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ORIGINAL RESEARCH

Correlation Between Hemoglobin A1c and Serum Lipid Profile in Afghani Patients with Type 2 Diabetes: Hemoglobin A1c Prognosticates Dyslipidemia

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ABSTRACT

Background:Patients with type 2 diabetes (T2DM) have an increased prevalence of dyslipidemia, which contributes to their high risk of cardiovascular diseases (CVDs). This study is an attempt to determine the correlation between hemoglobin A1c (HbA1c) and serum lipid profile and to evaluate the importance of HbA1c as an indicator of dyslipidemia with T2DM.

Materials and Methods: This is a prospective and observational study was accomplished at Tertiary care teaching Hospital over a period of 6 months. Patients of either gender with an established diagnosis of T2DM were selected according to the American Diabetes Association criteria (ADA). These criteria set the following as values that are indicative of T2DM: HbA1C ≥6.5%, FPG ≥126 mg/dl, 2-h plasma glucose ≥200 mg/dl during an oral glucose tolerance test (OGTT), or random plasma glucose ≥200 mg/dl.

Results: Blood glucose level was 149.35 ± 13.23 mg/dl and mean HbA1c was 7.96±1.46. Mean total cholesterol was 179.53±16.36, mean total triglyceride was 183.74±17.64, mean LDL was 105.85±8.50, Mean HDL was 36.94±4.28. HbA1c positively and significantly correlated with total cholesterol (r=0.091), LDL (r=0.013), HbA1c negatively and significantly correlated with HDL (r= - 0.126), and did not show any show correlation with VLDL (r=0.024) and total triglycerides (r=0.103).

Conclusion: 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.

Keywords: Diabetes mellitus, Dyslipidemia, HbA1c, Serum lipids Profile,

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder that occurs as a result of a complex inter-action of genetic, environmental factors, and life-style choices. Morbidity and mortality due to DM are increasing because of changes in behavior such as an unhealthy diet, physical inactivity, being overweight, obesity and tobacco use.[1]

T2DM is a rapidly growing public health problem worldwide, with a significant impact on health, quality of life and the healthcare system of the countries. According to current statistics from the International Diabetes Federation (IDF), 415 million adults have DM worldwide; this figure is expected to reach the 642 million marks by 2040, which means every 11th individual will be diagnosed as having T2DM.[2] The proportion of people with T2DM is increasing in most countries.[3] Nearly 80% of people with the disease live in low- and middle-income countries.[4-6]

Annually, 5% of all deaths globally are related to DM and its complications.[7] DM was responsible for 342,000 deaths in 2015 in this part of the world.[8] Over half (51.3%) of all deaths from DM in the region occurred in people under 60 years of age. These early deaths may be the result of a combination of factors: the rapidly changing environments and lifestyles in the region, late diagnoses, and healthcare systems that are not equipped to provide optimal management of the increasing numbers of people with DM.[9]

DM is a metabolic disorder that has a long-term impact on different body systems, contributing to the huge burden of morbidity associated with it. Cardiovascular disease (CVD) is one group among the spectrum of diseases; altered lipid metabolism in DM contributes to atherosclerosis-sis.[10] This greatly increases the risk of CVD com-pared with people without DM. The prevalence of CVD is higher in people with T2DM and is also the top killer in this population.[11] DM is an independent risk factor for CVD and it potentiates the effects of other common risk factors such as smoking, hypertension and dyslipidemia.[12]

HbA1c predicts the risk of developing diabetic complications in patients with DM. Apart from classical risk factors like dyslipidemia, elevated HbA1c is an independent risk factor for CVD. It is estimated that there is an 18% increased risk of CVD for each 1% rise in absolute HbA1c levels in the diabetic population. This positive correlation between HbA1c and CVD has been demonstrated in nondiabetic cases, even within the normal range of HbA1c.[13]

The aim of this study was to assess the relationship between glycemic control (HbA1c) and serum lipid profile as well as to evaluate the importance of HbA1c as an indicator of dyslipidemia in patients with T2DM.

