

Lipid Testing among Patients with Type 2 Diabetes who was About to Commence Treatment at a Tertiary Health Care

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Abstract: *Background:* Diabetes mellitus (DM) has been shown to be associated with disturbances in lipid, protein and carbohydrate metabolism. Studies had also shown that dyslipidaemia is a risk factor for the development of cardiovascular complications. We aimed to monitor the lipid profile pattern of type 2 diabetes mellitus patients attending clinic at Enugu State University of Science and Technology Teaching Hospital (ESUTTH). *Methods:* This prospective cohort study was conducted on 30 diagnosed type 2 DM patients who were about to commence treatment at Medical outpatient (MOP) clinic of ESUTTH. Blood samples were drawn from the patients before they commenced treatment, six months into the treatment and at twelve months of the treatment. Blood samples were also drawn from 25 age matched apparently healthy controls that fulfilled the inclusion criteria. The lipid profile included total cholesterol (TC), high density lipoprotein (HDL), triglyceride (TG), calculated low density lipoprotein (LDL) and very low density lipoprotein (VLDL). Glycated haemoglobin (HbA1c) and fasting blood sugar (FBS) levels were also evaluated along with the lipid profile. The study was done from January to December 2016. *Results:* This study was conducted on 30 participants with a mean age of 67.2 years for men and 60.8 years for women. At treatment naïve, significantly lower mean serum levels of HDL and significantly higher serum levels of LDL and HbA1c were observed in male patients ($p < 0.05$) compared with control. At twelve months into treatment, TC significantly reduced from $4.97 \pm 0.91 \text{ mmol/l}$ to $3.88 \pm 0.29 \text{ mmol/l}$ ($p = 0.002$), LDL significantly reduced from $2.69 \pm 1.24 \text{ mmol/l}$ to $1.01 \pm 0.02 \text{ mmol/l}$ ($p = 0.002$) in male patients. At twelve months into treatment, TG significantly increased from $1.98 \pm 0.59 \text{ mmol/l}$ to $2.66 \pm 0.03 \text{ mmol/l}$ ($p = 0.001$) in female patients, VLDL significantly increased from $0.90 \pm 0.27 \text{ mmol/l}$ to $1.21 \pm 0.02 \text{ mmol/l}$ ($p = 0.001$) in female patients. *Conclusion:* There was a significant increase of triglyceride and very low density lipoprotein at 12 months of treatment when compared with treatment naïve and 6 months into treatment in both male and female DM patients in this study.

Keywords: Cholesterol, Lipoprotein, Diabetes, treatment

1. Introduction

Diabetes is a critical, chronic disease that happens either when the pancreas does not generate sufficient insulin or when the body cannot effectively use the insulin it generates [1]. Recent report on diabetes mellitus showed that an estimated 422 million adults were living with diabetes in 2014, compared to 108 million in 1980. Also the global prevalence of diabetes has almost doubled since 1980, increasing from 4.7% to 8.5% in the adult population. Again, recent study on diabetes had shown that diabetes caused 1.5 million deaths in 2012. Greater-than-approved blood glucose level caused an additional 2.2 million deaths, by raising the risks of cardiovascular and other diseases. Forty-three percent of these 3.7 million deaths happen before the age of 70 years [2]. The number of deaths ascribed to diabetes that happen before the age of 70 years is greater in low- and middle-income countries than in high-income countries [2]. Type 2 diabetes is responsible for the

large number of people with diabetes around the world (3). The interaction between genetic and metabolic factors determines the danger of type 2 diabetes. Moreover, people history of diabetes, race, and earlier gestational diabetes couple with older age, poorly diet, obesity, overweight, smoking and physical inactivity increases the risk of type 2 diabetes. When diabetes is not well controlled, complications occur that threaten health and endanger life [4].

