Correlation of Lipid Profile with Duration of Diabetes and HbA1c Levels in Type 2 Diabetes Mellitus Patients: A Descriptive Cross-sectional Study

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ABSTRACT

Background: HbA1c predicts the risk for the development of complications in patients with diabetes mellitus. 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 nondiabetic cases even within the standard range of HbA1c. Numerous studies have been done to find the correlation between the blood glucose levels and parameters of the serum lipid profile.

Aims: This study aims to estimate the serum lipid profile and HbA1c levels in type 2 diabetes mellitus (T2DM) and determine the associated factors including the duration of diabetes mellitus among type 2 diabetes mellitus of a tertiary care hospital in Tamil Nadu, India.

Materials and methods: 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.

Results: Eighty patients (64.5%) were having bad glycemic control based on HbA1c >7.5% and the remaining were having good glycemic control. Correlation of the lipid profile with duration of diabetes and HbA1c levels showed a significant positive correlation with total cholesterol, LDL, VLDL, and triglycerides. Correlation of other numerical variables such as age, HbA1c, and hemoglobin with duration of diabetes shows a significant positive correlation of age with HbA1c.

Conclusion: Significant positive correlation of HbA1c with lipid profiles in our study suggests that HbA1c can also be used as a predictor of dyslipidemia in addition to a glycemic control parameter for prevention of complication.

Keywords: Diabetes, Duration of diabetes, HbA1c level, Type 2 diabetes mellitus.

SBV Journal of Basic, Clinical and Applied Health Science (2020): 10.5005/jp-journals-10082-02234

INTRODUCTION

The rate of patients with type 2 diabetes mellitus (T2DM) is increasing rapidly due to physical inactivity and obesity as a result of lifestyle modification.[1] Diabetes mellitus is due to abnormality in carbohydrate, lipid, and protein metabolism due to increase in insulin resistance in type 2 diabetics and due to insulin deficiency in type 1 diabetes mellitus (T1DM).[2]

The major risk factor in development of coronary vascular disease in patients with T2DM is evidenced by abnormal lipid profile parameters, apart from metabolic syndrome, which is a combination of T2DM and systemic hypertension.[3,4]

The number of receptors of low-density lipoprotein increase with elevation of the insulin level; hence, LDL receptor levels diminish with decrease in level of insulin, which causes higher level of LDL cholesterol in patients with T2DM.[5,6] It acts as a modifiable risk factor for cardiovascular disease in type 2 diabetes mellitus, as dyslipidemia accelerates progression of atherosclerosis. The level of HbA1c acts as a better indicator for analyzing the average blood glucose level for over a period of 3 months.[7,8] In order to take a suitable action at an appropriate time, it is essential to estimate the lipid profile of patients with T2DM.[9,10]

Numerous studies were done to assess the correlation of glycemic control of patients with T2DM with the serum lipid profile. The present study would help us to understand the pattern of dyslipidemia and also in regulating the incidence of hyperlipidemia in patients with T2DM.

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MATERIALS AND METHODS

This study was done by a cross-sectional study design among 124 inpatients and outpatients attending the department of general medicine in a tertiary care hospital in Tamil Nadu, South India. Convenient sampling from the outpatients and inpatients was followed. All patients with type 2 diabetes above 40 years of age with micro- and macrovascular complications willing to participate were included in the study. Patients on statin or fibrate therapy, oral contraceptive pills, steroids, hypothyroidism, nephrotic syndrome, chronic kidney disease, and familial hyperlipoproteinemia were excluded from the study. The minimum calculated sample size

derived from the previous study with prevalence of 61% is 115. However, we could collect up to 124 samples and were included in the study.

Procedure

Institutional ethical committee approval was taken prior to the study. Consecutive sampling was followed. After establishing rapport with the study subject, the purpose, procedure, benefits, risks, and confidentiality of the study were explained. An informed written consent from the study subject was taken before the interview schedule was administered. Data were collected from the eligible patients and basic patient's history was taken according to a standard questionnaire and subjected to clinical examination. In overnight fasted (at least 10–12 hours) patients 5 mL of the venous blood sample was collected for measurement of fasting blood sugar and lipid profiles. The lipid profile was evaluated by using the classification of the National Cholesterol Education Programme (NCEP-ATP III).

The blood samples were drawn in the fasting state for FBS, FLP (total cholesterol, HDL, LDL, VLDL, TGL), HbA1c, complete blood count, and renal and thyroid function tests. Urine routine investigation was also done.

Statistics and Analysis of the Data

The data were coded and entered in Microsoft Excel and analyzed using SPSS version 20. Frequencies and percentages with visualization were used for categorical variables such as gender, treatment type, and history of previous illness. Measures of central tendency and dispersion were used for numerical variables from the serum blood levels such as age, lipid profile parameters, duration of diabetes, Hb, and HbA1c. The p value of less than 0.05 was considered as statistically significant.

RESULTS

The study population comprised of 124 T2DM patients. The basic sociodemographic details of the study subjects are represented in Table 1. The mean and median age of the study population are 57.15 and 56 years, respectively. Majority (52, 41.8%) of the study population was belonging to the 51–60 age group category. A total of 74 (59.7%) were females and 50 (40.3%) were males.