MATERIALS & METHODS

This is a prospective and observational study was accomplished at Tertiary care teaching Hospital over a period of 6 months.

Inclusion criteria

Patients of either gender with an established diagnosis of T2DM were selected according to the American Diabetes Association criteria (ADA). These criteria set the following as values that are indicative of T2DM: HbA1C ≥6.5%, FPG ≥126 mg/dl, 2-h plasma glucose ≥200 mg/dl during an oral glucose tolerance test (OGTT), or random plasma glucose ≥200 mg/dl.[14]

Exclusion criteria

Patients suffering from CVD, thyroid disorders, renal problems and other endocrinopathies and those taking lipid-lowering agents were excluded from the study, as was one patient who had type 1 diabetes.

There were 50 patients who met our eligibility criteria, and their histories and examination data regarding their T2DM presenting symptoms, complications, treatment modalities, smoking and social drugs consumption and any other addictions were noted. Biochemical data such as FPG, HbA1c, and lipid profile were also taken.
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 all DM patients, blood samples were collected between 8:00 and 10:00 AM (12–14 h fasting), and plasma was used for estimating the glucose level. The FPG, and HbA1c and lipid profile levels were determined by using an auto analyser. For analysis, we characterized the participants' glycaemic control as poor (HbA1c >7%) or good (HbA1c <7%).[15]

Statistical analysis
SPSS version 25 was employed to compute the data. Therefore, the Student's t-test was used for comparison, and quantitative data were stated as the mean and standard deviation. The Pearson correlation coefficient was applied to measure the correlation between various parameters, and an independent sample t-test was utilized to measure the mean difference between different parameters. A linear regression test was computed to find out the association between HbA1c and lipid profile, FPG, BMI and age; the results were regarded as non-significant when the p-value was >0.050.

RESULTS
In our study, among 90 Type 2 diabetic individuals included in this study, 56 were male and 36 were female.

Table 1: Gender Distribution of study population

	Total	**Males**	**Females**
No. of patients	90	56	36
Percentage	100	62.2	37.8
Chi-Square test p=value	0.259		

Table 2: Base-line characteristics of the study subjects.

	Males	**Females**	**p-value**
Age	65.73±7.43	59.42±6.54	<0.05
BMI	31.63±4.64	28.64±3.73	<0.05

Table 3: Distribution of Lipid Profile and Blood indices

Parameters	**Mean ± SD**
Blood Glucose (mg/dl)	149.35 ± 13.23
HbA1c (%)	7.96 ± 1.46
Total cholesterol (mg/dl)	179.53 ± 16.36
Triglycerides (mg/dl)	183.74 ± 17.64
HDL (mg/dl)	36.94 ± 4.28
LDL (mg/dl)	105.85± 8.50
VLDL (mg/dl)	36.74±3.58

In [Table 3], Blood glucose level was 149.35 ± 13.23 mg/dl and mean HbA1c was 7.96±1.46. Mean total cholesterol was 179.53±16.36, mean total triglyceride was 183.74±17.64, mean LDL was 105.85±8.50, Mean HDL was 36.94±4.28.

Table 4: Correlation analysis between serum Lipid profile and HbA1c.

Parameters	Pearson Correlation (r)
Total cholesterol-HbA1c	0.091
Triglyceride-HbA1c	0.103
HDL-HbA1c	- 0.126
LDL-HbA1c	0.013
VLDL-HbA1c	0.024

In our study table 4, HbA1c positively and significantly correlated with total cholesterol (r=0.091), LDL (r=0.013), HbA1c negatively and significantly correlated with HDL (r= -0.126), and did not show any show correlation with VLDL (r=0.024) and total triglycerides (r=0.103).

