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Original Research Article

Correlation between Glycosylated Haemoglobin and Serum Lipid Profile in Patients with Type 2 Diabetes Mellitus in a Tertiary Care Hospital

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Abstract: ***Introduction:*** Globally, type 2 diabetes mellitus (T2DM) is a swiftly escalating public health issue with noteworthy effects on human health, living standards, the economy and health care systems. Statistics from the International Diabetes Federation (IDF) indicate that 425 million adults worldwide have diabetes mellitus (DM) and that by 2045, the number of DM patients will be 629 million and 352 million people were at risk of developing T2DM. T2DM patients are prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular (stroke, peripheral vascular disease and coronary artery disease [CAD]) and microvascular (nephropathy, neuropathy and retinopathy) diseases. Naqvi et al have reported that, for T2DM patients, one of the most common complications linked with uncontrolled hyperglycemia is dyslipidemia. ***Material & Methods:*** This is a cross sectional study conducted at Department of General Medicine, Shadan Institute of Medical Sciences, Teaching Hospital & Research Centre, Hyderabad. Total 70 patients of Type 2 diabetes mellitus were taken for the study after applying inclusion and exclusion criteria and after obtaining written and informed consent from them. ***Result:*** In our study, among 70 Type 2 diabetic individuals included in this study, 41 were male and 29 were female. 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. Mean total cholesterol was 276.53 ± 19.53, mean total triglyceride was 283.83 ± 20.65, Mean HDL was 35.63 ± 3.96, mean LDL was 184.14 ± 7.63 and VLDL was 56.76 ± 4.13. ***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: Glycated hemoglobin, DMT2, glycemic control, dyslipidemia, lipid profile.

INTRODUCTION

Globally, type 2 diabetes mellitus (T2DM) is a swiftly escalating public health issue with noteworthy effects on human health, living standards, the economy and health care systems. Statistics from the International Diabetes Federation (IDF) indicate that 425 million adults worldwide have diabetes mellitus (DM) and that by 2045, the number of DM patients will be 629 million and 352 million people were at risk of developing T2DM. [1]

T2DM patients are prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular (stroke, peripheral vascular disease and coronary artery disease [CAD]) and microvascular (nephropathy, neuropathy and retinopathy) diseases. Naqvi et al have reported that, for T2DM patients, one of the most common complications linked with uncontrolled hyperglycemia is dyslipidemia. [2]

Glycated hemoglobin (HbA1c) levels are routinely measured in diabetics to monitor their glycemic control. The goal is to achieve a level below 7%. Levels of HbA1c can be affected by multiple factors, including sugar intake, exercise and adherence to medications. [3] Some studies have reported that HbA1c could potentially be utilized as a possible biomarker for predicting dyslipidemia and cardiovascular disease (CVD). [4]

The level of circulating HbA1c is taken as the gold standard of glycemic control, and regulating it is imperative for avoiding T2DM complications. HbA1c values not only reflect glycemic control but are also the main factor in determining the risk of diabetes-related complications and mortality. [5]

There are several conflicting results in the literature, such as a Turkish study that found a significant relationship between total cholesterol (TC),

LDL, triglycerides (TGs) and HbA1c, while others reported no considerable relationship. [6] Similarly, while one study reported a significant negative relationship between HbA1c and LDL-C, others reported the opposite results. Importantly, a recent study revealed a positive relationship between HbA1c and high TGs, concluding that HbA1c could be a sign of TG levels and that it may predict CVD risk factors in T2DM. [7]

These reports indicate there is a discrepancy regarding the relationship between HbA1c and the lipid profile. Further studies could determine more precisely the relative risks of developing dyslipidemia that are dependent on HbA1c levels in order to truly say whether it is a marker for dyslipidemia in diabetics. Our study investigated the association between HbA1c and the lipid profile in patients with T2DM in a tertiary care hospital. [8]

MATERIAL AND METHODS

This is a cross sectional study conducted at Tertiary Care Hospital, from December 2020 to February 2021. Total 70 patients of Type 2 diabetes mellitus were taken for the study after applying inclusion and exclusion criteria and after obtaining written and informed consent from them.

Inclusion criteria

- Adults aged either gender above 30 years and having Type 2 Diabetes Mellitus

Exclusion criteria

- Patients with hypothyroidism, nephrotic syndrome, cholestatic liver disease, chronic kidney disease
- Patients with BMI >30kg/m2
- Patents on lipid lowering drugs
- Patients on OCP's, steroids and thiazide diuretics

HbA1c and Fasting Lipid profile: Total cholesterol, Triglycerides, HDL and VLDL cholesterol were measured using Erba blood analyser were done using appropriate tests.

- LDL cholesterol was calculated using Friedwald formula.
- HbA1c was estimated by appropriate standard kits.
- Dyslipidaemia was defined according to NCEP-ATPIII guidelines.

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) ≥ + 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.

RESULT

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	276.53 ± 19.53
Triglycerides	283.83 ± 20.65
Mean HDL	35.63 ± 3.96
Mean LDL	184.14 ± 7.63
Mean VLDL	56.76 ± 4.13

In table 3, Mean total cholesterol was 276.53 ± 19.53, mean total triglyceride was 283.83 ± 20.65, Mean HDL was 35.63 ± 3.96, mean LDL was 184.14 ± 7.63 and VLDL was 56.76 ± 4.13.

Table 4: Biochemical parameters of type 2 diabetes mellitus patients with glycated haemoglobin ≥7 and glycated haemoglobin <7.

Parameters	Glycated Haemoglobin (HbA1c)		p - value
	<7 (n=29)	≥7 (41)	
FBS	171.58±41.14	197.30±44.61	0.001
Total cholesterol	279.32 ± 11.59	281.24 ± 11.54	0.032
Triglycerides	276.43 ± 12.43	288.15 ± 13.43	0.002
Mean HDL	34.52 ± 3.86	31.54 ± 3.58	0.042
Mean LDL	179.51 ± 9.52	188.07 ± 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=0.036).

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. This is partly because all the major risk factors for heart failure can present in patients with type 2 diabetes such as dyslipidaemia, obesity, hypertension, advanced age, sleep apnoea, anemia, chronic kidney disease, and coronary heart diseases. [9]

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. In present study, diabetic patients with dyslipidaemia (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 and from different Indian states. [10] Nanaware M et al. also reported significant correlations between all components of the lipid profile and glycosylated haemoglobin. [11]

Maharjan et al. reported significant correlations between glycosylated hemoglobin and TG, TC, LDL and FBS and non-significant correlation with HDL. [12] Babikr et al. also reported correlations of HbA1c with LDL. Ju et al. [13] reported highly significant correlations between HbA1c and FBS, similar to our study; however, Devkar et al. also reported correlations with TC, TG, and LDL, similar to our observations. [14]

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. 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. [15]

Hyperinsulinemia is also associated with low HDL cholesterol levels. Normally, dyslipidemia is characterized by elevated levels of lipid profile components, including TG, TC, LDL and VLDL excepting HDL, which follows the reverse trend. 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. [16] 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. [17]

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. [18] The level of HbA1c value ≤7.0%

was said to be appropriate for reducing the risk of cardiovascular complications. It is shown that HbA1c was found to have positive correlation with total cholesterol, LDL cholesterol and triglycerides in diabetic patients. 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.

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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