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Original Research Article

Correlation between Glycosylated Hemoglobin (HbA1c) and Serum Lipid Profile in Patients with Type 2 Diabetes: A Cross Sectional Study

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ABSTRACT

Background: Diabetes Mellitus (DM) is a long-term metabolic condition. Even within the normal range of HbA1c, non-diabetic cases have shown a positive connection between HbA1c and CVD. This study aimed to evaluate the relationship between glycemic control (HbA1c) and serum lipid profile.

Materials and Methods: Between April 2020 and August 2020, a cross-sectional study was carried out on 100 T2DM patients who visited OPD (Diabetes clinic) at the rural health training center of RCSM, GMC in Kolhapur, Maharashtra, India. Fasting blood sugar (FBS), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), triglycerides (TGs), LDL and HbA1c were all measured by the American Diabetes Association's criteria to define DM. The assays were performed according to the manufacturers' instructions.

Results: The mean age of the cases was 56.67 ± 5.67 years with male preponderance. The mean duration of diabetes in the present study was 6.72 ± 4.56. We found a significant positive correlation between total cholesterol levels and HbA1c in the present study. ($r=0.555$; p value<0.001) Other parameters were having positive correlation with Hba1c but not a significant one. ($p>0.05$).

Conclusion: In the current investigation, there was a significant association between Hb1Ac and total cholesterol levels. HbA1c can predict dyslipidemia in addition to a valid glycemic index, and early identification of dyslipidemia can be used to stop the progression of CVD in people with T2DM.

Keywords: Type 2 Diabetes Mellitus, Glycosylated Hemoglobin (HbA1C), Serum Lipid Profile, Correlation

INTRODUCTION

Diabetes Mellitus (DM) is a long-term metabolic condition brought on by a complex interplay of genetic, environmental, and dietary variables.[1] Changes in behavior, such as an unhealthy diet, physical inactivity, being overweight, obesity, and tobacco use, contribute to morbidity and mortality from DM.[2] With over 62 million people in India already suffering from diabetes, it is quickly becoming a possible epidemic.[3] In terms of the possible burden that diabetes might place on India, the future is now undetermined. The frequency of disease varies significantly across a nation, and it is essential to identify these impacts to promote change while dealing with health issues.[4,5]

As a metabolic disorder with long-term effects on numerous bodily systems, DM is one of the leading causes of worldwide morbidity.[6] One disease category on the spectrum is cardiovascular disease (CVD), and DM's altered lipid metabolism facilitates atherosclerosis. Comparatively to those who do not have DM, this considerably raises the risk of CVD.[7] People with Type 2 Diabetes mellitus (T2DM) are more likely to have CVD, the leading cause of death in this population.[7,8]

DM increases the effects of other common risk factors like smoking, hypertension, and dyslipidemia. It is an independent risk factor for CVD.[8] In patients with DM, HbA1c predicts the likelihood of developing diabetic complications.

Elevated HbA1c is a CVD risk factor distinct from conventional risk variables like dyslipidemia.[8] According to estimates, the risk of cardiovascular disease (CVD) increases by 18% in the diabetic population for every 1% increase in absolute HbA1c levels.[9,10] Even within the normal range of HbA1c, non-diabetic cases have shown a positive connection between HbA1c and CVD. This study aimed to evaluate the relationship between glycemic control (HbA1c) and serum lipid profile.

MATERIAL AND METHODS

Study design and location

Between April 2020 and August 2020, a cross-sectional study was carried out. The study comprised T2DM patients who visited an outpatient department (diabetes clinic) at the rural health training center of RCSM, GMC in Kolhapur, Maharashtra, India. The Institute's ethical committee gave the study procedure their permission. After outlining the study's goals, all patients provided written informed consent. The study was conducted in full compliance with the declaration of Helsinki guidelines and written in accordance with strobe guidelines for reporting a cross-sectional study.[11] Participants were assured of their confidentiality and anonymity of their identity.

