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Study of Glycated Hemoglobin and Lipid Profile in Normotensive Type 2 Diabetic Patients

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Abstract

A cross-sectional study was conducted in the outpatient departments (OPD) of Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, between January and June of 2022, to evaluate the diagnostic value of glycated hemoglobin (HbA1c) in predicting diabetic dyslipidemia. A total of 206 normotensive type 2 Diabetes Mellitus patients were selected for the study (141 females and 65 males) and the data were collected through interview in our hospital. Patients' blood samples were sent for biochemical tests: HbA1c, fasting blood glucose (FBG) and lipid profile. Dyslipidemia was defined according to the National Cholesterol Education Programme (NCEP) Adult Treatment Panel (ATP) III guidelines. The mean age of male and female patients was 64.66±10.99 and 58.53±14.19 years respectively ($p<0.001$), while BMI was observed 29.08±4.58 and 31.59±6.56 kg/m^2 respectively ($p<0.05$). The mean values of HbA1c and FBG were found slightly higher in females ($p>0.05$). In lipid profile, the mean values of total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-C) were significantly higher in females ($p<0.05$). Besides, the mean levels of triglycerides (TG) were observed slightly lower and high-density lipoprotein-cholesterol (HDL-C) slightly higher in females ($p>0.05$). HbA1c demonstrated significant correlations with FBG, TC, TG, LDL-C, LDL-C/HDL-C ratio and risk ratio i.e., TC/HDL-C, as compared to the patients with HbA1c value ≤7.0%, as patients with HbA1c value>7.0% had significantly higher values compared to the patients with HbAlc≤7.0% ($p<0.05$). However, we found no difference in values of HDL-C between two groups ($p>0.05$). HbA1c can be utilized as a potential biomarker for anticipating dyslipidemia in type 2 diabetic patients in addition to ensuring glycemic control.

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Introduction

Diabetes mellitus (DM) is a group of metabolic disease described by hyperglycemia resulted because of deformities in insulin discharge, insulin activity, or both. Diabetes causes around 5% of all passing globally every year. The persistent hyperglycemia of diabetes is related with long-term damage, dysfunction, and failure of various organs, particularly the eyes, kidneys, nerves, heart, and blood vessels. 50% of individuals with diabetes die of cardiovascular

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disease (fundamentally coronary illness and stroke).[1,2] Diabetic patients with accompanied dyslipidemia (but frequently unnoticed) are easy targets of cardiovascular deaths. Patients with type 2 diabetes frequently show an atherogenic lipid profile, which enormously builds their risk of CVD contrasted and individuals without diabetes. An early mediation to standardize coursing lipids has been displayed to reduce cardiovascular complexities and mortality.[3,4]

Type 2 diabetes mellitus (T2DM) patients are inclined to diabetic dyslipidemia, which seriously endangers them of creating macrovascular (stroke, peripheral vascular infection and coronary artery disease) and microvascular (nephropathy, neuropathy and retinopathy) diseases.[3-5] For T2DM patients, one of the most widely recognized difficulties connected with uncontrolled hyperglycemia is dyslipidemia.[5,6] Glycated hemoglobin (HbA1c) levels are regularly estimated in diabetics to screen their glycemic contro.[1,5] The target is to accomplish a level below 7%. Levels of HbA1c can be impacted by numerous variables, including sugar admission, exercise and adherence to medications and follow ups. Research revealed that HbA1c might actually be used as a potential biomarker for predicting dyslipidemia and cardiovascular illness (CVD).[7,8] The degree of circling HbA1c is taken as the best quality level of glycemic control, and directing it is basic for staying away from T2DM complexities.[7-9] HbA1c values reflect glycemic control as well as the primary figure deciding the risk of diabetes-related complications, and also mortality.[9,10] Hence, we proposed this study to investigate the association between HbA1c and the lipid profile in patients with T2DM in a tertiary care hospital in Mymensingh, Bangladesh.

