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Correlation between HbA1c and Lipid Profile among Diabetics and Non-Diabetics Population: A Comparative Cross-Sectional Study

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ABSTRACT
The serum lipid profile of diabetic patients should be measured periodically to take suitable action based on age and type of disease. There exists a positive relationship between the HbA1c level and cardiovascular disease in non-diabetic cases even within the standard range of HbA1c. This study aims to estimate the serum lipid profile in diabetes and non diabetes individual and correlation of HbA1c levels with lipid profile. The cross-sectional study was done on 124 inpatients and outpatients in a tertiary care hospital, Tamil Nadu, India. Data were collected from the eligible patients on basic clinical details and blood investigations in the fasting state were assessed for FLP-total cholesterol, HDL, LDL, VLDL, TGL, HbA1c, CBC, urine routine, renal function test and thyroid function test. A total of 412 diagnosed cases of type 2 diabetes mellitus and same number of non diabetic control were analyesed in our study. Increasing age and obesity significantly associated with the diabetes mellitus. Correlation of the lipid profile with duration of diabetes and HbA1c levels showed a positive correlation with total cholesterol, LDL, VLDL and triglycerides. The glycemic control of the patient has got a strong impact on the serum lipid profile levels. Patients should be educated about regular monitoring of lipid profiles and should control blood glucose and cholesterol very effectively.

INTRODUCTION

Globally, type 2 diabetes mellitus (T2DM) is a swiftly escalating public health issue with noteworthy effects on human health, living standards, the economy and health care systemsp[1]. Statistics from the international diabetes federation (IDF) indicate that 425 million adults worldwide have diabetes mellitus (DM) and that by 2045, the number of DM patients will be 629 million and 352 million people were at risk of developing T2DM[1,2]. Diabetes mellitus (DM) is a metabolic disorder characterized by abnormally high blood glucose levels. Type 1 and 2, maturity-onset diabetes of the young (MODY), gestational diabetes, neonatal diabetes and secondary causes related to endocrinopathies, steroid usage and other factors are all types of diabetes[3]. Around one in every 11 persons in the globe now has diabetes, with 90% of those suffering from type 2 diabetes (T2DM)[4]. T2DM has a more gradual start, with an imbalance between insulin levels and insulin sensitivity leading to an insulin functional deficit. Insulin resistance can be caused by a variety of factors, although it is most typically caused by fat and aging[3]. T2DM patients are prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular (stroke, peripheral vascular disease and coronary artery disease [CAD]) and microvascular (nephropathy, neuropathy and retinopathy) diseases[5]. A study conducted in the Indian population have reported that, for T2DM patients, one of the most common complications linked with uncontrolled hyperglycemia is dyslipidemia[6]. The American Diabetes study (ADA) has designated HbA1c level of <7% as a goal of optimal blood glucose control and the American Association of Clinical Endocrinologist has further recommended HbA1c level of <6.5%[7,8]. Serum lipids are frequently abnormal and are likely to contribute to the risk of coronary artery disease[9]. Criteria for abnormal lipid profiles were based on the ADA criteria, Hypercholesterolemia refers to a total cholesterol level $\geq$200 mg dL^{-1}, Hypertriglyceridemia refers to a level is $\geq$150 mg dl^{-1}, HDL was considered low when the level is <40 mg dL^{-1} in males and <50 mg dL^{-1} in females, LDL was considered high when the level is $\geq$100 mg dL^{-1}. Dyslipidemia was defined as the presence of one or more of the previous abnormalities in serum lipids[10]. Diabetes is associated with a greater risk of morbidity and mortality from cardiovascular disease (CVD). Serum lipids are frequently abnormal and are likely to contribute to the risk of coronary artery disease, worsening of glycemic control deteriorates lipid and lipoprotein abnormalities and particularly of diabetes mellitus[11,12].

Aim: The aim of this study to analyze lipid profile in serum of patients with diabetes mellitus type 2 and its relationship with HbA1c levels.