Patients and Methods

A study conducted by Hussain A et al[12] reported that the Pearsons' correlation coefficient between the HbA1c and total cholesterol was 0.275. Considering this, with 95% confidence interval and 80% power we found the minimum sample size of 81. We achieved the final sample size of 100 considering an attrition rate of 10%. A total of 100 T2DM patients' venous blood samples were taken. Fasting blood sugar (FBS), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), triglycerides (TGs), and low-density lipoprotein cholesterol were all measured using the serum (LDL-C). In addition, HbA1c estimation was made. All cases were included with age group of 18-65 years in both male and female. Cases suffering from hypothyroidism, Cushing's syndrome were excluded from the study.

Patients diagnosed with the Type 2 diabetes were included whereas Type I diabetes patients were excluded from the study. In the selection of patients, patients below age of 18 years or known or suspected with pregnancy were excluded. The American Diabetes Association's criteria were used to define DM. Serum FBS was measured by GOD-POD (Glucose oxidase- Peroxidase method) method with the help of Randox RX, a fully automatic analyzer. Estimation of serum Cholesterol, serum Triglyceride & serum HDL was done by CHOD – POD (Cholesterol oxidase- Peroxidase method) method, GPO-POD Method (Glycerol-3-phosphate-peroxidase) & CHOD-POD Method respectively. LDL was calculated by Friedewald's Formula. HbA1c was measured by turbidimetric immunoassay with the help of HPLC (High performance liquid chromatography) Method. The assays were performed according to the manufacturers' instructions.

Statistical analysis plan

The data was collected, compiled, and analyzed using EPI info (version 7.2). The qualitative variables were expressed in terms of percentages. The quantitative variables were categorized and expressed in percentages or terms of mean and standard deviations percentages. The difference between the two

proportions was analyzed using the chi-square or Fisher exact test. Of the factors which were found to be significant based on univariate analysis, we did a binary logistic regression analysis using Wald's method using diabetic neuropathy as the outcome. All analysis was two-tailed, and the significance level was set at 0.05.

RESULTS

The mean age of the cases was 56.67 ± 5.67 years with male preponderance. The mean duration of diabetes in the present study was 6.72 ± 4.56. The levels of various laboratory parameters have been summarized in Table 1.

Table 1: Demographic and laboratory parameters of the sample

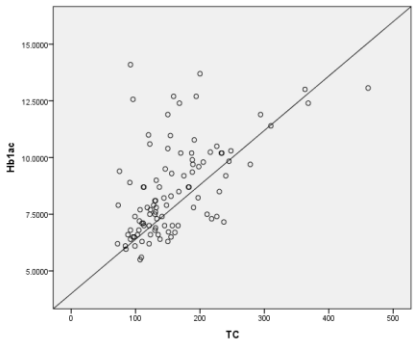
Parameter	Measure
Age (years; Mean ± SD)	56.67 ± 5.67
Gender (Male/Female; %)	54/36
Duration of diabetes (years; Mean ± SD)	6.72 ± 4.56
Total cholesterol (mg/dl; Mean ± SD)	159.25 ± 66.43
Low density lipoprotein (mg/dl; Mean ± SD)	176.63 ± 72.51
High density lipoprotein (mg/dl; Mean ± SD)	37.89 ± 7.73
Triglycerides (mg/dl; Mean ± SD)	140.67 ± 76.25
Glycosylated hemoglobin (gm%; Mean ± SD)	8.58 ± 2.05
Serum Creatinine (mg/dl; Mean ± SD)	0.80 ± 0.23
Systolic blood pressure (mmHg; Mean ± SD)	144.53 ± 8.92
Diastolic blood pressure (mmHg; Mean ± SD)	82.34 ± 5.66
Heart rate (beats per minute; Mean ± SD)	79.23 ± 4.56

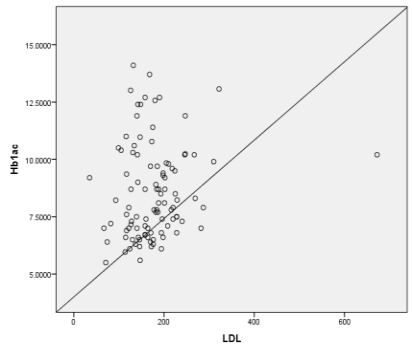
Correlation of various lipid profile parameters with HbA1c:

We found a significant positive correlation between total cholesterol levels and HbA1c in the present study. (r=0.555; p value<0.001) Other parameters were having positive correlation with Hba1c but not a significant one. (p>0.05) Scatter diagrams of the correlation have been summarized in figure 1.

