

Research Paper

Evaluation of Lipid Metabolism among Sudanese Patients with Type 2 Diabetes Mellitus

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Abstract: *There are few researchers who have reported high levels of total cholesterol, LDL, and triglyceride with high HbA_{1c} concentrations in diabetic patients. This was a quantitative, descriptive, analytic, case-control and hospital-based study aimed to evaluate the lipid metabolism among Sudanese patients with Type 2 Diabetes Mellitus. Blood specimens were collected from 200 type 2 diabetic patients and 100 healthy volunteers (age and sex matched) as a control group. Biosystem spectrophotometric methods were used for measurements of total cholesterol, high density lipoprotein, low density lipoprotein, triglycerides, fasting blood glucose and glycated hemoglobin. Total cholesterol, low density lipoprotein, and triglycerides were significantly elevated with significant positive correlation with each of body mass index, duration of diabetes and glycated hemoglobin. High density lipoprotein was significantly reduced with significant negative correlation with each of body mass index, duration of diabetes and glycated hemoglobin. In conclusion, total cholesterol, high density lipoprotein, low density lipoprotein and triglycerides must be considered as risk factors for atherosclerosis and coronary heart disease in diabetic patients, especially those with complications such as hypertension, ischemic heart disease and renal insufficiency.*

Keywords: Type 2 Diabetes Mellitus, Lipid Profile.

Introduction:

Diabetes Mellitus is a metabolic disorder with inappropriate hyperglycemia either due to an absolute or relative deficiency of insulin secretion or reduction in the biologic effectiveness of insulin or both. [1] It is also associated with disturbances concerned with protein, carbohydrate and lipid metabolism. [2] The decreased uptake of glucose into muscle and adipose tissue leads to chronic extra cellular hyperglycemia which results in tissue damage and chronic vascular complications in both type I and II Diabetes Mellitus. [3] The complications of diabetes mellitus are far less common and less severe in people who have well-controlled blood sugar levels. Wider health problems accelerate the deleterious effects of diabetes. These include smoking, elevated cholesterol levels, obesity, high blood pressure, and lack of regular exercise. [4]

People with Type 2 diabetes, regardless of blood sugar control, tend to have increased triglycerides, decreased HDL, and increased LDL. [5, 6, 7] This cholesterol profile tends to persist even if blood sugar levels are under control--pointing to an even higher likelihood of developing plaques. [8] These LDL molecules are oxidized and taken up by macrophages, which become engorged and form foam cells. These cells often become trapped in the walls of blood vessels and contribute to atherosclerotic plaque formation. In fact, plaques formed in the arteries of people with Type 2 diabetes tend to be fatter and less fibrous than in people with Type 1 diabetes, leading to an even higher risk of a plaque dislodging to cause a heart attack or stroke. [9]

Materials and Methods:

This was a quantitative, descriptive, analytic, case-control and hospital-based study conducted at Jabir-Abulizz Khartoum Diabetes Centre (Sudan), during the period between March and May 2012. A total of 200 patients with type 2 diabetes were included in this study, 116 of them were males (58%), and 84 were females (42%). The control group (100 healthy volunteers) was composed of 55 males and 45 females. Sixty seven patients (33.5%) were hypertensive, 28 patients (14%) had ischemic heart disease, 28 patients (14%) had renal insufficiency, and 70 patients (35%) (n=70) were obese.

Patients with type 1 diabetes mellitus and those with thyroid disorders were excluded from this study. All participants provided oral consent. An interview with a questionnaire to obtain the clinical data was used for each participant in this study whereas the clinical history and examination of the test group and the control group were done by a physician.

About 4 ml venous blood was taken from each participant, 2 ml put into fluoride oxalate anticoagulant container for plasma glucose, and 2 ml put into EDTA container for HbA_{1c} (whole blood) and then centrifuged at 3000 rpm for 3 minutes to obtain plasma for total cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), and triglycerides. Plasma was separated in plain container and kept at -80 C until used. Spectrophotometric methods were used for measuring glucose, total cholesterol, HDL, LDL, and triglycerides. HbA_{1c} was measured by using chromatographic-spectrophotometric ion exchange method. The precision and accuracy of all methods used in this study were checked each time a batch was analyzed by including commercially prepared control sera. Statistical Package for Social Science (SPSS) version 16 computer software was used for data analysis. (Significance levels were set at $P \leq 0.05$).

Results

Plasma levels of total cholesterol, LDL, and triglycerides were significantly raised in patients with type 2 DM either with or without ischemic heart disease, hypertension and/or renal insufficiency; whereas HDL was significantly reduced in these patients (tables 1, 2, and 3). Each table shows the mean \pm Std. deviation and probability value (P-value). Independent t-test was used for comparison. P-value ≤ 0.05 is considered significant.

Plasma levels of total cholesterol, LDL, and triglycerides showed significant positive correlation with durations in years of type 2 DM, BMI, and HbA_{1C}; whereas HDL showed significant reverse correlation with these parameters. There was significant positive correlation between FBS and HbA_{1C}.

