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Original Article

Evaluation of HbA1c as A Dual Marker for Glycemic Status and Dyslipidemia in Type 2 Diabetes Mellitus

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Abstract

Patients with type 2 diabetes mellitus (T2DM) have a greater risk of development of dyslipidemia that is an important risk factor for cardiovascular disease. The aim of the study is to investigate the role of HbA1c as a dual marker for glycemic status and dyslipidemia in type 2 diabetes mellitus for early intervention to reduce cardiovascular and other complications and their mortality, conducted in the department of Biochemistry Jalalabad Ragib- Rabeya medical college and hospital, Sylhet between the period of October 2020 to September 2021. A total 290 diagnosed type 2 diabetic patients of both sexes were included in this study. Three groups were made on the basis of their glycemic status. HbA1c, triglycerides, total cholesterol, HDL-cholesterol and LDL-cholesterol were measured in all three groups. Worst glycemic group showed statistically significant higher level of triglycerides, total cholesterol and LDL-cholesterol. But HDL-cholesterol was almost same in all three groups. It is observed that there is an association between HbA1C and some lipid parameters. Thus HbA1c is not only a useful biomarker of long term glycemic status but also can be a good predictor of lipid profile.

Keywords: Diabetes Mellitus, HbA_1C, Lipid profile, Dyslipidemia

Introduction

Diabetes mellitus (DM) is a metabolic disease characterized by a state of hyperglycemia caused by defect of insulin action, insulin secretion or both (insulin resistance).[1,2] For nearly 50 years, two types of diabetes mellitus have been found.[3] Type1 diabetes mellitus triggers insulin deficiency because of auto-immune pancreatic β-cell destruction.[4] Type2 diabetes mellitus is characterized as a heterogeneous disorder where β cell make insulin but pancreas does not secrete it properly.[5] T2DM is rapidly growing public health problem world wide, with a significant impact on health, quality of life and healthcare system of the countries. It was estimated that in 2017 there was 451 million (age 18-99 year) people with diabetes world wide. These figures were expected to increase 693 million by 2045.It was estimated that almost half of all people (49.7%) living with diabetes are undiagnosed.[6,7]

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T2DM patients are prone to diabetic dyslipidemia,which puts them at risk of developing macro-vascular (stroke, peripheral vascular disease and coronary artery disease) and microvascular (nephropathy, neuropathy and retinopathy) diseases.[8] Naqvi et al., (2017) havereportedfor T2DM patients that one of the most common complications linked with uncontrolled hyperglycemia is dyslipidemia.[9]

Lipid abnormalities are associated with diabetes mellitus because enzymes of lipid metabolism are affected by deficiency of insulin action.[10] High Triglycerides (TG), elevated low density lipoprotein cholesterol (LDL-C) and lower high density lipoprotein cholesterol (HDL-C) levels are characteristic features of diabetic dyslipidemia. It occurs due to over production of hepatic and intestinal lipoprotein in form of energy rich substrates as free fatty acids or glucose and due to elevated triglyceride rich lipoproteins(TRLs).[11] These elevated TRLs lead to catabolism of HDL, resulting in low HDL cholesterol or decreased VLDL catabolism resulting in hypertriglyceridemia.[12] A study conducted by Begum A, Irfan SR in 2019 reported that significant high values of triglycerides, total cholesterol and LDL-C were seen in bad glycemic control group when compared to good glycemic control group. In worst glycemic control group, the value of HDL-C was significantly lower.They also stated that HbA1c is a predictor of abnormal amounts of lipids present in diabetic patients.[13]

Glycosylated hemoglobin (HbA1c) is an absolute indicator of long term blood glucose control (a reflection of blood sugar control in last 3 months) and is a gold standard of glycemic control in patients with type 2 diabetes mellitus (T2DM).[14,15] IncreasedHbA1c has been known as a risk factor for cardiovascular disorders in patients with diabetes. Many individuals with diabetes who have poor glycemic control experience adyslipidemic state such as an increase in triglycerides (TG), low density lipoprotein

cholesterol (LDL-C) and decrease in high density lipoprotein cholesterol (HDL-C).[6,15] Individuals with diabetes accompanied by the co-existence of metabolic syndrome (hypertension, dyslipidemia, abdominal obesity and hyperglycemia) have a very high risk for the occurrence of a cardio vascular complications.[6,16]

