ORIGINAL RESEARCH

Correlation between glycosylated hemoglobin and dyslipidemia in type 2 diabetes mellitus patients

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ABSTRACT

Background: Diabetic patients with concomitant dyslipidemia are often soft targets for cardiovascular disease and deaths. An early intervention to normalize circulating lipids has been shown to reduce cardiovascular morbidity and mortality. Hence, this study aimed to determine the relationship between dyslipidemia and glycemic status in patients with type 2 DM (T2DM) patients.**Material and Methods:** This was a cross-sectional and prospective study was carried out at Tertiary Care Teaching Hospital over a period of 01 year. Total of 70 T2DM patients with dyslipidemia enrolled in this study. Fasting blood glucose (FBG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triglyceride (TG) and glycosylated hemoglobin (HbA1c) levels were evaluated. Test of significance was calculated by unpaired Student's 'test. Correlation studies (Pearson's correlation) were performed between glycosylated hemoglobin (HbA1c) and serum lipid profile.**Results:** Distribution of Glucose Triad results of FBS, PPBS and HbA1c levels of patients presented as Mean± SD, mean FBS was 173.59±39.64, mean PPBS was CBYU 234.59±94.59 and mean HbA1c was 7.78±0.83. Mean total cholesterol was 226.53 ± 19.53, mean total triglyceride was 213.83 ± 20.65, Mean HDL was 35.63 ± 3.96, mean LDL was 148.14 ± 7.63 and VLDL was 42.76 ± 3.69. HbA1c positively and significantly correlated with total cholesterol (r=0.213), LDL (r=0.304), HbA1c negatively and significantly correlated with HDL (r=-0.128), and did not show any show correlation with VLDL (r=0.049) and total triglycerides (r=0.049).**Conclusion:** The study indicates the usefulness of HbA1c as a marker for lipid profile for screening of diabetic patients at high risk of developing cardiovascular diseases.

Key words: Type 2 diabetes, glycosylated hemoglobin, dyslipidemia

INTRODUCTION

Diabetes mellitus (DM), a public health major concern, is a metabolic disorder due to failure of the pancreas to secrete insulin, insulin malfunction or both. This is mainly related to chronic uncontrolled T2DM associated with atherosclerosis, diabetic nephropathy, neuropathy and retinopathy [1]. Diabetes mellitus is emerging as a global endemic both in developing and developed countries. It is characterized by metabolic abnormalities and long-term micro and macro vascular complications. There is a high risk of CAD in people with type 2 diabetes. Individuals with coexisting diabetes and metabolic syndrome have a high prevalence of CAD [2].HbA1c was established as the gold standard of glycaemic control in the Diabetes Complications and Control Trial (DCCT). According to the American Diabetes Association (ADA) Guidelines on diabetes, HbA1c level less than 6.5% can reduce the risk of micro vascular and macro vascular complications [3]. It also can be used to predict the risk for diabetic complications, such as dyslipidemia and cardiovascular disease (CVD). ADA estimated that the risk of diabetes related mortality increased 25%

for each 1% increase in HbA1c [4]. Dyslipidemia in DM is characterized by high triglyceride and decreased high density lipoprotein cholesterol (HDL) levels. Indians are known to have relatively lower levels of lipids and lipoproteins, raised TG and low HDL Cholesterol and presence of metabolic syndrome explaining more than half of the excess burden of CAD [5]. According to NCEPATP III guideline, hypercholesterolemia is defined as total cholesterol > 200 mg/dl, high LDL cholesterol when value > 100 mg/dl, hypertriglyceridemia as triglyceride > 150 mg/dl and low HDL cholesterol when value < 40 mg/dl. Dyslipidemia was defined by presence of one or more than one abnormal serum lipid concentration from above [6]. Characteristic abnormalities in lipids in type 2 diabetes mellitus include elevated triglycerides levels, decreased atheroprotective high density lipoprotein cholesterol levels and increased levels of small dense LDL-cholesterol [7]. Previous studies have reported an association between HbA1c and various circulating lipid parameters [8]. This indicates that in addition to glycaemic control, HbA1c can be used as a potential biomarker for predicting dyslipidemia in patients with T2DM.

MATERIALS AND METHODS

This prospective study was carried out at a Tertiary Care Teaching Hospital over a period of one year. A total of 70 T2DM patients with dyslipidemia who had visited the hospital.

INCLUSION CRITERIA

- Adults aged above 30 years and having Type 2 Diabetes Mellitus with dyslipidemia.

EXCLUSION CRITERIA

- Patients age< 30 years.
- Patients taking multivitamin supplementation, or treated with lipid-lowering drugs.
- Patient having hepatic, renal or metabolic bone disorders, including parathyroid-related problems
- Patients with history of hemoglobinopathies were excluded from the study.

Overnight fasting venous blood samples were collected from the patients and analysis were done according to standardized protocol and equipment. They were separated into two samples: the first sample containing whole blood for the measurement of HbA1c and the other plasma specimen was used for fasting blood glucose (FBG) and lipid profile levels. LDL-cholesterol was measured according to Friedewald formula [9]. LDL was calculated as follows: LDL = TC-HDL-TG/5; very low-density lipoprotein (VLDL) cholesterol was calculated as follows: TG/5. Statistical Analysis: The data was analysed with SPSS version 25.0. The mean, SD and correlation (Pearson's) test was used to interpret the results. Correlation coefficient (r) $\geq +1$ is taken as positive correlation, ≤ -1 is taken as negative correlation and between -1 and $+1$ as no correlation. Correlation (Pearson's) test was used to interpret the result. RESULTS In our study, among 70 Type 2 diabetic individuals included in this study, 41 were male and 29 were female.

