Plasma Cholesterol of Sickle Cell Anemia Patients in Enugu, Nigeria

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Abstract

The plasma total cholesterol, HDL-cholesterol, LDL-cholesterol, VLDL cholesterol and triglyceride levels from 93 sickle cell anaemia (HbSS) patients aged between 15 and 30 years were determined. From the control, a total of 96 healthy volunteers with HbAA genotype matched for age and sex were used for the study. A comparison of the result obtained from patients with that found in the controls showed that sickle cell anemia patients have significantly lower plasma total cholesterol than do healthy control (P < 0.05) for example, for age range 15 – 19 (Males) mean plasma cholesterol 2.76 ± 20 mmol/L (patients) Controls = 3.93±19 mmol/L (P < 0.05) HDL-cholesterol patient = 0.88 ± 0.07 mmol/L. Control 1.23 ± 16 mmol/L (P < 0.05) LDL-cholesterol patients 1.50 ± 16mmol/L. Control 2.26 ± 0.15mmol/L (P < 0.05) However, there is no significant variation in the mean plasma levels of triglyceride and VLDL-cholesterol (P > 0.05). It appears that cholesterol is not contributory to congestive heart failure in patient with sickle cell anaemia.

Keywords: Plasma cholesterol, Sickle cell anemia, Triglyceride, Congestive heart failure

Introduction

Sickle cell disease was first recognized in people of West Africa ancestry, given rise to the common misconception that the illness was confined to this group. Since first described by Herrick (Herrick, 1910), a number of advances in the understanding of sickle cell anemia have constituted important milestones in human genetics.

Neel (Neel 1949) and Beet (Beet, 1949) have independently observed that it was the carrier patients with sickle cell traits who gave birth to children with sickle cell anemia, thus indicating the autosomal recessive nature of its inheritance. In 1949, Pauling (Pauling and Itano; Singer *et al.*, 1949) and associates localized the defect in sickle cell anemia to the haemoglobin molecule itself. Ingram in 1957 (Ingram, 1957) identified the precise nature of the molecule lesion as consisting of the substitution of an amino acid valine for the normal glutamic acid in the sixth position of the globin beta chain.

The unique environmental, economic and social conditions in Nigeria provide a background upon which the disease projects a picture different from that in technologically advanced nations (Fleming, 1989). This notwithstanding, the disease is yet to be viewed as a major public health problem. In Nigeria, many babies are born each year with sickle cell disease. The impact of this disease on infants and childhood mortality and morbidity, appears to have escaped the attention of both local and international agencies. Many children dying of malaria, diarrhea, malnutrition, measles and respiratory infections may have sickle cell anemia as an added risk factor, yet the disease is yet to be listed among the major killers of children in Nigeria and Africa.

It is on the light of the above that this study was embarked upon to ascertain the variation in plasma lipid levels in sickle cell anemia patients' via-a-via healthy control. Since lipid monitoring is an important guide to atherosclerotic and cardiac disorders, the study was equally undertaken that the knowledge gained from this work may suggest new therapeutic strategies for better management of sickle cell anaemia.

Materials and Methods

A total of 93 sickle cells anemia (HbSS0 patients between the ages of 15 and 30 years were used for this study. All patients attend regular sickle cell clinic in UNTH, Enugu and were in steady state. For control 96 healthy volunteers matched for age and sex were selected from hospital staff and students with normal adult haemoglobin (HbAA) following informed consent, 5 ml of fasted venous blood were collected into EDTA bottles plasma was obtained by centrifuging at 5,000g for 10 minutes. The resulting plasma (supernatant) was transferred from appropriately labeled tubes ready for analysis.

Plasma total cholesterol was determined by enzymatic colorimetric method (Allain *et al.*, 1974) while the HDL_cholesterol was estimated by the mg^{2+} phosphotungstate precipitation enzymatic-colorimetric and point method (Sustein *et al* 1970) plasma triglyceride was estimated by enzymatic colorimetric method (Surguira et al, Maeda et al 1977).

