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Glycemic Status and Lipid Profiles of Diabetics in Sokoto, Nigeria

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Abstract: Diabetes is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin. The hyperglycemia is associated with various forms of dyslipidemia, all of which are established risk factors for cardiovascular disease. Recent studies indicate that tight glycemic control and administration of cholesterol lowering agents among others are beneficial to diabetic patients. Data are lacking on the impact of treatment on glycemic status and lipid profiles of Nigerian diabetics. We studied the levels of fasting blood glucose, total cholesterol, High-Density Lipoproteins (HDL), Low-Density Lipoproteins (LDL) and triglycerides in 46 diabetics (on treatment) and ten treatment naive diabetics. Eighty apparently healthy individuals, matched for age, formed the controls. Serum glucose was determined by glucose oxidase kit method, total cholesterol by Trinder's method, HDL and LDL by quantitative precipitation with phosphotungstate in the presence of Mg^{2+} ions and triglycerides by enzymatic method. Glucose and total cholesterol levels were 14.5±9.8 and 11.5±3.5 mmol L^{-1}, 214.4±40 and 166.8±36 mg dL^{-1} for treatment naive and diabetics on treatment, respectively. Both were significantly higher ($p<0.05$) than in the controls. LDL and triglycerides levels were significantly higher ($p<0.05$) in the diabetics than in the controls. There was no significant difference ($p>0.05$) in the mean HDL levels between the diabetics and the controls. All the parameters were significantly higher ($p<0.05$) in the treatment naive diabetics. The results suggest that treatment has profound positive effect on the indices of diabetes and that strict glycemic and lipidemic control have not been achieved in the patients we studied.

Key words: Diabetes, hyperglycemia, glucose, lipid, Nigeria

INTRODUCTION

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin (Haslett *et al*., 2002). The disease occurs worldwide and its incidence is rising. It was estimated that in the year 2000, 150 million people had diabetes, 80% of which are in developing countries; and the number is expected to double by year 2010 (Amos *et al*., 1997). The global pandemic principally involves type 2 diabetes. Prevalence of both types (1 and 2) varies considerably around the world due to differences in genetic and environmental factors. In Nigeria, the prevalence of diabetes is 2.2% (NECNCD, 1999).

The clinical and biochemical abnormalities due to diabetes are numerous and have been extensively studied (Fuller, 1985; Mooney, 1999). The immediate metabolic effect is hyperglycemia, which then directly or indirectly triggers many other biochemical irregularities such as dyslipidemia and enhanced protein catabolism, resulting from the body's dependence for energy on fat and proteins as fuel molecules. One other notable effect of hyperglycemia is reduction of insulin secretion due to the toxic effect of glucose molecules on beta cell function (Haslett *et al*., 2002). In the absence of or abnormal

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response to insulin, hepatic glucose production and synthesis of triglycerides from non-esterified fatty acids and glycerol are enhanced, while uptake of glucose by skeletal muscles and adipocytes mediated by glucose transporter (GLUT 4) is suppressed.

Consequently, diabetic individuals present with abnormal blood levels of glucose, cholesterol, triglycerides and other atherogenic changes, which are easily detectable by routine biochemical analyses. Most of these conditions have been identified as independent risk factors for cardiovascular disease (Hu *et al*., 2005). Hence diabetics have higher prevalence of atherosclerosis, myocardial infarction, hypertension, among other complications, than the non-diabetic population. Coronary artery disease and stroke are the leading causes of morbidity and mortality in the diabetic population (Mooney, 1999; Hopes, 2000; Haslett *et al*., 2002). The diabetic state also has the tendency to enhance the effect of other cardiovascular risk factors.

The goal in management of diabetes is to restore normoglycaemia and improve lipid profiles so as to delay the onset of complications and improve the quality of life of the patients. Randomized controlled trials have demonstrated the benefit of strict glycemic control by the use of insulin or hypoglycaemic agents and satins and/or angiotensin converting enzyme inhibitors to improve lipid profiles (Pyoratin *et al*., 1997; UKPDS, 1998; HOPES, 2000; Haslett *et al*., 2002). Haslett *et al*. (2002) advocate regular assessment of glucose levels and lipid profiles at diagnosis and thereafter, as index for monitoring overall metabolic control in diabetic patients.