DISCUSSION

In the present study, we have evaluated the pattern of lipid profile parameters in diabetic subjects and its correlation with HbA1c. This study demonstrates the typical dyslipidemia in diabetics characterized by high triglyceride, low HDL. Although there was no significant difference between male and female, the levels of TC and LDL were significantly higher in female as compared to male Type 2 diabetic patients. This finding is in agreement with the previous studies.[16]

Hyperlipidemia in females may be attributed to the effects of sex hormones on body fat distribution, which leads to differences in altered lipoproteins.[17] Another reason includes differences in coagulation, the pattern of obesity between men and women, and possible role for hyperinsulinemia.[18] In our study reveals high prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL and low HDL levels which are well known risk factors for CVD and abnormality of cholesterol metabolism may lead to heart attacks. Insulin affects the liver apolipoprotein production. It regulates the enzymatic activity of lipoprotein lipase and Cholesterol ester transport protein. All these factors are likely cause of dyslipidemia in Diabetes mellitus.[19]

Moreover, insulin deficiency reduces the activity of hepatic lipase and several steps in the production of biologically active lipoprotein lipase may be altered in DM.[20] The main disorder in lipid metabolism was hypertriglyceridemia in our study. This finding is in concord with our previous study. In the study of Mahato RV et al,[21] 54% diabetic individuals had elevated LDL and > 50% individuals had increased TG. These findings are similar to our study. But in contrast to our present study, they reported low HDL in 73% individuals. In our study, a highly significant correlation between HbA1c and Lipid profile which is similar with various previous studies.[22]

We also observed significant correlations between HbA1c and TC, LDL and HDL. In various studies, HbA1c level was eminent as showing positive correlation with TC, LDL and TG in diabetic patients.[23] HDL was shown to be the stronger predictor of CVD in diabetic population by 'The Strong Heart Study' (data evaluated by Liu et al), with hazard ratios of 2.23 and 1.80 respectively in male and female.[24] This study showed that increasing HDL cholesterol concentrations had significant, curvilinear relationships with CVD and CHD risk. Moreover, NCEP ATPIII has recommended using HDL cholesterol in assessing CVD risk in patients with diabetes. The measurement of HDL is simple which can be conducted even in non-fasting state of patients and can be determined regardless of TG concentration. Hence, HDL cholesterol can be of great value in determining dyslipidemia in diabetic subjects.[25,26]

Significant association of HbA1c with various lipid parameters such as TC, HDL, and LDL in present study suggests the importance of glycemic control in order to control dyslipidemia. According to, Diabetes complications and control trial (DCCT) established HbA1c as 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.[27] In the present study, we divided diabetic patients into 2 groups as per the HbA1c cutoff of 7.0%. The diabetic patients with HbA1c value > 7.0% exhibited a significant increase in TC, TG, LDL, VLDL and without any significant alteration in HDL in comparison to patients with HbA1c value ≤7.0%.

According to Sultania HA et al showed the impact of glycemic control on various lipid parameters in which the diabetic patients were categorized into 3 groups according to their HbA1c levels: group 1, good glycemic control (HbA1c 6%–9%) and group 3, worst glycemic control (HbA1c>9%). Poor and worst glycemic control is considered as risk factor for complications in diabetes. Strict glycemic control lowers the risk of micro- and macrovascular complications of diabetes mellitus.[28] Severity of dyslipidemia increases in patients with higher HbA1c value. As elevated HbA1c and dyslipidemia are independent risk factors of CVD, diabetic patients with elevated HbA1c and dyslipidemia can be considered as a very high-risk group for CVD. Improving glycemic control can substantially reduce the risk of cardiovascular events in diabetics.[29]

The strength of the study is that we had the complete biochemical data of the patients and we computed a comparison, a correlation and a regression analysis. The present study had a few limitations, including being a retrospective study as well as 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. The patients included in our study were all taking different antidiabetic medications. However, we could not analyze the data according to the treatment modalities, and it is possible that such a patient grouping would have some impact on the study results. We have not tested the effect of glycemic control on various lipid ratios as study of these ratios have proven to be useful as markers for insulin resistance and CVD risk in T2D patients.

CONCLUSION

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.

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