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Original Research Article

Study of Glycated Haemoglobin (HbA1c) and Lipid Profile as a Predictor of Dyslipidemia in Type 2 Diabetes Mellitus

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Abstract:

Background: Dyslipidemia is a very common finding in patients with type 2 Diabetes Mellitus (DM) which strongly increases risk for the development of cardiovascular diseases. the aim of the study was to investigate the association between glycated hemoglobin (HbA1c) and the lipid profile in patients with type 2 diabetes mellitus (T2DM) at a tertiary care hospital in Kurnool.

Methods: The prospective observational case study was conducted on 120 Type 2 diabetic patients of age group more than 30 years, who visited the OPD/IPD of General Medicine affiliated diabetic center at Viswabharathi Medical College & General Hospital. Venous blood samples were collected from all subjects for fasting plasma glucose, Post prandial plasma glucose, HbA1c and serum lipid profile. The statistical analysis was done by SPSS.

Results: Age of the patients ranged from 30 to 90 years and more than half were older than 60 years. Among patients with uncontrolled DM, uncontrolled FBS was in 84 (70%) and uncontrolled PPBS in 69 (57.5%) patients. Their mean fasting and postprandial blood sugars were 170.87±39.42 and 229.98±54.36 mg% respectively. Among poor glycemic control patients, mean serum value of TG, LDL were statistically significantly higher and mean HDL was statistically significantly lower. Among various lipid profile, LDL cholesterol had moderate positive correlation and HDL cholesterol had moderate negative correlation with HBA1c values. Among various lipid profile in males, LDL cholesterol had moderate positive correlation whereas HDL cholesterol had moderated negative correlation. Among females, LDL had high positive correlation and HDL had high negative correlation.

Conclusion: This study confirms higher prevalence of dyslipidemia in diabetic patients than in non-diabetic patients. With the higher HbA1c, the severity of dyslipidemia increases in diabetic patients. So diabetic patients with elevated HbA1c and dyslipidemia can be considered as a very high risk group for cardiovascular diseases. Improving glycemic control can considerably reduce the risk of cardiovascular diseases up to a great extent.

Keywords: Diabetes Mellitus, Cardiovascular disease, Dyslipidemia, Glycated hemoglobin, Lipid profile.

Introduction

Diabetes Mellitus accounts for approximately 5% of annual fatalities. Epidemiological studies have shown that Type-2 diabetes mellitus (DM) is an established risk factor for cardiovascular disease (CVD), cerebrovascular accidents (CVA), and peripheral vascular diseases.[1] Diabetic dyslipidemia, which is the leading cause of micro and macro vascular complications, is characterised by an increase in plasma triglyceride (TG), low-density lipoprotein (LDL), and apolipoprotein B concentrations and a decrease in high-density lipoprotein cholesterol (HDL-C) concentrations. Dyslipidemia is a well-known and modifiable risk factor that, if detected early, can lead to the implementation of aggressive cardiovascular preventative management.[2]

In Type-2 DM, relative insulin deficiency and decreased adiponectin decrease lipoprotein lipase activity, resulting in elevated levels of low-density lipoprotein (LDL) and triglyceride and decreased levels of high-density lipoprotein (HDL). In Type-2 diabetes, qualitative defects in LDL, such as atherogenic, glycated, or oxidised LDL, further increase the risk of thermogenesis.[3,4]

DCCT established HbA1c as the gold standard for measuring glycemic control.[5] It is regarded as the gold standard marker and has demonstrated a significant correlation with the lipid profile of Type-2 diabetic patients in a number of research studies. Due to the phenotypic and genotypic differences between this region and other Asian, European, and Western regions, there are insufficient published data from our setting to determine whether a linear

or inverse linear relationship exists between HbA1c and diabetic dyslipidemia in our region. Therefore in order to determine the relationship between HbA1c (glycemic control) and serum lipid profile in Type 2 Diabetic patients at a tertiary hospital, the present study was conducted.

Material & Methods

A prospective observational case study was carried out on Type 2 diabetic patients over the age of 30 who visited the OPD/IPD of General Medicine affiliated diabetic centre at Viswabharathi Medical College & General Hospital, Kurnool.

The study was carried out after approval from the Institutional Ethics Committee and consent from the patients. The study participants were known or recently diagnosed type 2 diabetes patients, including males and females above the age of 30.

Inclusion criteria: The study included all patients over the age of 30 who had a known diagnosis or were newly diagnosed with Type 2 Diabetes mellitus according to American Diabetic Association (ADA) criteria [6] and were willing to participate.

Patients with type 1 diabetes, hypothyroidism, chronic renal failure, Nephrotic syndrome, familial hypercholesteremia, cholestatic jaundice, alcohol consumption, patients on lipid-lowering drugs for other indications, beta blockers or thiazide diuretics, paraneoplastic syndrome, anaemic patients, and obese patients were excluded.

