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Lipid profile in Type 2 diabetes mellitus and in diabetic nephropathy

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Abstract

Introduction: Diabetes mellitus (DM) is characterized by abnormalities of carbohydrate, protein and fat metabolism due to absolute or relative deficiency of insulin secretion, accompanied by varying degrees of resistance to insulin. Diabetes mellitus is currently the most common etiology for chronic kidney disease (CKD).

Abnormalities of lipoprotein metabolism is associated with Diabetic nephropathy(DN), which can be influenced by derangement of renal function and the degree of metabolic control in diabetes mellitus.

Our objective is to compare the levels of lipid profile, urine microalbumin and glycated haemoglobin (HbA_1c) between type 2 Diabetes mellitus (T2DM) without any complications, T2DM with nephropathy and normal controls who were age and sex matched.

Materials and Method: Study group consisted of 75 individuals of whom 25 were T2DM without any complications, 25 were T2DM with nephropathy and 25 were healthy controls.

Total cholesterol (TC), Triglycerides(TG), LDL Cholesterol(LDL-c), HDL Chlolesterol (HDL-c), HbA_1c and urine microalbumin were measured in these subjects.

Results: The values of TC, TG, LDL-c, HbA_1c and urine microalbumin levels were significantly higher in T2DM without any complications and T2DM with nephropathy when compared to controls. HDL- c level was significantly lower in T2DM without any complications and T2DM with nephropathy when compared to controls.

Conclusions: T2DM and DN are associated with dyslipidemia which is more pronounced in diabetic nephropathy. Therefore, early detection of dyslipidemia in Type 2 diabetics and accordingly therapeutic intervention could control the resulting cardiovascular or renal complications.

Keywords: Type 2 diabetes mellitus, Diabetic nephropathy, Lipid profile, Urine microalbumin

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Introduction

Diabetes Mellitus is a disorder associated with chronic hyperglycaemia resulting from complete or partial decrease in insulin secretion or decrease in biological action of insulin or both.(1)

A variety of interrelated lipid and lipoprotein abnormalities is known to be associated with T2DM commonly termed as diabetic dyslipidemia.(2) Hypetriglyceridemia, Low HDL-c, small dense LDL particles is commonly associated with T2DM.(3)

Deficiency of insulin decreases lipolysis and increases the hydrolysis of stored triglyceride, resulting in greater release of non-esterified fatty acids (NEFA), which is delivered to the liver leading to increased hepatic triglyceride production, which will lead to hepatic VLDL production.(4)

Action of insulin on the lipoplytic enzyme lipoprotein lipase is reduced which will lead to decreased clearance of triglyceride rich lipoproteins, VLDL and chylomicrons, thus contributing to hypertriglyceridemia in T2DM.(5)

Insulin resistance increases the catabolism of HDL in the presence of normal levels of Cholesterol Ester Transport Protein (CETP) and Hepatic Lipase, which promotes the movement of cholesterol ester from HDL to Very Low Density Lipoprotein (VLDL), in the presence of higher VLDL- TG level. HDL-c production is also decreased secondary to impaired catabolism of VLDL – c and impaired lipoprotein lipase activity.(6)

The most common pathology for CKD (Chronic kidney disease) is Diabetes Mellitus. Reduction in lipid abnormalities might preserve glomerular filtration rate, decrease proteinuria, thus reducing the rate of micro and macrovascular complications of diabetes mellitus.(7)

This study compared the levels of lipid profile, urine microalbumin and HbA1c between T2DM without any complications, T2DM with nephropathy and age and sex matched normal controls.

Materials and Method

The study population consists of seventy five individuals, who were divided into following groups:

Group I: Diagnosed cases of T2DM without any complications (25)

Group II: Diagnosed cases of T2DM with nephropathy (25)

Group III: Normal controls who were age and sex matched (25)

Selection Criteria:

Inclusion Criteria: Known cases of T2DM without any complications and T2DM with nephropathy aged between 40-70 years.