Dyslipidemia is common in diabetes. Dyslipidemia is one of the important risk factors for cardiovascular disease in diabetes mellitus. These are the distinctive features of diabetic dyslipidaemia, hypertriglyceridaemia, low HDL cholesterol concentration and increased concentration of small dense LDL-cholesterol particles. The lipid variations related with diabetes mellitus are attributed to high free fatty acid flux subordinate to insulin resistance [5]. Cholesterol is essential to overall health, but when levels are increased, cholesterol can be dangerous by contributing to narrowed or

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blocked arteries. Unfortunately, people with diabetes are more likely to having poorly increased cholesterol levels, which are partly responsible to cardiovascular disease. By taking steps to control cholesterol, people can decrease their chance of cardiovascular disease and premature death [6]. With HDL-C, increased levels are partly responsible with a reduced risk for CVD. Reduced HDL cholesterol puts individual at increase risk for heart disease. Individuals with increased blood triglycerides normally have lower HDL cholesterol. Type 2 diabetes, and certain drugs, such as beta-blockers and anabolic steroids, also reduces HDL cholesterol levels [7]. The American Diabetes Association recommends that all adults with diabetes obtain, at least annually, a fasting lipid profile test to find out levels of serum total cholesterol, triglycerides, HDL cholesterol (HDL-C), and LDL cholesterol (8). To the best of our knowledge, there has not been any previous study at Enugu that has shown the pattern of lipid profile in type 2 DM. The purpose of the present study was to observe the order of lipid profile in type-2 Diabetes Mellitus patients during treatment.

2. Materials and Method

This prospective cohort study was conducted at Medical outpatient (MOP) clinic of Enugu State University of Science and Technology Teaching Hospital (ESUTTH) Enugu, Nigeria. Diabetic patients, who were referred to medical outpatient clinic between January and March, 2016 were screened for eligibility. Approval was obtained from Research Ethics committee of Enugu State University of Science and Technology Teaching Hospital (ESUTH) Enugu. Each participant in this study signed an informed consent form before blood sample was collected from them. A total number of 50 participants were recruited for this study. The study population is 30 known type 2 diabetic patients comprising of 13 male and 17 female aged 40-80years were investigated. Twenty five age-matched apparently healthy individuals who had no previous history of type 2 diabetes mellitus were included as control subjects. The mean age for the patients was 67.2 ± 9.5 , for the male and 60.7 ± 12.5 for female. Inclusion criteria were individuals exceeding 40 years of age, about to commence treatment. Those who were unable to sign inform consent form, could not observe a minimum of 10-12 hours fast, and who had other chronic diseases were excluded. Subjects were divided into two groups based on their gender. Blood samples for serum lipid, glycated hemoglobin and fasting blood sugar were drawn from each patient before treatment, 6 months into treatment and 12 months of treatment. Each patient was given a questionnaire form which was filled and returned. Data such as age, sex, mobile phone number, name of tablet for diabetes were obtained.

3. Measurements

In each patient, 6ml of venous blood samples were obtained after overnight fast into plain tubes (for lipid profile), fluoride oxalate tubes (for blood glucose), and EDTA tubes (for glycated hemoglobin). The lipid profile assay comprising of serum total cholesterol, triglycerides, high density lipoprotein cholesterol were done by the methods based on enzymatic determination using the kits purchased from Randox laboratories Ltd. United Kingdom. Low

Density Lipoprotein (LDL) was calculated from friedewald formula. Very low density lipoprotein was calculated by dividing triglyceride value of each patient by five. Glycated hemoglobin was done by the method based on weak binding cation-exchange resin using kit purchased from TECO diagnostics U.S.A.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21. The data were expressed as mean \pm SD. The group comparisons were determined by ANOVA. P value less than 0.05 was considered significant.

