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Full Length Research Paper

Analyses of Cu and Zn in serum of sickle cell disease patients in Jos

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Levels of Cu and Zn in the serum was assessed in a total of one hundred and four (104) subjects comprising of sixty-eight (68) sickle cell disease (SCD) patients attending SCD clinics in Bingham University Teaching Hospital (BUTH), Jos University Teaching Hospital (JUTH) and Plateau Specialist Hospital all in Plateau State, Nigeria and thirty-six (36) age and sex matched apparently healthy control subjects. Blood samples collected from participants were analyzed for Zinc and Copper using spectrophotometry techniques as described by (Yamashita et al., 1989). The mean serum level of Zinc and Copper in sickle cell disease patients was 22.43±13.33 and 109.96±103.96 µmol/L respectively. While serum Zinc levels was significantly lower (P< 0.05), Serum Copper level was significantly higher (P<0.05) in sickle cell disease patients when compared with apparently healthy control. Serum Zinc and Copper levels was not age and sex dependent, as similar pattern of the metal was observed in both male and female SCD patients. Conclusively, the assessment of trace element levels particularly Zinc is vital in the management of SCD. Therefore, the use of zinc supplementation in SCD is strongly advocated.

Key words: Sickle cell disease, copper, zinc, genetic, patient.

INTRODUCTION

Genetic diseases especially heredity blood disorder such as Sickle Cell Disease (SCD) and Thalassemia syndromes, are a significant problem in many countries. Their chronic nature with no prospect for cure, make them important causes of morbidity and mortality.

Sickle cell disease is an inherited blood disorder that affects the red blood cells. People with sickle cell disease have red blood cells that contain mostly hemoglobin, abnormal type of hemoglobin. In certain situation, these red cells become sickled and have difficulty in passing through blood vessels (Platt, 2000; Platt etal., 2004). Although Sickle Cell Disease is present from birth, symptoms are rare before the age of 3 to 6 months since a large percentage of the erythrocyte hemoglobin is of fetal type (HbF). As more HbS replaces HbF in the subject. The main symptoms; episode of anaemia, pains, and infections and associated crises becomes manifested due to irreversible sickling of the erythrocytes when HbS molecules polymerizes invariably leading to vaso-occlusion in the small capillaries (Duro Sinmietal., 1993).

In the United States, SCD affects about 72,000 people and 2 million are carriers (Crearyet et al., 2007). In Africa, more than 200,000 infants are born yearly with SCD (Makani and Williams, 2007). In Nigeria, HbSS and HbSc (a milder-variant) are the main forms of SCD, with the former being the most prevalent affecting up to 2% of the Nation's population (Akinkugbe, 1992 and Akinyanju, 1989).

In Africa unlike in America, where comprehensive medical care is less available, death in early childhood is usual (Makaniand Williams, 2007). The essential metals are well known for their biochemical role in biological systems and in the human body, but can be toxic when present in excess. Trace elements include Zinc, Copper, Selenium, Manganese, Chromium, Magnesium, Fluoride, Cobalt, Iron, and Iodine. Some of such as lead, Cadmium,

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Table 1. Serum Copper and Zinc in sickle cell disease patients.

Trace element	Patients (n=68)	Control(36)	P
Zn (µmol/L)	22.43±13.33	31.96±10.61	0.000
Cu (µmol/L)	109.96±103.96	102.42±25.61	0.670

Values are expressed as mean ± SD, P < 0.05 is considered significant compared to control.

Table 2. Serum Copper and Zinc Profiles in Male.

Trace element	Patients (n=36)	Control(21)	P
Zn (µmol/L)	25.48±14.93	33.18±10.13	0.049
Cu (µmol/L)	102.56±88.89	105.44±31.74	0.892

Values are expressed as mean ± SD, P < 0.05 is considered significant compared to control.

Arsenic, Aluminum and Nickel are classified as pharmacologically beneficial and toxic, hence monitoring of dosage is required (Burtisetal, 2008).

People with sickle cell disease suffer from micronutrients deficiency but preliminary research on dietary habits, show that food and nutrients intake by sickle cell patients meet or exceed recommendation and is not significantly different from healthy controls. This suggests that higher rates of nutrients deficiency may be due to increased needs of many nutrients in sickle cell patients (Tagneyetal, 1989). The global use of micronutrients in health care delivery system has taken central stage due to the realization of their importance in disease management.