Both LDL-cholesterol and VLDL-cholesterol were determined using the Fredwald formula (Peters and Vanslyka, 1931) LDL-C = T cholesterol- (HDL-C) – (Plasma TG) mmol/L 2.175. The result of the statistical analysis using student t-test of both patients and control is as shown in the tables.

Results

Table 1: Shows the mean and standard deviation of total cholesterol (mmol/L) in patients and controls.

Table 1: Mean plasma total cholesterol (mmol/l) ±S.D. by age and sex for patients and control

Age Group	Patient	Male Control	P Value	Patients	Female Control	P Value
15 – 19	2.76±.20 (n=15)	3.93±.19 (n=15)	<0.05	2.61±.11 (n=15)	3.85±.12 (n=17)	<0.05
20 – 24	2.87±.20 (n=14)	4.42±.27 (n=15)	<0.05	2.76±.16 (n=17)	3.95±.13 (n=19)	<0.05
25 – 29	3.13±.13 (n=15)	4.52±.25 (n=14)	<0.05	2.82±.15 (n=17)	4.22±.25 (n=16)	<0.05

Table 2: Mean plasma HDL-cholesterol (mmol/l) ±S.D by age and sex for patients and control

Age Group	Patient	Male Control	P Value	Patients	Female Control	P Value
15 – 19	0.88±.07 (n=15)	1.23±.16 (n=15)	<0.05	0.90±.08 (n=15)	1.43±.09 (n=17)	<0.05
20 – 24	0.89±.07 (n=14)	1.39±.15 (n=15)	<0.05	1.60±.12 (n=17)	3.95±.13 (n=19)	<0.05
25 – 29	1.0±.07 (n=15)	1.4±.11 (n=14)	<0.05	1.17±.06 (n=17)	1.74±.11 (n=16)	<0.05

Table 3: Mean plasma triglyceride (mmol/l) ±S.D by age and sex for patients and control

Age Group	Patient	Male Control	P Value	Patients	Female Control	P Value
15 – 19	2.20±.12 (n=15)	2.24±.12 (n=15)	>0.05	2.19±.13 (n=15)	2.20±.12 (n=17)	>0.05
20 – 24	2.21±.17 (n=14)	2.25±.11 (n=15)	>0.05	2.23±.11 (n=17)	2.26±.16 (n=19)	>0.05
25 – 29	2.48±.11 (n=15)	2.53±.24 (n=14)	>0.05	2.53±.07 (n=17)	2.55±.06 (n=16)	>0.05

Table 4: Mean plasma LDL-cholesterol (mmol/l) ±S.D by age and sex for patients and control

Age Group	Patient	Male Control	P Value	Patients	Female Control	P Value
15 – 19	1.50±.16 (n=15)	2.26±.15 (n=15)	<0.05	1.18±.15 (n=15)	1.19±.16 (n=17)	<0.05
20 – 24	1.530±.16 (n=14)	2.44±.29 (n=15)	<0.05	1.28±.11 (n=17)	1.97±.14 (n=19)	<0.05
25 – 29	1.59±.13 (n=15)	2.54±.23 (n=14)	<0.05	1.32±.18 (n=17)	1.97±.14 (n=16)	<0.05

Table 5: Mean plasma VLDL-cholesterol (mmol/l) ±S.D by age and sex for patients and control

Age Group	Patient	Male Control	P Value	Patients	Female Control	P Value
15 – 19	0.44±.03 (n=15)	0.45±.02 (n=15)	>0.05	0.44±.03 (n=15)	0.44±.03 (n=17)	>0.05
20 – 24	0.44±.03 (n=14)	0.45±.02 (n=15)	>0.05	0.45±.03 (n=17)	0.45±.02 (n=19)	>0.05
25 – 29	0.47±.02 (n=15)	0.51±.05 (n=14)	>0.05	0.50±.01 (n=17)	0.51±.01 (n=16)	>0.05

There is statistical significant difference between cholesterol the patient and control in the level of total cholesterol (P<05). There is increase in total cholesterol as the age group is increasing. Table 2: Shows mean and standard deviation of plasma HDL-cholesterol (mmol/L).