The mean and median duration of diabetes of the study population are 7.29 and 7 years, respectively. The mean and median HbA1c level among the study population are 8.18 and 8.1, respectively. About 64.5% were having bad glycemic control based on HbA1c >7.5% and the remaining were having good glycemic control. About 89.5% were having dyslipidemia (characterized by any one of the abnormal values of TC, LDL, VLDL, TG, and HDL). Among diabetics, insulin was taken by 40 (32.3%) and the rest 84

Table 1: Sociodemographic details of the study subjects

S. no	Variable	Category	Frequency	Percent
1	Age	<40	4	3.2
		41–50	26	20.9
		51–60	52	41.8
		61–70	37	29.8
		>70	5	4.0
2	Gender	Female	74	59.7
		Male	50	40.3
		Total	124	100.0

(67.7%) were managed by oral hypoglycemic drugs. All of them had normal values in the renal function test, thyroid function test, and urine routine tests. Table 2 represents the clinical details of the study subjects.

Correlation of the lipid profile with duration of diabetes and HbA1c levels shows that there is a significant positive correlation of total cholesterol, LDL, VLDL, and triglycerides with duration of diabetes ($p < 0.05$, using Pearson's correlation test). The data on the correlation of the lipid profile with HbA1c levels and duration of diabetes are shown in Table 3.

Correlation of other numerical variables such as age, Hb A1C, and hemoglobin with duration of diabetes shows a significant positive correlation of age with HbA1c. This positive relationship using the Pearson's correlation test is statistically significant with p value of less than 0.05. Table 4 represents the correlation of age, HbA1c, and hemoglobin with duration of diabetes.

The association between diabetic control and triglycerides, VLDL, LDL, HDL, and total cholesterol is statistically significant.

DISCUSSION

The study was conducted in a tertiary healthcare hospital in South India. A significant positive correlation was found in patients'

Table 2: Clinical details of the study subjects

S. no	Variable	Category	Frequency	Percent
1	Treatment type for diabetes	Insulin	40	32.3
		Oral hypoglycemic drugs	84	67.7
2	Glycemic control based on HbA1c	Bad (>7.5%)	80	64.5
		Good (<7.5%)	44	35.5
3	Lipid level	Dyslipidemia	111	89.5
		Normal	13	10.5
		Total	124	100.0

Table 3: Correlation of lipid profile with HbA1c levels and duration of diabetes

Biochemical parameter	Statistical test	HbA1c	Duration of diabetes
Total cholesterol	Pearson correlation	0.520**	0.469**
	Sig. (two-tailed)	0.000	0.000
HDL	Pearson correlation	−0.127	−.048
	Sig. (two-tailed)	0.161	0.594
LDL	Pearson correlation	0.549**	0.541**
	Sig. (two-tailed)	0.000	0.000
VLDL	Pearson correlation	0.432**	0.297**
	Sig. (two-tailed)	0.000	0.001
Triglycerides	Pearson correlation	0.653**	0.578**
	Sig. (two-tailed)	0.000	0.000

*Correlation is significant at the 0.05 level (two-tailed)
**Correlation is significant at the 0.01 level (two-tailed)

Table 4: Correlation of age, HbA1c, and hemoglobin with duration of diabetes

Parameter	Statistical test	Duration
HbA1c	Pearson correlation	0.558*
	Sig. (two-tailed)	0.000
Age	Pearson correlation	0.582*
	Sig. (two-tailed)	0.000
Hemoglobin	Pearson correlation	0.060
	Sig. (two-tailed)	0.505

*Correlation is significant at the 0.01 level (two-tailed)

lipid profile parameters with T2DM duration.[11] Two other studies done by Mangesh Nanaware et al. and Moss et al. showed similar results.[12,13]

An earlier study done in Nepalese population showed a positive correlation of lipid profile parameters with HbA1c levels and time span of T2DM. Other variables like serum hemoglobin with time span of T2DM and age of the patient also show significant positive results.[14]

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.[15]

Mahajan et al. 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.[16] A cross-sectional study conducted in Bangladesh showed significant association of lipid profile parameters with HbA1c levels, in patients with T2DM. They concluded that HbA1c can be used as a better tool for predicting the incidence and prevalence of dyslipidemia in patients with T2DM.[17]

Further a study conducted by Anand et al. 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.[18]

A study from north eastern population investigated the lipid profile and its correlation with HbA1c levels in incidence of myocardial infarction, which concluded that 60% patients with myocardial infarction had poor glycemic control and also found that the serum HbA1c level has direct relationship with the serum lipid profile and also identified its indirect association with levels of HDL cholesterol.[19] A similar study from Chidambaram, Tamil Nadu, showed HbA1c as a marker of abnormality in the lipid profile of patients with T2DM. They also revealed the raise in the level of HDL-C concentration in patients with T2DM and increase in all other lipid profile parameters in both T1DM and T2DM.[20]

CONCLUSION

Our study accomplished that HbA1c has a direct, significant correlation with total cholesterol, triglyceride, VLDL, and LDL but not with HDL among the lipid profile. Significant positive correlation of HbA1c with lipid profiles from our study results implies that HbA1c can also be used as a predictor of dyslipidemia in addition to as a glycemic control parameter for prevention of complication.

ETHICAL CLEARANCE

ACKNOWLEDGMENTS

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