Since (SCD) is among the disease plaguing a sizeable population of the developing world and the cost implication of its management is very high and is characterized by anaemia and immunological disturbances, including the generation of free radicals; a balance between minerals and anti-oxidants is imperative in maintaining red cell membrane integrity and function (Okpuzor and Okochi, 2009). And because protection of red cell membrane from free radical mediated oxidative stress is crucial to the management of SCD, minerals such as Copper, Zinc, Iron, Chronium, Magnesium, Selenium, Vanadium as well as Vitamins like Vitamins A, C, E, folate (folic acid) and Vitamin B complex will be of great benefit towards relieve of oxidative stress associated with rbc's cell membranes (Reed etal., 1987).

As well as for the fact that Zinc and Copper are known to compete with each other for similar binding sites in the body (Makani and Williams, 2007) makes this study important.

MATERIALS AND METHODS

Study Design

In this case control study, a sequential recruitment of study participants with sickle cell disease and those without the disease (apparently healthy individuals) with genotype AA or AS who served as control was performed.

Study subjects

A total of 68 sickle cell disease patients and 36 apparently healthy controls were recruited for this study from sickle cell clinics in Bingham University Teaching Hospital (BUTH), Jos University Teaching Hospital (JUTH) and Plateau Specialist Hospital (PSSH), all in Plateau State, Jos. This was done after obtaining ethical clearance from their respective ethical review boards and appropriate informed consent from the subjects as well as their parents/guardian. The recruited participants were appropriately age and sex matched.

Sample collection/Analysis

Blood samples (5ml) were collected by venepuncture from each subject into a plain container. The labeled samples were carefully retrieved and spun in a bucket centrifuge at a speed of 2500 rpm for 30 minutes having allowed the samples to clot for 15 minutes. The serum obtained was stored in a chest freezer at a temperature of -20oCin cryovials. Serum trace elements (Copper and Zinc) levels were performed using Spectrophotometry techniqueas described by (Yamashita etal., 1989) and (Johnsen and Eliason R, 1987).

RESULTS

As shown in table 1, there was a reduction in serum Zn levels. This reduction was highly significant (P< 0.05) when compared with control. This was also the case in male and female sickle cell disease patients as shown in tables 2 and 3 respectively. However, the serum copper con-

Table 3. Serum Copper and Zinc Profiles in Female.

Trace element	Patients (n=32)	Control(15)	P
Zn (µmol/L)	19.01±10.47	30.58±11.28	0.001
Cu (µmol/L)	118.13±119.59	99.05±16.69	0.515

Values are expressed as mean ± SD, P < 0.05 is considered significant compared to control.

Table 4. Serum Zinc and Copper Ratio in sickle cell disease patients.

Trace element	Patients (n=68)	Control(36)	P
Zn/Cu Ratio	0.32±0.38	0.33±0.02	0.093

Values are expressed as mean ± SD, P < 0.05 is considered significant compared to control.

centration (109.96±103.96µmol/L) though elevated as shown in tables 1,2 and 3; when compared against the controls(102.4225.61, 105.4431.74 and 99.0516.69) respectively. Such concentrations were not statistically - significant (P>0.05) when compared with control. The Zinc/Copper ratio too was statistically not significant (table 4).

DISCUSSION

Sickle cell disease (SCD) is common especially in Africa and among Negroid race.In sickle cell disease, the deficiencies of essential elements some of which are vital in red cell maintenance, body growth and development have been observed (Durosinmi et al., 1993; Okfugar and Okochi, 2009).

In this study, a significantly low zinc concentration was obtained from the general comparison of sickle cell disease patients with control subjects. This is in agreement with the report of (Parad and Cossack, 1993; Parad, 2002;Idonije et al., 2011) who related zinc deficiency in sickle cell disease to manifestations such as growth retardation, hypogonadism in males, hyperammonemia, abnormal dark adaptation and cell mediated immune disorder. Similarly, the biochemical evidence for zinc deficiency in patients with SCD includes low zinc concentrations in plasma, erythrocytes, hair lymphocytes and granulocytes (Zemel et al., 2002; Singhi et al., 2003). In another report by Parad, et al. (1975), low activities of zinc dependent enzymes such as carbonic anhydrase, alkaline phosphate and thymidine kinase have also been observed. A higher than normal activity of plasma ribonuclease in patients with SCD is also seen because zinc is known to inhibit the activities of this enzyme (Parad et al., 1975).

Zinc deficiency can also be the result of the adverse effect of hydrourea which increase zinc excretion as reported by Silliman et al., (1993).