Table 1: Comparison of means of plasma levels of Total cholesterol, HDL, LDL, and triglycerides of the diabetic patients with ischemic heart disease and those without ischemic heart disease

Variable	Patients with ischemic heart disease n=28	Patients without ischemic heart disease n=172	P value
T.Cholesterol (mg/dL)	231.07 ± 13.72	183.31 ± 38.68	0.000
HDL (mg/dL)	29.38 ± 2.62	42.15 ± 9.72	0.000
LDL (mg/dL)	160.45 ± 10.47	115.91 ± 26.53	0.007
Triglycerides (mg/dL)	164.28 ± 16.13	130.94 ± 36.68	0.016

Table 2: Comparison of means of plasma levels of Total cholesterol, HDL, LDL, and triglycerides of the diabetic patients with hypertension with those without hypertension

Variable	Patients with hypertension n=67	Patients without hypertension n=133	P value
T.Cholesterol (mg/dL)	229.52 ± 9.45	170.44 ± 13.51	0.000
HDL (mg/dL)	28.82 ± 0.98	46.08 ± 7.27	0.006
LDL (mg/dL)	159.81 ± 6.19	103.50 ± 14.59	0.000
Triglycerides(mg/dL)	183.43 ± 15.39	116.13 ± 29.47	0.000

Table 3: Comparison of means of plasma levels of Total cholesterol, HDL, LDL, and triglycerides of the diabetic patients with renal insufficiency with those without renal insufficiency

Variable	Patients with renal insufficiency n=28	Patients without renal insufficiency n=172	P value
T.Cholesterol (mg/dL)	232.89 ± 13.72	183.29 ± 26.62	0.011
HDL (mg/dL)	29.82 ± 5.21	42.00 ± 9.67	0.010
LDL (mg/dL)	160.36 ± 11.79	116.18 ± 26.61	0.015

Triglycerides (mg/dL)	183.29 ± 19.92	131.41 ± 38.74	0.006
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Discussion:

The elevated cardiovascular risk of diabetic patients is only partially explained by the presence of conventional cardiovascular risk factors, such as glycemic control, lipid abnormalities, hypertension and visceral obesity. This has suggested that additional risk factors, such as genetic risk factors, may favour the increased cardiovascular morbidity and mortality observed in diabetic patients.

Several studies agreed with the results of the current study. **Gardener H et al** [10] found significant elevation of the levels of plasma triglycerides in diabetic patients with ischemic heart disease when compared to those without ischemic heart disease ($P=0.045$). They also reported that there was significantly raised levels of plasma triglycerides in diabetic patients with renal insufficiency when compared to those without renal insufficiency ($P=0.040$).

Taskinem MR [11] reported that the plasma levels of total cholesterol were significantly higher in diabetic patients than in control subjects ($P=0.001$). He also reported that the levels of plasma triglycerides were significantly higher in diabetic patients than in control subjects ($P=0.011$).

Emile E et al [12] found significantly increased levels of total cholesterol among diabetics with hypertension when compared to non-hypertensive patients ($P=0.041$). They also reported that the plasma levels of HDL were significantly lower among diabetic patients with hypertension when compared to those without hypertension ($P=0.040$). In addition, they found insignificant difference between plasma levels of LDL among diabetic patients with hypertension and those without hypertension ($P=0.426$).

Jones SL et al [13] found significant moderate positive correlation between duration of diabetes and plasma levels of total cholesterol ($r=0.62$).

Facchini FS et al [14] found significant strong correlation between BMI and plasma levels of total cholesterol ($r=0.79$). They also reported significant reduction of the levels of plasma HDL in diabetic patients with renal insufficiency when compared to those without renal insufficiency ($P=0.015$). Also there was strong negative correlation between BMI and plasma levels of HDL ($r=0.82$).

Reaven GM [15] found that the plasma levels of HDL were significantly lower in diabetic patients than in healthy control subjects ($P=0.009$). He also found that the plasma levels of LDL were significantly higher in diabetic patients than in control subjects ($P=0.029$).

Garfagnini A et al [16] found significant reduction of plasma levels of HDL among diabetics with ischemic heart disease when compared to those without ischemic heart disease ($P=0.010$). They also reported significant moderate negative correlation between duration of diabetes and plasma levels of HDL ($r=0.63$) and found significant raised levels of LDL among diabetics with ischemic heart disease compared to those without ischemic heart disease ($P=0.030$). In addition, they found significant strong positive correlation between duration of diabetes and plasma levels of LDL ($r=0.79$).

Wildmann RP et al [17] demonstrated significant increase of plasma levels of LDL among hypertensive diabetic patients when compared to non-hypertensive ones ($P=0.034$). They also reported significant elevation of the levels of plasma LDL in diabetics with renal insufficiency when compared to those without renal insufficiency ($P=0.041$). Also there was significant strong positive correlation between BMI and plasma levels of LDL ($r=0.70$).

McLaughlin T et al [18] found significant moderate correlation between BMI and plasma levels of LDL ($r=0.61$), whereas there was insignificant weak positive correlation between HbA_{1C} and plasma levels of LDL ($r=0.32$, $P=0.117$). They also reported significant strong positive correlation between BMI and plasma levels of triglycerides ($r=0.77$).

Yadav D and Pitchumoni CS [19] reported that the levels of plasma triglycerides were significantly increased in hypertensive diabetic patients when compared to non-hypertensive ones ($P=0.014$).

Conclusion

Total cholesterol, high density lipoprotein, low density lipoprotein, and triglycerides can be considered important risk factors for atherosclerosis and coronary heart disease in diabetic patients, especially those with complications such as hypertension, ischemic heart disease and renal insufficiency.

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