Table 1: Sex Distribution of study population.

	Total	Males	Females
No. of patients	70	41	29
Percentage	100	58.5	41.4
Chi-Square test p=value	0.573		

Table 2: Distribution of Glucose Triad.

Parameters	Mean ± SD
FBS	173.59±39.64
PPBS	234.59±94.59
HbA1C	7.78±0.83

In table 2, distribution of Glucose Triad results of FBS, PPBS and HbA1c levels of patients presented as Mean±SD, mean FBS was 173.59±39.64, mean PPBS was 234.59±94.59 and mean HbA1c was 7.78±0.83.

Table 3: Distribution of Lipid Profile and HbA1c.

Parameters	Mean ± SD
Total cholesterol	226.53 ± 19.53
Triglycerides	213.83 ± 20.65
Mean HDL	35.63 ± 3.96
Mean LDL	148.14 ± 7.63
Mean VLDL	42.76 ± 3.69

In table 3, Mean total cholesterol was 226.53 ± 19.53, mean total triglyceride was 213.83 ± 20.65, Mean HDL was 35.63 ± 3.96, mean LDL was 148.14 ± 7.63 and VLDL was 42.76 ± 3.69.

Table 4: Correlation of biochemical parameters of type 2 diabetes mellitus patients with glycosylated hemoglobin

Parameters	Glycosylated Hemoglobin (HbA1c)		p-value
	<7 (n=29)	≥7 (41)	
FBS	171.58±41.14	197.30±44.61	0.001
Total cholesterol	179.32 ± 11.59	181.24 ± 11.54	0.032
Triglycerides	176.43 ± 12.43	208.15 ± 13.43	0.002
Mean HDL	34.52 ± 3.86	31.54 ± 3.58	0.042
Mean LDL	109.51 ± 9.52	108.07 ± 8.31	0.069

Table 5: Correlation analysis between serum Lipid profile and HbA1c.

Parameters	Correlation coefficient (r)	p-value
Total cholesterol-HbA1c	0.213	0.021
Triglyceride-HbA1c	0.036	0.382
HDL-HbA1c	-0.128	0.045
LDL-HbA1c	0.304	0.051
VLDL-HbA1c	0.049	0.624

In our study table 4, HbA1c positively and significantly correlated with total cholesterol (r=0.213), LDL (r=0.304), HbA1c negatively and significantly correlated with HDL (r= -0.128), and did not show any show correlation with VLDL (r=0.049) and total triglycerides (r=0.049).

Discussion

The incidence of type 2 diabetes has rapidly increased over recent decades and become one of leading public health problems in India. Lipid abnormalities are common in diabetics and frequently seen in type-2 diabetics [9]. This is partly because all the major risk factors for heart failure can present in patients with type 2 diabetes such as dyslipidemia, obesity, hypertension, advanced age, sleep apnoea, anemia, chronic kidney diseaseand coronary heart diseases. Hyperglycaemia is a risk factor for heart failure in persons with type 2 diabetes. Excess body weight, is also a major risk factor for cardiovascular disease[10].In present study, diabetic patients with dyslipidemia (n = 70). Severity of dyslipidemia was higher in patients with increased levels of Glycated hemoglobin (HbA1c >7%). The similar findings by Habiba NM *et al.* [11] and from different Indian states. Nanaware M *et al.* also reported significant correlations between all components of the lipid profile and glycosylated haemoglobin[12]. Maharjan *et al.* reported significant correlations between glycosylated hemoglobin and TG, TC, LDL and FBS and non-significant correlation with HDL [13]. Babik *et al.* also reported correlations of HbA1c with LDL [14].Ju*et al.* [15] reported highly significant correlations between HbA1c and FBS, similar to our study; however, Devkar *et al.* [18] also reported correlations with TC, TGand LDL, similar to our observations. The actual pathogenesis of diabetic dyslipidemia evidences suggest that insulin resistance has a central role in the development of diabetic dyslipidemia. The main cause of diabetic dyslipidemia is the increased free fatty-acid release from insulin-resistant fat cells [19]. The increased flux of free fatty acids into the liver in the presence of adequate glycogen stores promotes triglyceride production, which in turn stimulates the secretion of apolipoprotein B and VLDL cholesterol. The impaired ability of insulin to inhibit free fatty-acid release leads to enhanced hepatic VLDL cholesterol production which correlates with the degree of hepatic fat accumulation. Hyperinsulinemia is also associated with low HDL cholesterol levels [20].Normally, dyslipidemia is characterized by elevated levels of lipid profile components, including TG, TC, LDL and VLDL excepting HDL, which follows the reverse trend[21]. Our lipid profile results in diabetics with hypertension completely matched those of dyslipidemics. The levels of all the lipid profile components are above the desirable levels for diabetics with hypertension, showing the progression of the spread of the harmful effects of diabetes to various body parts. The significant difference in the populations observed for the lipid profile of our sample populations was in accordance with the results of diabetics in studies by Sultania *et al.* [22].The Diabetes complications and control trial (DCCT) carried out by National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), USA, established that, HbA1c is the gold standard of glycemic control. The level of HbA1c value ≤7.0% was said to be appropriate for reducing the risk of cardiovascular complications [25]. It is shown that HbA1c was found to have positive correlation with total cholesterol, LDL cholesterol and triglycerides in diabetic patients [23]. The present study had a few limitations, including having too small of a sample size and the fact that patients' dietary habits, lifestyle patterns, time since diagnosis with DM and duration of regular physical activity were undetermined.

Conclusions

Our study accomplished that HbA1c has a direct,significant correlation with total cholesterol, triglyceride, VLDL and LDL 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.

Conflicts of interest: None.

Source of funding: None.

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