Data collection procedure: At the time of enrollment, all demographic, clinical, and laboratory characteristics such as age, gender, diabetes, height, weight, blood sugar fasting and postprandial levels, and various lipid profiles were gathered using a pre-designed questionnaire and a guided interview. The Clinical Biochemistry Laboratory measured all of the research parameters.

Blood Collection: An 8 ml intravenous fasting blood sample was taken in sterile EDTA (3ml) and plain (5ml) vials. The serum was separated after allowing the venous blood sample to clot at room temperature in a simple test tube. About 5 ml of Serum was used for investigations on the same day, with the remainder of the sample preserved at -20o C.

Fasting blood sugar was labelled following an eight-hour fast and postprandial blood sugar was measured two hours after food consumption. The Glucose Oxidase-Peroxidase (GOD-POD) enzymatic technique and the Nycocard Reader were used to determine Glycated Haemoglobin (HbA1c) and measure fasting blood.

Serum lipids (triglycerides-TG, total cholesterol-TC, and high-density lipoprotein cholesterol-HDL-C) were measured directly using an enzymatic kit method and the value of LDL-C was estimated using Friedewald's formula. All of these parameters were measured using a fully automated chemistry analyser (Mindray Fully automated Chemistry analyser BS-240) and ready-to-use reagent kits, as directed by the manufacturer.

According to ADA standards, glycemic status was classified into two groups: Good Glycemic Control (GGC) if HbA1c was 7.0% and Poor Glycemic Control (PGC) if HbA1c was 7.0%. [6]

Quality control:

Commercial quality control was obtained from M/s Bio-Rad laboratories and processed alongside the case study group and control individuals. The record of the same is kept.

Statistical analysis: The Statistical Package for Social Sciences (SPSSTM) software version IBM 20.0 was used to analyse the data.

Results

In our study, there were a total of 120 patients. Age of the patients ranged from 30 to 90 years and more than half were older than 60 years. Demographic parameters are shown in Table 1. There was no statistically significant difference in age, height, weight, BMI, FBS, PPBS, and HbA1c between the two genders.

Table 1: Demographic and Clinical Data in Different Genders

Characteristics	Male Patient (n=68) Mean ± SD	Female Patient (n=52) Mean ± SD	P-Value
Age	63.77 ± 24.13	68.89 ±28.43	0.546
Body Mass Index	21.32 ± 4.07	22.23 ± 5.42	0.920
Fasting Blood Sugar	162.40 ± 36.78	168.16 ± 42.21	0.291
Postprandial Blood Sugar	252.59 ± 54.49	238.66 ± 56.91	0.123
HbA1C	8.31 ± 1.72	8.67 ± 1.92	0.387
Triglyceride(mg/dl)	171.22 ± 30.18	91.92 ± 21.28	< 0.001*
Total Cholesterol(mg/dl)	228.17 ± 32.93	158.14 ± 21.78	< 0.001*
HDL-C (mg/dl)	31.28 ± 11.32	48.29 ± 9.17	< 0.001*
LDL-C (mg/dl)	162.67 ± 15.57	71.47 ± 10.95	< 0.001*

*significance. A total of 96 (80%) patients had poor glycemic control as shown in Table 2:

Table 2: Frequency and Mean of Poor Glycemic Control Patients in Different Gender

Characteristics	N	%	Mean ± SD
HbA1c ≥ **7**%	96	80	9.05 ± 1.65
HbA1c ≥ **7(male)**	53	55.2	8.72 ± 1.66
HbA1c ≥ **7(female)**	46	44.8	9.50 ± 1.53

Among poor glycemic control patients, mean serum value of TG, LDL were statistically significantly higher and mean HDL was statistically significantly lower as shown in Table 3.

Table 3: Mean of Lipid Profiles among Good and Poor Control DM Patients

Characteristics	HBA1c		P value
	<7%	≥7%	
Total Cholesterol	284.21 ± 84.53	254.51 ± 70.74	0.322
TG	172.33 ± 12.25	225.26 ± 76.78	<0.01*
LDL	103.04 ± 23.55	162.74 ± 56.02	<0.01*
HDL	51.71 ± 3.91	44.36 ± 6.94	<0.02*

*significance. Among various lipid profile, LDL cholesterol had moderate positive correlation and HDL cholesterol had moderate negative correlation with HBA1c values as shown in Table 4.