4. Results

The mean \pm SD age of the subjects were 67.2 ± 9.5 for men and 60.8 ± 12.5 years for women. The sex distribution showed that diabetic female 17 (57%), were more compared to diabetic male 13 (43%). Table 1 showed mean \pm SD of TC, HDL, TG, LDL, VLDL, HbA1c and FBS of male patients at treatment naïve, 6 months of treatment, 12 months of treatment and control subjects. The TC of male subjects were significantly lower at 12 months of treatment (3.88 ± 0.29 mmol/L) compare with 6 months of treatment (4.97 ± 0.88 mmol/L) ($p=0.004$). The HDL of male subjects at treatment naïve (1.15 ± 0.66 mmol/L) were significantly lower compare with control subjects (2.11 ± 0.26 mmol/L) ($p=0.001$), however at 12 months of treatment (1.90 ± 0.26 mmol/L), HDL of male subjects were significantly higher compare with treatment naïve (1.15 ± 0.24 mmol/L) ($p=0.007$). The LDL of male subjects at treatment naïve (2.46 ± 0.99 mmol/L) were significantly higher compare with control subjects (1.50 ± 0.14 mmol/L) ($p=0.021$), but at 12 months of treatment (1.01 ± 0.02 mmol/L), LDL was significantly lower compare with treatment naïve (2.46 ± 0.99 mmol/L) ($p=0.001$). However, TG of male subjects were significantly higher at 12 months of treatment (2.19 ± 0.17 mmol/L) compare with treatment naïve (1.57 ± 0.36 mmol/L) and 6 months of treatments (1.55 ± 0.40 mmol/L) respectively, ($F=12.65$; $p=0.000$). The VLDL of male subjects were significantly higher at 12 months of treatment (0.99 ± 0.08 mmol/L) compare with treatment naïve (0.73 ± 0.18 mmol/L) and 6 months of treatment (0.77 ± 0.19 mmol/L) respectively ($F=8.62$; $p=0.000$). The HbA1c of male subjects at treatment naïve (9.45 ± 1.59 %) were significantly higher compare with 6 months treatment (5.76 ± 0.49 %), 12 months treatment (6.96 ± 0.06 %) and control (5.40 ± 1.79 %) respectively ($F=29.88$; $p=0.000$). Table 2 showed mean \pm SD of TC, HDL, TG, LDL, VLDL, HbA1c and FBS of female patients at treatment naïve, 6 months of treatment, 12 months of treatment and control subjects. The TC of female subjects were significantly higher at 12 months of treatment (5.34 ± 0.08 mmol/L) and 6 months of treatment (5.87 ± 1.30 mmol/L) compare with treatment naïve (4.48 ± 1.12 mmol/L) ($F=5.53$; $p=0.002$). TG of female subjects were significantly higher at 12 months of treatment (2.66 ± 0.03) compare with treatment naïve (1.91 ± 0.91 mmol/L), 6 months of treatment (1.98 ± 0.59 mmol/L), and control (1.43 ± 0.18 mmol/L) respectively ($F=10.43$; $p=0.000$). The VLDL of female subjects were significantly higher at 12 months of treatment (1.21 ± 0.02 mmol/L) compare with treatment naïve (0.86 ± 0.41 mmol/L)

and 6 months of treatment (0.90 ± 0.27 mmol/L) respectively ($F=3.54$; $p=0.020$). The HbA1c of female subjects at treatment naïve (9.08 ± 1.64 %) were significantly higher

compare with 6 months treatment (6.95 ± 1.17 %), 12 months treatment (6.83 ± 0.16 %) and control (5.15 ± 2.08 %) respectively ($F= 19.19$; $p= 0.000$).

Table 1: Biochemical parameters of the male subjects

	TC (mmol/L)	HDL (mmol/L)	TG (mmol/L)	LDL (mmo/L)	VLDL (mmol/L)	HbA1c (%)	FBS (mmol/L)
TN	4.35±0.91	1.15±0.66	1.57±0.36	2.46±0.99	0.73±0.18	9.45±1.59	7.77±3.27
T6	4.97±0.88	1.59±0.86	1.55±0.40	2.69±1.24	0.77±0.19	5.76±0.49	6.05±0.57
T12	3.88±0.29	1.90±0.26	2.19±0.17	1.01±0.02	0.99±0.08	6.96±0.06	5.36±1.13
C	4.41±0.77	2.11±0.24	1.79±0.16	1.50±0.14	0.82±0.07	5.40±1.79	5.24±0.35
F (p) value	5.75(0.002)	6.07(0.001)	12.65(0.000)	11.88(0.000)	8.62(0.000)	29.88(0.000)	5.10(0.004)
TN VS T6 (p) value	0.296	0.466	0.999	0.948	0.934	0.000	0.288
TN VS T12 (p) value	0.338	0.007	0.000	0.001	0.001	0.001	0.099
TN VS C (p) value	0.990	0.001	0.239	0.021	0.431	0.000	0.070
T6 VS T12 (p) value	0.004	0.615	0.000	0.002	0.006	0.000	0.236
T6 VS C (p) value	0.169	0.211	0.243	0.021	0.890	0.922	0.003
T12 VS C (p) value	0.000	0.225	0.000	0.000	0.000	0.088	0.986

