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Original research article: Estimation of plasma levels of fasting blood glucose, triglycerides, total cholesterol, and HbA1c in patients with type 2 diabetes mellitus

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Abstract
Background: Type 2 diabetes accounts for approximately 90 to 95% of all diagnosed cases of diabetes. Multi-system effects of diabetes mellitus such as retinopathy, nephropathy, neuropathy and cardiovascular diseases are important public health concerns.
Objective: This was a cross-sectional study aimed to evaluate the significance of glycosylated Hemoglobin, triglycerides and total cholesterol in type 2 Southern Rajasthan diabetic patients.
Material and Methods: The participants were 120 patients with type 2 diabetes and 80 apparently healthy individuals as control group. Venous blood samples were collected from all participants. The whole blood and sera were analyzed for glycosylated hemoglobin, fasting blood glucose and lipid profile. The statistical analysis was done by using online student t-test.
Results: Plasma glucose, triglycerides and total cholesterol were significantly increased in diabetic patients compared with control group. HbA1c showed positive correlations with fasting blood glucose, triglycerides and total Cholesterol.
Conclusion: It is concluded from the results of this study that HbA1c can be used as a predictor of dyslipidemia in patients with type II diabetes.

Keywords: Diabetes mellitus; Fasting Blood Glucose; Lipid profile; glycosylated Hemoglobin

Introduction

Diabetes mellitus is a metabolic disease which is caused by absolute or relative insulin deficiency. About 10% of the Indian population suffers from this disease. Various factors play a role in the aetiopathogenesis and in the glycaemic control among the type 2 diabetic patients [1]. The chronic hyperglycemic condition is associated with long term damage, dysfunction and failure of various organs especially eyes, kidneys, nerves, heart and blood vessels. Complications of diabetes mellitus include acute complications that are generally a reflection of altered energy homeostasis either from hyperglycemia (diabetic ketoacidosis and non-ketotic hyperosmolar syndrome) or hypoglycemia and chronic microvascular complications consisting of retinopathy, nephropathy, neuropathy and angiopathy [5].

Triglyceridemia is associated with increased risk of coronary heart disease, both in nondiabetic and type 2 diabetic subjects [6, 7]. Diabetic patients with dyslipidemia are targets of cardiovascular deaths. Patients with type 2 diabetes often exhibit an atherogenic lipid profile, which greatly increases their risk for cardiovascular disease compared with people without diabetes [8, 9]. The combination of hyperglycemia, diabetic dyslipidemia, insulin resistance and hypertension produces an enhanced atherogenic environment within the circulation [10]. Severe hyperlipidemia in diabetes may also lead to lipid infiltration into the retina, causing macular edema and retinal hard exudates and blindness [11].

Glycated hemoglobin (HbA1c) is a routinely used marker for long-term glycemic control as an indicator for the mean blood glucose level. HbA1c predicts the risk for the development of diabetic complications in diabetes patients [12].

Material and Method

This Retrospective study was conducted at Geetanjali Medical college and Hospital, Udaipur, Rajasthan from 2010-2011. The participants were 120 patients with type 2 diabetes and 80 apparently healthy individuals as control group. Venous blood samples were collected from all the participants after at least 8 hours fasting. The whole blood and sera were used for analyzing Fasting Blood Glucose (FBG), Total Cholesterol (TC) and Triacylglycerol (TAG) using enzymatic spectrophotometic method in fully automated biochemistry analyser. HbA1c was estimated by using Turbidimetry method.

Obtained data were analyzed statistically by calculating p-value by using online student t-test.

Results

The results in this study showed significant increase in total cholesterol, fasting blood glucose, triglycerides and HbA1c in type 2 diabetic patients compared with non-diabetic control subjects ($P = \leq 0.05$), as shown in table 1.

Table 1: Comparision of various biochemical parameter between test (n=120) and control (n=80) group

Parameter	Test (N=120)	Control (N=80)	p-Value
FBS(mg/dl)	169 ± 5.6	104± 6.5	<0.05
T.cholesterol(mg/dl)	182 ± 10.23	171 ± 15.21	<0.05
Triglyceride(mg/dl)	113 ± 10.32	93 ± 11.56	<0.05
Hba1c (%)	8.9± 1.1	5.9 ± 0.5	<0.05

Table 2: Comparison of Mean of Total Cholesterol, Triglycerides and Fasting Blood Glucose in type II diabetic patients in reference to Glycemic Control (HbA1c).

Parameter	Hba1c <7 %	Hba1c > 7 %	p-value
T.cholesterol(mg/dl)	165 ± 5.6	184 ± 10.23	<0.05
Triglyceride(mg/dl)	99 ± 8.3	113 ± 9.2	<0.05
FBS(mg/dl)	121 ±5.8	171 ± 5.3	<0.05

Discussion

In the present study, triglycerides and total cholesterol were increased in diabetic patients when compared with that of the control group. These findings are inagreement with reports of Abdella NA *et al*., [13] Hayden JM and Reaven PS [14], Smaoui M *et al*., [15].

Many studies have shown altered lipid profile in diabetes Mellitus and it has been further shown that the dyslipidaemia predisposes the diabetic patients to cardiovascular complications, especially coronary heart disease. HDL acts by enhancing the removal of cholesterol from the peripheral tissues and so reduces the body's cholesterol pool [16]. Type II diabetes mellitus was usually associated with low plasma levels of HDL cholesterol. Low HDL concentrations are often accompanied by TG levels as seen in this study and this combination has been strongly associated with an increased risk of CHD. The relative insulin deficiency that occurs in type II diabetes mellitus impairs the action of lipoprotein lipase and results in lower HDL cholesterol levels and higher TG levels, which may improve with improved glycaemic control. Results of prospective studies also suggest that a high LDL/HDL ratio combined with hypertriglyceridaemia is associated with highest CHD risk. This dyslipidaemic state (lipid triad) has been described as atherogenic Dyslipidaemia...

This approach could be further simplified by using TC/HDL and LDL/HDL ratios as markers of CHD. The TC/HDL ratio is a specific and sensitive index of cardiovascular risk and predictor of CHD especially with values above 6. Because of this overwhelming evidence that an elevated LDL concentration in plasma is atherogenic, whereas a high HDL level is cardioprotectiv the measurement and interpretation of LDL and HDL levels is emphasised in the US National Cholesterol Education Programme Guidelines. According to these guidelines, LDL concentration should be considered primary therapeutic target, whereas HDL levels may also be critical in the assessment of CHD risk.

The significant increase in total cholesterol and triglycerides in patients with higher HbA1c value indicates that severity of dyslipidemia increases in patients with increased HbA1c value. This is found in Agreement with findings of Rohlfing, C.L. *et al.*, [17].

Conclusion

We conclude that dyslipidaemias and DM go hand in hand, so all type II diabetic patients should undergo lipid profile as a routine test. It is also concluded from the results of this study that HbA1c can be used as a predictor of dyslipidemia in patients with type II diabetes in addition to its importance as glycemic control parameter.

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