Table 4: Correlations of Hba1c to Lipid Profile Level

		Total Cholesterol	TG	LDL	HDL
HbA1c	**Correlation (r)**	0.179	0.409	0.657	-0.675
	P-value	0.04	0.01	0.001	0.002

Among various lipid profile in males, LDL cholesterol had moderate positive correlation whereas HDL cholesterol had moderated negative correlation. Among females, LDL had high positive correlation and HDL had high negative correlation as shown in Table 5.

Table 5: Lipid Profiles Correlation between Male and Female

Variables	Male Correlation (r)	P-Value	Female Correlation (r)	P-Value
TG	0.35	0.001*	0.48	0.002*
LDL	0.63	0.02*	0.68	0.01*
HDL	-0.57	0.03*	-0.81	0.001*
TC	0.23	0.04*	0.14	0.01*

*Significance

Discussion

In this study, a positive correlation between Hba1c and dyslipidemia in type 2 diabetes was identified. In type 2 diabetic patients, glycated haemoglobin is considered both a biomarker for long-term glycemic control and a predictor of diabetic dyslipidemia. Lipid abnormalities are prevalent in patients with type II diabetes.

Diabetes is more susceptible to cardiovascular diseases and other complications of atherosclerosis due to dyslipidemia. Hyperglycemia, which is a persistent increase in blood glucose levels, causes glycosylation of all proteins, particularly collagen cross-linking and matrix proteins of arterial wall. This process progressively leads to dysfunctional endothelial cells, which is a factor in the development of atherosclerosis (37 7,38 8,39 9). The main cause of diabetic dyslipidemia is the increased release of free fatty acids from adipose cells with insulin resistance (40 10, 41 110). Increased influx of free fatty acids into the liver in the presence of adequate glycogen storage stimulates triglyceride synthesis, which in turn stimulates the secretion of VLDL, apolipoprotein B, and cholesterol.

Thus, a decrease in insulin's ability to bind to free fatty acids causes an increase in the production of hepatic VLDL cholesterol, which in turn increases hepatic fat accumulation [37 7,42 12]. Patients with type 2 diabetes are at a high risk for cardiovascular disease due to diabetes and hyperglycemia. Therefore, strict glycemic control may enhance the lipid profile of diabetic patients and reduce their risk of cardiovascular disease. The average age of type 2 DM patients was 63.7 years for men and 68.8 years for women. Hussain et al.[3] found that the mean age of men was 59.7years and that of women was 55.9 years. Another study by Baranwal et al.[4] with nearly the same number of participants as ours depicted the mean age of male and female patients to be 52.7 and 51.8 years, respectively, indicating that our hospital saw a greater proportion of geriatric type 2 DM patients.

The presence of various risk factors, changes in lifestyle, inadequate dietary intake, and lack of physical activity may explain these observed differences.[9 13,10 14,11 15] With this understanding, an intervention to prevent or reduce these hazardous behaviours is necessary and warranted. Eighty percent (n=96) of our patients had inadequate glycemic control. Patients with impaired glycemic control were predominantly male, with a mean HbA1c of 9.05 (Table 2) (Table 2).

This result was corroborated by a number of other studies, although many of these studies contradicted gender preponderance. [4,5,] More than 80% of patients had elevated TC, TG, and low HDL. Likewise, 44.2% had elevated LDL levels. Several studies also supported these findings.[2,5] Poor glycemic control was associated with an increase in mean TG, LDL, and a decrease in HDL levels compared to good glycemic control. Alzahrani et al.'s study revealed partial agreement with ours, wherein the high Hba1c group had elevated TG levels. [16] We also investigated the relationship between HbA1c and various lipid parameters.

HbA1c demonstrated a significant positive correlation with TG (r=0.418, p0.01) and LDL (r=0.64, p0.01), as well as a significant negative correlation with HDL (r=-0.683, p0.01). We found a significant positive correlation between HbA1c and TC, LDL, and TG, as well as a significant negative correlation between HbA1c and HDL. Regarding the metabolic effect of hyperglycemia and insulin deficiency on various lipid parameters, these findings are legitimate.

Various studies conducted by numerous authors have produced contradictory results regarding the correlation between HbA1c and various lipid profile components.[2,4,5,6 These contradictory results can be attributed to differences in lifestyle, genetic and environmental factors.[16,17,18] In order to improve or control diabetic dyslipidemia, it is necessary to take steps to modify a sedentary lifestyle, promote a healthy diet, reduce body weight, and engage in regular physical activity.[19,20,21]

Conclusion

This study confirms that diabetic patients have a higher prevalence of dyslipidemia than non-diabetic patients. In diabetic patients, the severity of dyslipidemia increases as HbA1c levels rise.

Therefore, diabetic patients with elevated HbA1c and dyslipidemia are a group with a very high risk for cardiovascular disease. Improving glycemic control can reduce the risk of cardiovascular disease by a substantial amount.

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