We therefore report the glycemic status and lipid profiles among diabetic patients (newly diagnosed and those on management) in Sokoto, Nigeria.

MATERIALS AND METHODS

All chemicals used were of analytical grade.

Study Subjects and Blood Specimen

About 5 mL fasting blood samples were obtained from newly diagnosed diabetic patients, (treatment naive, Group 1) and diabetics who have been on treatment (Group 2) at General Outpatients' Department, Usmanu Danfodiyo University Teaching Hospital, Sokoto. Apparently healthy (non-diabetic) persons formed the controls (Group 3). Recruitment of subjects and sample collection were done in April 2006. The samples were transferred into specimen bottles containing no anticoagulant. They were allowed to stand at room temperature for 15 min to clot. They were later spun to obtain the sera. Aliquot portions of the sera were used to determine fasting blood sugar concentration immediately. The aliquots parts of the samples were stored at -20°C until further analyses. The study was approved by the Ethical Committee of the Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria.

Serum cholesterol was estimated using Trinder's (1988) method. Serum triglycerides were estimated by enzymatic method with quinonimine as chromogen, measured colorimetrically at 490 nm. LDL and HDL were measured quantitatively by precipitation with phosphotungstic acid in the presence of Mg^{2+} ions. Serum glucose was assayed using the glucose oxidase method. All analyses were conducted at the Department of Biochemistry, Faculty of Science, Usmanu Danfodiyo University, Sokoto, Nigeria.

Statistical Analysis

Variables are presented as means and standard deviation. Differences between means were computed and analyzed by student's t-test (unpaired) using Graphpad's Instat Statistics Software (Graphpad Corporation, USA). A p-value of <0.05 was considered statistically significant.

Table 1: Fasting blood sugar and lipid profiles in the study subjects

Parameters	Group I	Group II	Group III
FBS (mmol L^{-1})	14.5±9.8*	11.5±3.5**	4.6±0.62
Cholesterol(mg dL^{-1})	214.4±40*	166.8±36**	140.8±28.9***
Triglycerides (mg dL^{-1})	211.1±47*	169.5±35**	100.9±20.1***
HDL (mg dL^{-1})	42.4±21*	51.8±20	54.1±11.4
LDL (mg dL^{-1})	120.4±18*	91.1±43**	66.5±24.3***

FBS = Fasting Blood Sugar, HDL = High Density Lipoproteins, LDL = Low Density Lipoproteins. Values (mean±standard deviation) are for fasting state. Asterisk indicate significant difference at $p<0.05$; * Compared with control (Group 1 versus Group 3) **Comparison between Group 2 and Group 3, ***Comparison between Group 1 and Group 2. HDL high density cholesterol, LDL low density cholesterol

Table 2: Variation of the parameters with age among the diabetic patients

Age group (years)	FBS (mmol L^{-1})	TG (mg dL^{-1})	HDL (mg dL^{-1})	LDL (mg dL^{-1})	Cholesterol (mg dL^{-1})
30-40	10.1±1.6	150.3±12	48.7±18	134.8±16	149±18
41-50	11.4±2.1	166.1±15	53.1±11	64.8±24	157±21
51-60	12.2±2.4	182.4±18	37.2±09	63.3±19	174±25
61-70	14.3±2.7	194.3±21	40.6±10	114.4±12	182±2

FBS = Fasting Blood Sugar, TG = Triglycerides, HDL = High Density Lipoproteins, LDL = Low Density Lipoproteins Values (mean±standard deviation) are for fasting state