MATERIALS AND METHODS

This was a comparative cross-sectional study, accomplished at a tertiary care center, central India. All the patients attending outpatient department (OPD) during the study period were enrolled in our study. A total of 412 cases of type 2 diabetes mellitus and same number of age matched control (non diabetic) people were analysed and compared with their lipid profile level.. Cases were diagnosed as DM type -2 (DM-2) as per the American Diabetes Association criteria 2007. These criteria set the following as values that are indicative of T2DM: HbA1C $\geq$6.5%, FPG $\geq$126 mg dL^{-1} (7.0 mmol L^{-1}), 2 hrs plasma glucose $\geq$200 mg dL^{-1} (11.1 mmol L^{-1}) during an oral glucose tolerance test (OGTT), or random plasma glucose $\geq$200 mg dL^{-1} (11.1 mmol L^{-1})[13].

Inclusion criteria:

- Patients 20-80 years of age group, with both gender
- Participant who provide written inform consent for the study

Exclusion criteria:

- Participants <20 or >80 years of age
- Patients with DM type 1, pregnancy, renal problems and other endocrinopathies, patients on lipid-lowering agents and with a serum triglyceride (TG) >400 mg dL^{-1}
- Patients not willing for the study

All patients comprising the diabetic and non diabetic groups were subjected to blood sampling for estimation of fasting and postprandial blood glucose, glycated hemoglobin (HbA1c) and lipid profile.

HbA1c assay was done by high performance liquid chromatography (HPLC). Fasting Blood Glucose, Total cholesterol, Triglycerides and HDL was measured by enzymatic method by using auto-analyzer on the same day of collection. The levels of LDL by using Friedewald's formula

All patients' anthropometric measurements (weight, height and BMI), blood pressure and laboratory results, including HbA1c levels, TC levels, TG levels, LDL-C levels and HDL-C levels, were collected.

For analysis, we characterized the participants' glycemic control as poor (HbA1c >7%) or good (HbA1c <7%).

All the requisite information was collected by using pretested standard proforma by trained persons

Statistical analyses: The results were evaluated by SPSS statistical package version 20 by one-way analysis of variance (ANOVA) followed by Bonferroni multiple comparison test and students t test. The results were expressed as Mean±Standard deviation (S.D), $p<0.05$ was considered statistically significant.

Table 1: Socio-demographic profile of study participants

Socio-demographic characteristics	Diabetic group (n = 412)	Non diabetic group (n = 412)	p-value
Age in years			
20-40	70 (17%)	110 (26.7%)	0.003
40-60	230 (55.8%)	198 (48.1%)	
60-80	112 (27.2%)	104 (25.2%)	
Gender			
Male	264 (64.1%)	249 (60.4%)	0.281
Female	148 (35.9%)	163 (39.6%)	
BMI			
Normal BMI	60 (14.6%)	76 (18.5%)	<0.001
Mild obesity	58 (14.1%)	112 (27.2%)	
Moderate obesity	154 (37.3%)	127 (30.8%)	
Severe obesity	140 (34%)	97 (23.5%)	
Socio-economic class			
Lower	90 (21.8%)	102 (24.8%)	0.589
Middle	198 (48.1%)	194 (47.1%)	
Upper	124 (30.1%)	116 (28.1%)	
Residential status			
Rural	162 (39.3%)	176 (42.7%)	0.321
Urban	250 (60.7%)	236 (57.3%)	

Table 2: Lipid profile parameters among non diabetic and diabetics group

Lipid parameters	Diabetic group	Non diabetic group	p-value
TG (mg dL^{-1})			
Up to 150	228 (55.3%)	255 (61.9%)	0.056
>150	184 (44.7%)	157 (38.1%)	
CHOL (mg dL^{-1})			
Up to 200	282 (68.4%)	303 (73.5%)	0.106
>200	130 (31.6%)	109 (26.5%)	
HDL (mg dL^{-1})			
>40	235 (57%)	230 (55.8%)	0.725
Up to 40	177 (43%)	182 (44.2%)	
VLDL (mg dL^{-1})			
Up to 30	239 (58%)	267 (64.8%)	0.045
>30	173 (42%)	145 (35.2%)	
LDL (mg dL^{-1})			
Up to 130	298 (72.3%)	313 (76%)	0.232
>130	114 (27.7%)	99 (24%)	