Methods

This cross-sectional study was conducted in the outpatient departments (OPD) of Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, between January and June of 2022. A total of 206 normotensive type 2 Diabetes Mellitus patients were selected for the study (141 females and 65 males) and the data were collected through interview in our hospital (based on our inclusion and exclusion criteria). Our inclusive criteria were normotensive patients with T2DM and among them, those who agreed to participate in this study. Exclusion criteria included any pregnant women, hypertensive individuals and who had other comorbidities like cancer, coronary heart disease, heart failure, renal failure or psychiatric disease.

Patients' blood samples were sent for biochemical tests: HbA1c, fasting blood glucose (FBG) and lipid profile. HbA1c was estimated by using Ion exchange chromatography. Fasting blood glucose (FBG) and TC, TG, HDL-C were estimated using colorimetric enzymatic methods (BT1500 autoanalyzer by Coral Clinical Systems, USA). Indirect LDL-cholesterol was calculated by Friedwald formula. For lipid reference level, National Cholesterol Education Program (NCEP) Expert Panel's Adult Treatment Panel III guideline was folloed,[11] as hypercholesterolemia was defined as TC>200 mg/dl, high LDL-C when value>100 mg/dl, hypertriglyceridemia as TAG>150 mg/dl and low HDL-C when value <40 mg/dl. Dyslipidemia was defined by presence of one or more than one abnormal serum lipid concentration. Diabetes was defined by following American Diabetes Association (ADA) criteria.[12]

Data was collected through interviews and clinical assessment and recorded in a data collection sheet. All data was checked, edited and analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0 for the Windows. Independent samples t-test (2-tailed) was used to compare means of different parameters. All Values are expressed as Mean±SEM (standard error of mean). The results were considered statistically significant when $p<0.05$. Ethical clearance was taken from the Ethical Review Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh.

Results

A total of 206 normotensive type 2 diabetic patients were selected for the study (141 female and 65 male). The mean age of male and female patients was 64.66±10.99 and 58.53±14.19 years respectively ($p<0.001$), while BMI was observed 29.08±4.58 and 31.59±6.56 kg/m^2 respectively ($p<0.05$) (Table-I).

Table-I: Gender-wise comparison of age and BMI among patients

Variables	Total (N=206)	Female (N=141)	Male (N=65)	p-value
Age (years)	60.46 ±13.54	58.53 ±14.19	64.66 ±10.99	<0.001*
BMI (Kg/m²)	30.8 ±6.1	31.59 ±6.56	29.08 ±4.58	<0.05*

Data were expressed as Mean ± SD; *=Statistically significant

The mean values of HbA1c and fasting blood glucose (FBG) were found slightly higher in female compared to male patients (7.43±0.27% vs. 7.20 ± 0.10% and 158.4 ± 8.56 mg / dl vs. 149.54±5.73 mg/dl respectively); however, the differences were not statistically significant ($p>0.05$). In lipid profile, the mean values of total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-C) were significantly higher in female than that of male patients (196.66±7.25 mg/dl vs. 176.03±4.99 mg/dl and 113.79±5.57 mg/dl vs. 92.85±3.86 mg/dl respectively) ($p<0.05$). Although the mean levels of triglycerides (TG) were observed slightly lower and high-density lipoprotein-cholesterol (HDL-C) slightly higher in female than that of male patients (183.61±9.43 mg/dl vs. 191.21±8.37 mg/dl and 46.52±0.97 mg/dl vs. 45.93±0.61 mg/dl respectively), the differences were not statistically significant ($p>0.05$) (Table-II).