In furtherance to the study of SCD, Parad et al. (1975) studied the effect of zinc supplementation (for one year) on the growth and body composition of children with SCD, since zinc deficiency was known to retard growth. The result provided further evidence that zinc deficiency, which resulted in growth retardation, was a major clinical problem in such patients. Prasad and Cossack, (1975) and Prasad AS, (2002) concluded that zinc supplementation could help sickle cell patients resume normal growth. In addition, these patients showed a reduction in crippling attacks of severe abnormal pain and vomiting, which had hitherto caused them to be hospitalized more often than not.

Copper is known to be essential in the proper functioning of different metal enzymes which include ceruloplasmin involved in iron metabolism. Deficiency of copper is known to cause anaemia. Studies have suggested that the copper containing enzyme, ceruloplasmin may have specific role, probably related to its function in mobilization of stored iron in the liver which makes iron available for haemoglobin synthesis (Das, 1990). However, it has been observed that in copper deficiency induced anaemia, in spite of elevated iron level in the liver, the rate of haemoglobin synthesis remain significantly reduced (Das, 1990).

In this study, an increase in plasma copper was observed in SCD subjects. Zinc and copper competes with each other for similar binding sites on proteins, and in zinc deficient tissues increase in copper has been observed previously, (Prasad et al., 1967). Thus it is likely that increased inplasma copper was secondary to zinc deficiency in our subjects. On the other hand, in view of the fact that high doses of zinc may be used for prolonged periods in the future for the treatment of SCD, one may produce copper deficiency in such subjects. This possibility must be kept in mind by physicians involved in the management of SCD with zinc therapy. In view of the above, intermittent laboratory investigation of these elements becomes inevitable.

CONCLUSION

The assessment of serum zinc levels in SCD patients is cardinal to their management and the use of zinc supplementation is strongly advocated following the outcome of this study. Although, the traditional method of Atomic Absorption Spectrophotometry (AAS) is widely accepted for analysis of metals, our study has proved too that the use of spectrophotometry in the analysis of serum zinc and copper is also reliable.

REFERENCES

Abe A, Yamashita S, Noma A (1989). Clin. Chem. (552): 554-35.

Akinkugbe OO (1992). Sickle Cell disease. In: Non communicable disease in Nigeria. Akinkugbe OO, ed. 1sted, Federal ministry of Health, Lagos, 45-52.

Akinyanju OO (1989). A profile of Sickle anaemia in Nigeria. Ann N Y Acad. Sci. 546:126-136.

Burtis CA, Ashwood ER, Bruns DE (2008). Trace elements. Tietzfundamentals of clinical chemistry. WB Saunders Philadelphia (25): 496-508.

Creary M, Williamson W, Kulkami R (2007). Sickle Cell Disease: Current activities, health implications and future- directions. J. Women's Health (Larchant)(16):575-82.

Das AK (1990). A textbook on medicinal aspects of Bio-Inorganic chemistry.First edition CBS publishers and distributors India.5-9.

Durosinmi MA, Ojo JO, Oluwole AF, Akanle OA, Arshed W, Spyrou NM (1993). Trace elements in sickle cell disease. J. Radio Analyt.Nucl.Chem. 168(1): 233-242.

Johnsen, Eliasson R (1987). Evaluation of a commercially available kit for the colorimetric determination of Zinc. Int. J. Androl.10(2): 435-440.

Makani J, Williams TN (2007).Sickle Cell disease in Africa: Burden and research priorities. Ann. Trop. Med. parasitol. (101): 3-14.

Okpuzor J, Okochi VI (2009). Micro-nutrients as theurapeutic tools in the management of sickle cell anaemia.Afr. J. Biotechnol. 7(5):416-420.

Platt OS (2000).Care and treatment of lung disease. Massachusetts Medical Hospital. The N. Eng. J. Med. Health. ISSN 0028-4793.

Platt OS, Brambilla DJ, Rose WF (2004). Mortality in sickle cell disease, life expectancy and risk factors for early death. N. Engl. J. Med. 330(23): 1639-1644.

Prasad AS, Oberleas D, Wolf PL (1967).Studies on zinc deficiency. J. Clin. Invest. 46:549-557.

Reed JD, Redding-Lallinger R, Orringer EP (1987).Nutrition and sickle cell disease. Ann. J. Hematol. (24):441-455.

Tagney CC, Philips G, Bell RA (1989).Selected indices of micro-nutrient status in adult's patients with sickle cell anaemia. Ann. J. Hematol. 32:161-166.