detected levels of plasma coagulation factors. Blood coagul Fibrinolysis 2005; 16: 597-605.
10. Wang WC. Sickle cell anaemia and other sickling syndromes. In: Green JP, Forester J, Lukens JN (eds). Wintrobes clinical haematology, Philadephia, Lipinkott, William and Wilkson 2004;1263-1311 Clinical Practice. 4th ed. London. McGraw- Hill Medical Publishers 2005; 329-330.
11. Ibia EO. Studies on physical growth status of sickle cell anaemia children seen in Calabar (Dissertation). Lagos, Nigeria:West African College of Physician, 1991.
12. Covitz W, Espland M, Gallager D, Hellen brand W, Leff S, Tainer N. The heart in sickle cell anaemia (the cooperative study of sickle cell disease). Chest 1995; 108: 1214-19
13. Orah SP. Sickle cell anaemia as an inflammatory disease. J Clin Invest 2000; 106: 337-338
14. Alexandra CM, Eleftherie CH, Anestis M, Konstantinos LB. Alpha-2-macroglobullin and interleukin-6 levels in steady state sickle cell disease patients. Acta Haematol 2000, 104: 164-168.
15. Blumgart HI, Aitshule MD. Clinical significance of cardiac and respiratory adjustments in chronic anaemia. Blood 1948; 3: 329-351
16. Duke M, Abelman WH. The haemodynamic response to chronic anaemia.Circulation 1969; 39: 503-515
17. Sweitzer. Role of endorphin receptor in males. Obtainable at Http://the aps.org/meetings aps/ETII Montreal/index.htm. Assessed on 17: 09:09.

Correspondence to:

Josephat M. Chinawa
Department of Paediatrics
College of Medicine
University of Nigeria Enugu Campus (UNEC)
PMB 01129, Postal Code 400001
Enugu, Nigeria