Table-II: Gender-wise comparison of biochemical parameters among patients

Variables	Female (N=141)	Male (N=65)	p-value
FBG	158.4±8.56	149.54±5.73	0.296
TC	196.66±7.25	176.03±4.99	0.011*
TG	183.61±9.43	191.21±8.37	0.558
HDL-C	46.52±0.97	45.93±0.61	0.593
LDL-C	113.79±5.57	92.85±3.86	0.002*
HbA1c	7.43±0.27	7.20±0.10	0.105

Data were expressed as Mean ± SEM; *=Statistically significant

Then our patients were distributed into two groups as per their glycemic index; first group consists of patients with HbA1c value ≤7.0% (n=101) and second group consists of patients with HbA1c value >7.0% (n=106). Patients with HbA1c value >7.0% had significantly higher values of FBG (175.0 ± 6.79 mg / dl vs.

123.56±3.03 mg/dl), TC (181.78±5.19 mg/dl vs.176.89±3.29 mg/dl), TG (199.36±9.07 mg/dl vs. 173.04±7.89 mg/dl), LDL-C (107.86±4.60 mg/dl vs. 91.53±4.37 mg/dl), LDL-C/HDL-C ratio (2.43±0.107 vs. 1.99±0.088) and risk ratio TC/HDL-C (4.31±0.127 vs. 3.75±0.099) as compared to the patients with HbA1c value ≤7.0% ($p<0.05$). However, no difference was observed in values of HDL-C between two groups (45.61±0.78 mg/dl vs. 46.79±0.84 mg/dl) ($p>0.05$). (Table-III).

Table-III: Biochemical parameters categorized by patients' glycemic control (HbA1c)

Variables	Glycated Hemoglobin (HbA1c)		p-value
	≤7.0 (N=82)	>7.0 (N=85)	
FBG	123.56±3.03	175.0±6.79	0.000*
TC	176.89±3.29	181.78±5.19	0.024*
TG	173.04±7.89	199.36±9.07	0.03*
HDL-C	46.79±0.84	45.61±0.78	0.322
LDL-C	91.53±4.37	107.86±4.60	0.011*
Risk ratio (TC/HDL-C)	3.75±0.099	4.31±0.127	0.001*
LDL-C/HDL-C	1.99±0.088	2.43±0.107	0.002*

Data were expressed as Mean±SEM; *=Statistically significant

Discussion

The present study evaluated the pattern of lipid profile in type 2 diabetic patients and its correlation with HbA1c. The levels of HbA1c and FBG did not differ significantly between the two groups of male and female patients. Although there were no significant difference in TG and HDL-C levels, TC and LDL-C values were significantly higher in female as compared to male type 2 diabetic patients. The findings of the study are in congruence with the findings of some other previous studies.[13-16] Hyperlipidemia in females was observed which may be due to effects of sex hormones on body fat distribution, which leads to differences in altered lipoproteins.[15,16]

A highly significant correlation between HbA1c and FBG found in our study is comparable with different previous studies.[17-19] It was noticed that huge correlations exist between HbA1c and TC, TG, LDL-C and LDL-C/HDL-C proportion and risk ratio, i.e., TC/HDL-C. In different studies, HbA1c levels showed positive correlation with TC, TG, LDL-C and risk ratios in diabetic patients.[18-21] All study findings recommend the significance of glycemic control to control dyslipidemia among type 2 diabetic patients. As raised HbA1c and dyslipidemia are free risk variables of CVD, diabetic patients with raised HbA1c and dyslipidemia can be considered as an exceptionally high-risk bunch for CVD. Improving glycemic control can significantly lessen the risk of cardiovascular occasions in diabetics.[22,23] It has been assessed that lessening the HbAlc level by 0.2% could bring down the mortality by 10%.[23] However, our study was limited in a single city which tends to limit the illustration of the overall scenario of Bangladesh.

Conclusion

Our data indicates that significant correlation between HbA1c and different circulating lipid parameters and significant distinction of lipid parameters in two groups (≤7.0% and>7.0%) of glycated hemoglobin demonstrated that HbA1c can be utilized as a potential biomarker for anticipating dyslipidemia in type 2 diabetic

patients in addition to ensuring glycemic control. Thus, early finding can be achieved through relatively inexpensive blood testing. However, for more clear identification, further research with larger samples and in different regions of the country is recommended.

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