According to the study of Hussein A, Ali et al., 2017 there was significant increase in values of triglycerides, total cholesterol and low density lipoprotein cholesterol and significant decrease was seen in high density lipoprotein cholesterol (HDL-C).The study revealed that HbA1c can be used to predict diabetic dyslipidemia.[17] The interaction between dyslipidemia and hyperglycemia plays an important role in the onset and progression of T2DM and its chronic complication.[18] Glycated hemoglobin (HbA1c) has been finally established as an index of long term glucose concentrations and as a measure of the risk for development of microvascular complications in T2DM.[19]. This study has been designed to evaluate the use of glycated hemoglobin (HbA1c) as a dual marker of glycemic status and dyslipidemia in type 2 diabetes mellitus for early intervention to reducecardiovascularand other related complications and their mortality.

Materials & Methods

A descriptive cross sectional study was done among 290 diagnosed type 2 diabetic patients with age range from 25-60 years of both sex, selected through convenient sampling technique. The study was conducted in the department of Biochemistry Jalalabad Ragib-Rabeya medical college Sylhet and data were collected from both indoor and outdoor of medicine department between the periods of October 2020 to September 2021.

Patients with hypothyrodism, nephritic syndrome, chronic kidney diseases, and familial hyper lipoproteinemia were excluded from the study. Venous blood sample were collected from all participants and serum was separated by centrifugation. This serum was used for analyzing total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and HbA1c was determined byusing an auto analyzer. Value of HbA1c was given as percentage of total hemoglobin and values of all other parameters were given in mg/dl. The grouping of research subjects was based on their HbA1c level (glycemic status). Group-1 (HbA1c 4.2-6.2%) comprised of (66) diabetics having normal glycemic status, Group-2 (HbA1c 6.3-6.8%) comprised of (48) diabetic having good glycemic control and Group-3 (HbA1c >6.8%) comprised of (176) diabetics having worst glycemic control. Data were generated using a checklist and entered and analyzed by using SPSS V 26. The Mean ±SD was measured for quantitative variables such as lipid profile and HbA1c. Frequency was given for qualitative variable such as gender. One way ANOVA was used for comparison of lipid profile and HbA1c between three groups. A probability (p) value of < 0.05 was considered statistically significant.

Results

The study population comprised of 290 diagnosed T2DM patients. Among them 160 (55.17%) were males and 130 (44.83%) were females as shown below. (Table 1)

Table 1: Distribution of the patients according to gender (n=290)

Gender	Frequency	Percentage
Female	130	44.83%
Male	160	55.17%
Total	290	100%

Table 2: Comparison of HbA1c between males and females (n=290)

Parameter	Mean ±SD		p-value
	Male n=160	Female n=130	
HbA1c	6.605±0.8527	6.799±0.7147	0.040

Table 2 shows, mean and standard deviation of HbA1C in male was (6.605±0.8527) and in females it was (6.799±0.7147).

Table 3: Comparison of lipid profile between subjects with normal, good and worst glycemic control

Attributes	HbA1c			p-value
	Group 1 Normal glycemic control (n=66)	Group 2 Good glycemic control (n=48)	Group3 Worst glycemic control (n=176)	
S. Total Cholesterol	213.70±18.155	273.33±27.643	324.26±24.131	0.000*
TG	184.14±42.668	283.29±32.072	292.57±22.886	0.000*
HDL-C	35.60±2.636	35.46±2.387	35.48±2.567	0.950
LDL-C	160.20±4.568	165.83±4.834	169.49±7.552	0.000*

*P- value ≤ 0.05 is statistically significant.