RESULTS

The glycemic status and lipid profiles in the study subjects are presented in Table 1. Diabetic individuals (untreated) had mean higher fasting glucose levels than either diabetics on treatment or the controls. The difference between the diabetic groups and control was very significant ($p<0.05$), but was not statistically significant between diabetics treated and untreated. Total cholesterol levels were statistically significantly higher in the diabetics untreated than in either diabetics treated or the control; and between the diabetic subgroups (group 1 versus 2). Mean HDL was significantly higher ($p<0.05$) in the controls (Group III) than in the treatment naive diabetics (Group I). Mean HDL was also higher in the controls (Group III) than in the diabetics on treatment (Group II). However, there was no statistically significant ($p<0.05$) difference in mean HDL levels between treatment naive diabetics (Group I) and diabetics on treatment (Group II), but the latter have higher mean HDL levels. LDL levels were significantly higher ($p<0.05$) in controls (Group III) and diabetics on treatment (Group II) than in the treatment naive diabetics (Group I). Mean triglyceride levels were significantly higher ($p<0.05$) in the treatment naive diabetics (Group I) than either diabetics on treatment (Group II) or the controls (Group III).

The age specific variations of the glycemic status and lipid profiles are presented in Table 2. Mean higher glucose levels, total cholesterol and triglycerides were higher in the age group 61-70 years indicating poor efficiency in controlling the levels of these analyses at advanced age.

DISCUSSION

This is the first study to compare glycemic status and serum lipid profiles in treatment naive diabetics and those on treatment in Sokoto, Nigeria. The benefit of treatment was clearly evident. The glycemic status in the diabetics on treatment subjects was however poorer than in a previous report by Umar *et al.* (2004), from diabetics in Sokoto. The results of this study suggest normoglycemia has not been achieved in the diabetic subjects and that more aggressive means of restoring normoglycemia have to be employed if the onset of diabetic complications is to be delayed and to achieve improved quality of life. Glycemic normalization is recognized as the best chance of prevention of complications. This is based upon the assumption that the pathogenic processes responsible for the specific complications of diabetes are a fairly direct consequence of inadequately corrected hyperglycemia and may be averted with better diabetic control (Anonymous, 1987).

Much of the belief that the level of diabetic control (glycemic control) is relevant to the development of specific complications arises from long term studies of diabetic populations (Tchobroutsky, 1978). For example, The Diabetes Control and Complications Trial (DCCT, 1983), involved a sample size of between 1500 and 2000, reaching the conclusion that patients are not equally at risk for developing micro-vascular complications and this variation cannot be attributed to varying efficacy of diabetic control (Pirat, 1978). Other factors-genetic and non-genetic play some contributory roles in the pathologic process.

The maintenance of serum lipid profiles within near normal limits is a worthwhile venture so also is their regular determinations as they provide an important index of overall metabolic control. Although this will be of benefit to diabetics of all ages, it will more clearly benefit long-standing diabetics or diabetics in advanced age where the need for tight control is greater. The need to control LDL fractions is also greater as they are more atherogenic (Dejagar *et al*., 1993; Rainwater, 2000).

Our findings of poor glycemic status and abnormal lipid profiles amongst diabetics on treatment were neither uncommon nor surprising. Haslett *et al*. (2002) reported that the long-term results of treatment of diabetics could be disappointing in many diabetic patients. Despite various forms of treatment with pharmacological agents (sulphonylureas, insulin, etc.), cardiovascular diseases like atherosclerosis, stroke and myocardial infarction occur with greater prevalence in the diabetic population than in the population free of the disease. The pathologic changes associated with these diseases manifest earlier and are more extensive and severe in the diabetic population (Muller, 1998). Consequently the search for more effective and efficient strategies has been on. In recent years, several randomized control trials had been conducted which demonstrated the usefulness of aggressive management of diabetic patients. Intensive blood glucose control with sulphonylureas or insulin significantly improve diabetic outcome (UKPDS, 1998; DCCTRG, 1993), whereas the use of statin-based pharmacological agents and angiotensin converting enzyme inhibitors improve prognosis/reduced the relative risk of any diabetes related end-point by 12% and of micro vascular complications by 25%.

Our present study recommends the adoption of more aggressive strategies for restoring normoglycaemia and lowering cholesterol and related molecules in diabetic patients and regular screening for lipid disorders especially in developing countries.

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