Key= $p<0.05$

Abbreviation: TN=treatment naïve, T6= 6 months into treatment, T12= 12 months into treatment, c=control, total cholesterol= TC, high density lipoprotein= HDL, triglyceride= TG, low density lipoprotein= LDL, very low density lipoprotein= VLDL, glycated haemoglobin= HbA1c, fasting blood sugar= FBS, VS= versus

Table 2: Biochemical parameters of the female subjects

	TC (mmol/L)	HDL (mmol/L)	TG (mmol/L)	LDL (mmo/L)	VLDL (mmol/L)	HbA1c (%)	FBS (mmol/L)
TN	4.48±1.12	1.38±0.78	1.91±0.91	2.34±1.43	0.86±0.41	9.08±1.64	8.60±2.49
T6	5.87±1.30	1.59±1.38	1.98±0.59	3.35±1.83	0.90±0.27	6.95±1.17	7.71±2.58
T12	5.34±0.08	1.67±0.58	2.66±0.03	2.46±0.49	1.21±0.02	6.83±0.16	7.11±0.35
C	4.83±1.27	2.04±0.82	1.43±0.18	2.14±1.08	0.83±0.65	5.15±2.08	5.00±0.71
F(p) value	5.53(0.002)	1.02(0.390)	10.43(0.000)	2.47(0.071)	3.54(0.020)	19.19(0.000)	7.65(0.000)
TN VS T6 (p) value	0.011	0.942	0.991	0.300	0.986	0.001	0.734
TN VS T12 (p) value	0.027	0.596	0.018	0.989	0.014	0.000	0.103
TN VS c (p) value	0.888	0.209	0.193	0.975	0.999	0.001	0.000
T6 VS T12 (P) value	0.375	0.996	0.001	0.246	0.001	0.977	0.773
T6 VS c (p) value	0.212	0.729	0.008	0.162	0.989	0.107	0.003
T12 VS c (p) value	0.600	0.621	0.000	0.816	0.331	0.117	0.000

Key= $p<0.05$

Abbreviation: TN=treatment naïve, T6= 6 months into treatment, T12= 12 months into treatment, c=control, total cholesterol= TC, high density lipoprotein= HDL, triglyceride= TG, low density lipoprotein= LDL, very low density lipoprotein= VLDL, glycated haemoglobin= HbA1c, fasting blood sugar= FBS, VS=versus

5. Discussion

Diabetes mellitus is connected with a higher risk of morbidity and mortality from cardiovascular disease. Diagnosis and treatment of dyslipidemia in diabetes is one crucial step towards lessen the risk of cardiovascular disease connected with diabetes [9]. Type 2 DM is commonly associated with a dyslipidaemia denoted by hypertriglyceridaemia and reduce HDL levels, while the levels of total cholesterol and LDL may or may not vary significantly from those in the non-diabetics [10]. The possible process in control of hypertriglyceridaemia may be due to higher hepatic secretion of very low density lipoprotein (VLDL) and retarded clearance of triglyceride rich lipoproteins, which is most important due to increased levels of substrates for triglyceride production, free fatty acids and glucose [11]. In the present study, significant continuous increase in triglyceride (TG) and very low density lipoprotein (VLDL) from treatment naïve to six

months and to twelve months was observed in both male and female type 2 DM patients. This is in agreement with existing evidence that hypertriglyceridemia and decreased HDL-C need a longer therapeutic duration to counteract than lowering LDL-C [12]. According to Murwan *et al*, 2016, Hanish *et al*, 2016, Veeramalla *et al*, 2017 in type 2 DM significant elevation of total cholesterol, triglyceride, LDL-C, and low level of HDL-C was observed when compared to non diabetic subjects [13]-[15]. Our study has shown similar results except for total cholesterol which are lower in diabetic patients compared with control subjects. In this study, it is observed that 43% were males, 57% were females. This completely disagrees with study done by Hanish *et al*, 2016, that observed 82% males and 18% females during their study [14]. However, the influence of exercise and diet on serum lipid levels was not addressed by this study. Further study that will involve high number of patients, longer period is required in Enugu and indeed Nigeria to identify the main areas of intervention.

6. Conclusion

There was a significant increase of triglyceride and very low density lipoprotein at 12 months into treatment when compared with treatment naïve and 6 months into treatment of both male and female DM patients in this study.

7. Competing Interests

Authors have declared that no competing interests exist

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