Exclusion Criteria: Subjects with previous history of thyroid disease, patients on medications such as thyroxine, antithyroid drugs, oral contraceptives and glucocorticoids, pregnancy and coexisting hepatic disease.

Ethical considerations: Approval by the institutional ethical committee was obtained. The objectives of the study were explained to all eligible subjects who participated in the study. Informed consent was sought from all participants.

Sample collection: 7 ml of venous blood specimen was collected from the antecubital vein after fasting for 8-12 hours. Out of which, 2 ml of blood was transferred into EDTA vacutainer and 5 ml blood was transferred into a plain vacutainer. 5 ml of urine sample was collected. The blood samples were subjected to centrifugation and the sera was collected.

Total cholesterol is measured by enzymatic method CHOD-PAP (Cholesterol Oxidase-Peroxidase 4-aminoantipyrine) in semiautoanalyzer using commercially available kit.

Serum HDL-c is measured by enzymatic method after precipitation with polyanions in a semiautoanalyzer using commercially available kit.

Friedewald Formula was used to calculate serum LDL-c

LDL cholesterol mg/dl = Total cholesterol – [HDL Cholesterol + Triglycerides/5]

Serum triglycerides is measured by enzymatic method GPO-ESPAS (Glycerol 3 Phosphate Oxidase-Peroxidase N-Ethyl-N-Sulfopropyl-n-anisidine) using commercially available kit in semiautoanalyser.

Ion Exchange Resin method was used to measure HbA1c.

Turbidimetric immunoassay method was used to estimate urine microalbumin in a semiautoanalyzer using commercially available kits.

Statistical analysis: Obtained data was analyzed using SPSS software. Quantitative variables were presented in the form of Mean ± SD Analysis of variance (ANOVA) was used to do the comparison between the quantitative variables. Statistical significance was considered to be moderate at p value < 0.05 and p value < 0.01 was considered strongly significant.

- Serum TC levels in T2DM without any complications was 255.52 ± 19.75, in T2DM with nephropathy was 258.56 ± 21.20 and in controls was 163.68 ± 17.68.
- T2DM without any complications and T2DM with nephropathy had statistically significant higher levels of total
- Cholesterol when compared to controls. (p <0.001)(Table 1)
- Serum triglycerides levels in T2DM without any complications was 180.84 ± 18.57, in T2DM with nephropathy was 182.28 ± 14.16 and in controls was119.72 ± 25.34.
- T2DM without complications and T2DM with nephropathy had statistically significant higher levels of triglycerides when compared to controls (p <0.001) (Table 2)
- Serum HDL- c levels in T2DM without any complications was 32.04 ±7.13, in T2DM with nephropathy was 31.92 ± 5.13 and in controls was 55.04 ± 11.03.
- T2DM without any complications and T2DM with nephropathy had statistically significant lower levels of HDL when compared to controls. (p <0.001) (Table 3)
- Serum LDL-c levels in T2DM without any complications was 187.43 ± 22.01, in T2DM with nephropathy was 189.78 ± 22.93 and in controls was 84.67 ± 19.66.
- T2DM without any complications and T2DM with nephropathy had statistically significant higher levels of LDL-c when compared to controls. (p <0.001) (Table 4)
- Urine microalbumin levels in T2DM without any complications were 17.24 ± 4.56, in T2DM with nephropathy was 166.12 ± 34.45 and in controls was 14.12 ± 3.79.
- T2DM without any complications and T2DM with nephropathy had statistically significant higher levels of urine microalbumin when compared to controls. (p <0.001) (Table 5)
- HbA1c levels in T2DM without any complications were 6.92 ± 1.40, in T2DM with nephropathy was 8.93 ± 2.35 and in controls was 5.45 ± 0.50.
- T2DM without any complications and T2DM with nephropathy had statistically significant higher levels of HbA1c when compared to controls, which was statistically significant (p <0.001) (Table 6).