There is statistical significant difference in the level of HDL-cholesterol in patient and control (P<0.05). Table 3: Shows mean plasma Triglyceride in patients and controls (mmol/L). There is no statistical significance variation between patients and control (P>0.05).

Table 4: Shows mean level and standard deviation of LDL-cholesterol (mmol/L) in patient and control. There is significant increase in the value of LDL-cholesterol as the age group is increasing. The mean level of LDL-cholesterol in patient when compared with control is significantly increased (P<0.05). Table 5: Shows mean and standard deviation of VLDL-cholesterol in patients and control. There is no significant variation between the mean and standard deviation in patient when compared with control. (P>0.05).

Discussion

Sickle cell anaemia is a chronic form of stress with a serious impact on the physiological indicator as well as on the mental and emotional life of the victim. A number of plasma factors are believed to be involved in the initiation of the sickling phenomenon.

The patterns of lipid profiles seen in the various age groups in this study are interesting. A comparison of the results shows that patients have significantly lower plasma total cholesterol, HDL-

cholesterol and LDL-cholesterol than normal controls for the same age and sex ($P<0.05$). However, it is observed that plasma triglyceride and VLDL-cholesterol levels in patients did not vary significantly for all age groups from that of controls ($P>0.05$). A further look at the tables shows that there is a progressive but gradual increase in the values of these parameters with increasing age for both sexes (Table 1-5). Earlier studies (Peters and Vanglyka, 1931; Rifkind, 1968; Hashmi and Nishat, 1982) have pointed to lower plasma lipid levels in sickle cell anemia patients. Further work (Hashmi and Nishat, 1982) revealed that while serum cholesterol and phospholipids were depressed, the triglyceride level was normal. The significantly lower plasma cholesterol seen in these patients in the present study is in agreement with the observations of other workers (Saha and Samuel, 1982; El-Hazmi *et al.*, 1995).

The hypercholesterolemia may be a consequence of increase cholesterol utilization, decreased endogenous production or decreased intake. The low HDL-cholesterol level seen in patients would be expected to predispose them to increase risk of coronary heart disease. Though HDL-cholesterol levels in patients are significantly lower than in controls.

Due to the chronic state of anemia in sickle cell anemia, cholesterol utilization is expected in increase significantly as it is a major component of red cell membrane. The increase reticulocyte count usually encountered in sickle cell anemia patients, indicates increase red cell synthesis and hence cholesterol mobilization. The implications of the low plasma cholesterol are far-reaching; with respect to red cell survival. Since there is always a free flow and exchange of cholesterol between plasma and red cell membrane, a dynamic equilibrium is usually established. Any condition in which plasma cholesterol is reduced would result in a shift in the equilibrium with mobilization of the membrane cholesterol to maintain the status quo (Ower *et al.*, 1982). Red cell fragility and subsequent haemolysis usually result when membrane cholesterol level is lower beyond a critical value. In fact it has been proposed that erythrocytes rupture in regions of low cholesterol content. It is hereby suggested that the low plasma cholesterol seen in sickle cell anemia may reach a critical value beyond which osmotic fragility is enhanced and subsequent hemolytic crisis ensues.

In conclusion, it is further suggested that there is perhaps a membrane dilapidation, which may be free radical mediated, resulting in an imbalance in the membrane/plasma cholesterol ratio. The net effect of this equilibrium shift is the increased liability, increased permeability of the membrane and decreased deformability thus leading sickling. It appear that cholesterol is not contributory to congestive heart failure in patient with sickle cell disease. Further work in relation to rate of lipid metabolism in these patients as well as anti-oxidant status both during crisis and in steady state is strongly recommended.

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