Table 2: Correlation of various lipid profile parameters with HbA1c

Lipid profile	r	P value
Total cholesterol (mg/dl)	0.555	<0.001
Low density lipoprotein (mg/dl)	0.154	0.126
High density lipoprotein (mg/dl)	0.039	0.698
Triglycerides (mg/dl)	0.107	0.291





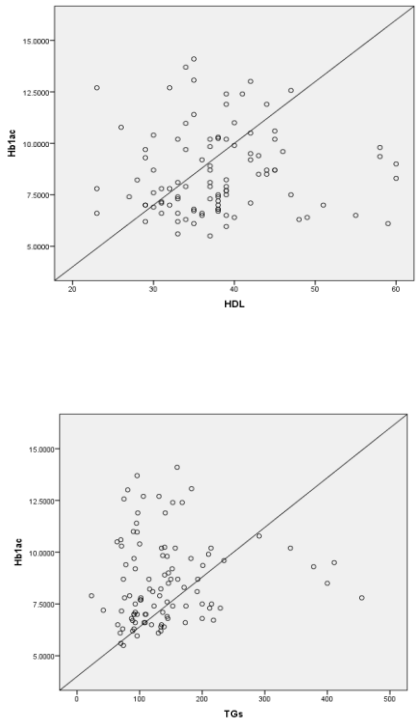


Figure 1: Scatter diagrams of total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL) and triglycerides (TGs) with Glycosylated hemoglobin (HbA1c) levels

DISCUSSION

In addition to dyslipidemia, elevated HbA1c is increasingly recognized as a separate risk factor for CVD in individuals with or without diabetes.[10] Since there is evidence of an increased release of free fatty acids from insulin-resistant fat cells, insulin resistance plays a significant role in the pathophysiology of diabetic dyslipidemia. In the presence of glycogen, the free fatty acids that enter the liver stimulate the formation of triglycerides and apolipoprotein B and VLDL cholesterol, leading to fatty liver. Similarly, low HDL levels are also linked to greater circulating insulin levels.[13,14] With this context in mind, we carried out a cross-sectional study to link the HbA1c levels with several lipid profile characteristics.

Our study indicated a significant link between the HbA1c and total cholesterol levels, but non-significant correlations were discovered with other lipid profile parameters. Begum et al.[15] showed no significant link between HbA1c value and LDL-C in diabetic patients. However, significant correlations were seen between HbA1c value and serum levels of TC, TG, and HDL-C (p0.05).

According to Alzahrani SH et al.[16], no significant link was found between HbA1c and the other indices, although there was a significant correlation with TG (r=0.16, p=0.020). According to Nnakenyi ID et al.'s conclusion, there was a positive, statistically significant connection between HbA1c and TC (r=0.406), LDL-C (r=0.409), and TG (r=0.273), with a p-value of 0.05[17]. On the other hand, HbA1c and HDL-C did not correlate well (r=-0.269, p0.05). Similar research was conducted in our environment by Naqvi et al.[18], and the results are intriguing. They demonstrate that high HbA1c (cut-off of 9%) raises the risk of hypertriglyceridemia by 2.69 (OR=1.71-4.23, p 0.001) or that poor glycemic management can increase the risk of hypertriglyceridemia by 2.69%. Hussain A. et al[12], Kidwai SS. et al.[19], Wang S. et al., and Prabhavathi K. et al.[20] all reported drawing similar conclusions.

Due to the small sample size in our investigation, additional RCTs with a large sample size are needed to support or contradict the results from our region in various situations. Therefore, to reduce cardiovascular morbidity and mortality in Type-2 diabetes patients, early intervention for screening all diabetic patients with a high HbA1c to confirm dyslipidemia and aggressive treatment strategy is advised.

CONCLUSIONS

In the current investigation, there was a significant association between Hb1Ac and total cholesterol levels. HbA1c can predict dyslipidemia in addition to a valid glycemic index, and early identification of dyslipidemia can be used to stop the progression of CVD in people with T2DM.

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