Results

Table 1: Comparison of serum total cholesterol (mg/dl) between the study groups

Study Groups	n	Mean (mg/dl)	SD	F	P
Type 2 diabetics without any complications	25	255.52	± 19.75	189.28	< 0.001
Type 2 diabetics with nephropathy	25	258.56	± 21.20		

Controls	25	163.68	± 17.68		

Table 2: Comparison of serum triglycerides (mg/dl) between study groups

Study Groups	n	Mean (mg/dl)	SD	F	P
Type 2 diabetics without any complications	25	180.84	± 18.57	80.56	< 0.001
Type 2 diabetics with nephropathy	25	182.28	± 14.16		
Controls	25	119.72	± 25.34		

Table 3: Comparison of serum HDL (mg/dl) between the study groups

Study Groups	n	Mean (mg/dl)	SD	F	P
Type 2 diabetics without any Complications	25	32.04	± 7.13	66.87	< 0.001
Type 2 diabetics with nephropathy	25	31.92	± 5.13		
Controls	25	55.04	± 11.03		

Table 4: Comparison of serum LDL (mg/dl) between the study groups

Study Groups	n	Mean (mg/dl)	S D	F	P
Type 2 diabetics without any Complications	25	187.43	± 22.01	193.27	< 0.001
Type 2 diabetics with nephropathy	25	189.78	± 22.93		
Controls	25	84.67	± 19.66		

Table 5: Comparison of urine microalbumin (mg/dl) between the study group

Study Groups	n	Mean (mg/dl)	S D	F	P
Type 2 diabetics without any complications	25	17.24	± 4.56	463.23	< 0.001
Type 2 diabetics with nephropathy	25	166.12	± 34.45		
Controls	25	14.12	± 3.79		

Table 6: Comparison of glycated haemoglobin (mg/dl) between the study groups

Study Groups	n	Mean (mg/dl)	S D	F	P
Type 2 diabetics without any Complications	25	6.92	± 1.40	29.62	< 0.001
Type 2 diabetics with nephropathy	25	8.93	± 2.35		
Controls	25	5.45	± 0.50		

Discussion

The world wide prevalence of diabetes mellitus is predicted to increase to 5.4% by the year 2025, most of this increase will occur in developing countries.[8]

HbA1c is considered to be the gold standard for measurement of glycemic control. It is also a predictor of diabetic complications.[9] T2DM without any complications and T2DM with nephropathy had increased levels of HbA1c when compared with controls.

TC, TG and LDL -c levels are increased and HDL -c is decreased in T2DM without any complications and T2DM with nephropathy, when compared to controls in the present study. These observations are according to the findings of Ejuoghanran OSO et al.[10]

Altered lipid profile in T2DM is due to insulin resistance and defective insulin action on lipoprotein metabolism. Increased lipolysis will increase the synthesis of VLDL and triglyceride rich LDL-c. It will also increase triglyceride synthesis and promote quick breakdown of HDL-c.[11]

Diabetic nephropathy is the consequence of diabetes mellitus characterised by excretion of albumin in urine, increased blood pressure, decreased glomerular filtration rate and high risk of cardiovascular disease.[12] Abnormal lipid profile in

diabetes mellitus may lead to worsening of the condition and direct the disease to renal impairment.[13] Elevated lipoproteins and lipids may cause glomerular and tubulointerstitial injury thus contributing to the progression of diabetic nephropathy.[14]

Conclusion

The present study showed that the common lipid abnormalities associated with patients of T2DM without any complications and T2 DN are hypercholesterolemia, hypertriglyceridemia, elevated LDL-c and decreased HDL -c. Diabetic nephropathy is considered an independent risk factor for cardiovascular disease and altered lipid levels will increase the risk. Routine monitoring of lipid profile should be included in the optimal care for diabetic patients. Lifestyle modifications such as appropriate nutrition, exercise and pharmacological interventions for hyperlipidemia should be implemented for diabetics to prevent or delay its renal manifestations.

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