Table 3: Correlation of lipid profile parameters according to their glycemic control (HbA1c level)

Parameters	HbA1c ≤7% (n = 32)	HbA1c>7% (n = 32)	p-value
	Mean±SD		
Age (years)	59.34±12.84	60.59±13.35	0.704
TG (mg dL^{-1})	129.40±67.85	156.09±92.62	0.193
CHOL (mg dL^{-1})	164.74±36.80	172.89±42.34	0.414
HDL (mg dL^{-1})	48.44±17.71	47.42±15.14	0.805
VLDL (mg dL^{-1})	28.70±12.9	33.50±13.5	0.150
LDL (mg dL^{-1})	101.33±38.20	106.96±33.4	0.532

RESULTS

A total of 412 diagnosed cases of type 2 diabetes mellitus patients and equal number non diabetic participants were selected for the study. Majority of the participants were 40-60 years age groups (55.8% in diabetic and 48.1% in non diabetic group), Mean age±SD of diabetic group was 52.8±12.1. Statistically significant difference was observed among diabetic and non diabetic group in respect to age. Most of the participants were male (64%) and mainly belong to upper socio-economic class (30.1%), residing at urban area (60.7%). BMI were significantly higher in diabetic group as compared to non diabetic group (p<0.05%) (Table 1).

Correlation of lipid profile parameters between diabetic and non diabetic group, VLDL were significantly differ between both the group, rest other parameters (TG, cholesterol, HDL and LDL) were no significant difference. Details was shown in Table 2.

No statistically significant difference was observed among poor glycemic control (HbA1c>7) and good glycemic control group in respect ot lipid profile parameters (Table 3).

DISCUSSIONS

Abnormality of Cholesterol metabolism may lead to cardiovascular disease and heart attacks. Total cholesterol levels are different in the presence of risk factor for diabetes mellitus. The national cholesterol educational program (NCEP) identified elevated LDL as a primary risk factor for coronary heart disease (CHD)[14].

In our study increasing age group significantly associated with the type 2 diabetes mellitus, we observed statistically significant difference between the diabetic and non diabetic group with respect to age, similar finding also reported by Reddy *et al*.[15] and Walden *et al*.[16].

Present study found significant association between the obesity and diabetes mellitus and dyslipidemia, our results correlate with the Alzahrani *et al*.[17] and Singh and Kumar[18].

According to the results of our study, diabetic individuals have a significant prevalence of dyslipidemia. Hypertriglyceridemia (44.7%) and high LDL (27.7%) were the most and least prevalent dyslipidemic parameters seen in our study, respectively, concordance finding seen by Kumar *et al*.[19] and Samdani *et al*.[20].

Current study observed high VLDL level was significantly associated with diabetes mellitus than non diabetic group (p<0.05), accordance to Sarfraz *et al*.[21] and Begum *et al*.[22].

Poor glycemic control (HbA1c >7) have positively associated dyslipidemia (higher triglycerides, higher cholesterol, VLDL and LDL), similar finding observed by many other studies: Priya and Begum[23], Panjeta *et al*.[24] and Niranjan *et al*.[25].

An Iran study correlating HbA1c levels and lipid profile parameters of patients with T2DM concluded that raise in the level of HbA1c is associated with increase in the serum lipid profile, which can be used as a better diagnostic indicator of cardiovascular diseases in diabetic patients[26].

Mahajan and Koley[27], conducted a similar study, which showed correlation of HbA1c with LDL, triglycerides, total cholesterol, high-density lipoprotein, very-low-density lipoprotein, high-density lipoprotein C and low-density lipoprotein C levels.

Further a study conducted by Anand[28]. established that serum HbA1c levels, adequate glycemic control and lipid profile screening help to identify high-risk patients for timely diagnosis of hyperlipidemia, hence decreases the incidence of cardiovascular diseases and peripheral vascular complications through appropriate interventions.

CONCLUSION

HbA1c is associated with dyslipidemia in patients with type 2 diabetes mellitus in addition to as glycemic control parameter. Improving glycemic control may improve the serum lipid profile and thus significantly reduce the risk of cardiovascular events in this population of patients.

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