Table 3 shows, lipid profile findings such as total cholesterol (TC), triglycerides(TG), low density lipoprotein cholesterol (LDL-C) were significantly higher in group-3 (Poor glycemic control group) than other two groups. But high density lipoprotein cholesterol (HDL-C) in all three groups were almost same. Mean and standard deviation of total cholesterol in group-3 was found (324.26±24.131), group-2 (273.33±27.643) and group-1 (213.70±18.155) respectively. When it was compared it was statistically significant (p value=0.000). The mean and standard deviation of triglycerides were in group-3 (292.57±22.886), group-2 (283.29±32.072) and group-1 (184.14±42.668) respectively. When it was compared it was statistically significant (P-value=0.000). The mean and standard deviation of LDL cholesterol in group 3(169.49±7.552), group-2 (165.83±4.834) and group-1 (160.20±4.568) respectively and was compared it was statistically significant (P value= 0.000). The mean and standard deviation of HDL cholesterol in group-1 (35.60±2.636), group-2 (35.46±2.387) and group-3 (35.48±2.567) respectively and when it was compared it was not statistically significant (P- value=0.950).

Discussion

The current work revealed that mean value of HbA1c was almost same in males and females, when it was compared it was statistically non-significant (P=0.040). This study showed similarities with the results of study conducted by Glygor R. Talpes S et al., 2011 who also reported that diabetic patients of both gender had similar patterns of glycemic control.[20] However the present study was found dissimilar with the study of Prabhavati K, Kirthana K et al., 2014 who documented that female diabetic patients had higher level of HbA1c as compared to males, the reason for this might be obesity which was more common in women.[21] The impact of gender on glycemic control, specifically HbA1c level, was less clear. In clinical trials,women with type 2 diabetes mellitus have significantly higher HbA1c level and significantly fewer women than men achieved target HbA1c levels of 7% - <8%.[22]

In various studies it was observed that the correlation between HbA1c and HDL-C was negative, however there was a positive, significant correlation between HbA1c and TC, LDL-C and TG.[23,24,25,26] In this study the mean and standard deviation of HDL-C in three groups was almost same that was (35.60±2.636), (35.46±2.387) and (35.48±2.567) in group 1, group 2 and group 3 respectively. When comparison between group 1, group 2 and group 3 was made it was statistically non-significant. This is in agreement with the results from a few other studies,[17,27] but inconsistent with several studies that reported a notable negative relationship between HbA1c and HDL-C.[28,29,30] Some studies found described a positive relationship between HbA1c and HDL-C.[31,32] The mean and standard deviation of total cholesterol in group 1, group 2 and group 3 was (213.70±18.155), (273.33±27.643) and (324.26±24.131) respectively and when it was compared it was statistically significant (P=0.000). This study was in accordance with the study of Hussain A, Ali I et al., 2017 who documented that patients having worst glycemic control had noticeable higher values of total cholesterol when they were compared with patients having normal or good glycemic control (p=0.004).[17] The mean and standard deviation of triglyceride was in group 1, group 2 and group 3 (184.14±42.668), (283.29±32.072) and (292.57±22.886) respectively and when it was compared it was statistically significant (p=0.000). This study was found concurrence with the study of Muraliswaran P, Elamathi T et al., 2016 who documented that mean and standard deviation of triglyceride in poor glycemic control group was high (162.11±32.34)as compared to normal and good glycemic control group, that was (123.24±34.65) and (117.36±21.44) respectively however, when compared it was found statistically significant (P=0.001).[33] The mean and standard deviationof LDL cholesterol in group 1, group 2 and group 3 were (160.20±4.568), (165.83±4.834) and (169.49±7.552) respectively and when it was compared it was statistically significant (P value =0.000). This study has similarity with the study of Jordan D, Mangling L et al., 2018 who documented that LDL-C had significant positive relationship with HbA1c, elevated level of LDL cholesterol considered as major determinant of cardiovascular risk and coronary atherosclerosis in diabetic patients.[34]

Conclusion

In this study it was seen a significant correlation between HbA1c and various circulating lipid parameters.The findings clearly suggests that HbA1c has the ability of predicting serum lipid profile in type 2 diabetic patients.Thus dual biomarker capacity of HbA1c (glycemic control as well as lipid profileindicator) can be used for screening of high risk diabetic patients. Therefore an early intervention can reduce cardiovascular and other related complications and their mortality towards improved quality of life indeed.

Conflict of interest: No

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