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Original Research Article

A Hospital-Based Study Assessing Relationship between Glycated Hemoglobin (Hba1c) and Lipid Profile Components in Newly Diagnosed T2DM Patients

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Abstract

Aim: The aim of the present study was to find the relationship between Glycated hemoglobin (HbA1c) and lipid profile components in newly diagnosed T2DM patients.

Material & Methods: In the study, 50 newly diagnosed type 2 diabetes patients were included as cases and 50 non-diabetic subjects were included as controls. Blood samples were collected from the subjects of both the study and control groups and were analysed for fasting and post-prandial plasma glucose, HbA1c, TC, TG, LDL-C, and HDL-C. 84% of cases had dyslipidemia whereas only 52% of controls were found to have dyslipidemia and the difference between the two groups was statistically significant ($p<0.05$).

Results: 84% of cases had dyslipidemia whereas only 54% controls were found to have dyslipidemia and the difference between the two was statistically significant ($P < 0.05$). The difference of mean age between two groups was not statistically significant ($p> 0.05$). Statistically significant difference ($p<0.05$) was found when the mean values of HbA1c, FBS, PPBS, S. Total Cholesterol, S. Triglycerides, LDL-C, HDL-C of cases and control groups, were compared. The frequency of raised blood sugar parameters (HbA1c>6.5, FBS>126mg/dl, PPBS>200mg/dl) and dyslipidemia (S. Cholesterol-total, S. Triglycerides, LDL-C, HDL-C) in cases and control groups were noted. The statistically significant ($p<0.05$) difference was found between the two groups, when compared. A significant positive correlation was found between glycemic parameters (HbA1c, FBS and PPBS) and lipid profile parameters (Serum Triglyceride, Serum Total Cholesterol, Serum LDL Cholesterol) with $p<0.05$. But insignificant correlation was found with Serum HDL-Cholesterol ($p>0.05$).

Conclusion: Significant positive correlation of HbA1c with lipid profiles in our study suggests that HbA1c can also be used as a predictor of dyslipidemia in addition to a glycemic control parameter for prevention of complication**.** Furthermore, HbA1c shows a significant correlation with TC, TG, LDL, and VLDL, whereas it has a significant negative correlation with HDL. The study showed thatHbA1c might be useful for predicting dyslipidemia in T2DM patients.

Keywords: Diabetes; Diabetic dyslipidemia; Hypertension; Glycosylated haemoglobin.

Introduction

Diabetes is defined as a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. [1] Chronic hyperglycemia is associated with significant long-term complications and affects many organ systems. Cardiovascular disease (CVD) is the major cause of morbidity and mortality in diabetes mellitus. [2] It has been shown that the estimated risk of CVD increases by 18% for each 1% increase in absolute glycated hemoglobin (HbA1c) value in the diabetic population. [3] HbA1c is considered the standard routine indicator of glycemic control. [4,5] Moreover, HbA1c may forecast risks of the advancement of diabetic-related complications. [6]

One of the most common complications is abnormal levels of serum lipids, also called dyslipidemia. [7] Impaired lipid metabolism is commonly observed in T2DM patients due to insulin resistance. [8] Dyslipidemia is defined as a disorder of lipoprotein metabolism, including lipoprotein overproduction, or deficiency. [9] Primary changes include not only just hypertriglyceridemia and decreased high-density lipoprotein (HDL) cholesterol levels but also abnormalities that can be seen in the structure of lipoprotein particles. In diabetes, the predominant

form of low-density lipoprotein (LDL) cholesterol is the small, dense form. Small LDL particles are more atherogenic than large LDL particles because they can more easily penetrate and form stronger bound to the arterial wall, forming atherosclerotic plaque, and promoting atherosclerosis. [10] Diabetic patients with elevated HbA1c values and dyslipidemia can be considered as a very high-risk group for CVD. [11]

In Type-2 DM, the relative insulin deficiency and decreased adiponectin causes decrease lipoprotein lipase activity resulting in high levels of low-density lipoprotein (LDL), triglyceride and low levels of high-density lipoprotein (HDL). Qualitative defects in LDL are also seen in Type-2 diabetes including atherogenic, glycated or oxidized LDL further amplifying the risk of atherogenesis. [12,13] The diabetes complications and control trial (DCCT) established HbA1c as the gold standard to assess glycemic control. [14] It is considered to be the gold standard marker and has shown significant relationship with lipid profile of Type- 2 diabetic patients in several research studies.

Therefore, the aim of this study was to analyze lipid profile in serum of newly diagnosed patients with diabetes mellitus type 2, and its relationship with HbA1c levels.

Material & Methods

A total of 100 subjects were included in this cross-sectional study and were divided into two groups: a study group having 50 newly diagnosed T2DM patients and a control group with 50 non-diabetic subjects. The study was conducted at the Department of General Medicine, Netaji Subhas medical College and Hospital, Bihta, Patna India from Jan 2022 to December 2022.The study protocol was performed following the Helsinki Declaration as revised in 2000. All patients have signed written consent to participate in this study on a careful explanation of the study procedure.

Inclusion Criteria

All patients with type 2 diabetes above 40 years of age with micro-and macrovascular complications willing to participate were included in the study

Exclusion Criteria

Known Type 2 diabetes mellitus patients and patients with acute metabolic complications (diabetic ketoacidosis, hyperglycemic hyperosmolar syndrome); patients having acute illnesses/ infections; patients with h/o acute myocardial infarction, cerebrovascular accidents, thyroid disorders, liver disorders and renal disease; patients having known inherited disorders of lipids and patients with secondary dyslipidemia either due to pregnancy or drugs(Beta-blockers, Thiazides, Steroids, Hypolipidemic drugs, Oral contraceptives, Anti –coagulants) and patients with h/o alcohol dependence were excluded from the study.

Methodology

Patients were assigned to two groups depending on their glycated hemoglobin values:

Group 1, 100 patients with good glycemic control (HbA1c ≤7%)

Group 2, 100 patients with poor glycemic control (HbA1c >7%)

All patients underwent standard diagnostic protocol comprised of the detailed medical history questionnaire and physical examination. Blood samples from all patients were obtained in the morning after the 12-h fasting period. The blood samples were collected into empty tubes and immediately stored at +4°C. Biochemical analyses were performed the same day. The blood samples were drawn in the fasting state for FBS, FLP (total cholesterol, HDL, LDL, VLDL, TGL), HbA1c, complete blood count, and renal and thyroid function tests. Urine routine investigation was also done.

Serum glucose levels were determined by spectrophotometric hexokinase/G-6-PDH method. Serum total cholesterol (TC) was determined using spectrophotometric cholesterol oxidase/4-aminoantipyrine method. Triglyceride (TAG) levels were determined by spectrophotometric glycerol phosphate oxidase method. The LDL-cholesterol value was analyzed using an enzymatic method with cholesterol-esterase and cholesterol oxidase. The HDL-cholesterol value was determined in serum by cholesterol oxidase/phenol aminoantipyrine method. HbA1c was determined in whole blood by enzymatic method.

All analyses were performed at ARCHITECTc8000 Systems analyzer.[11]

- Castelli risk index 1 (TC/HDL-cholesterol),
- Castelli risk index 2 (LDL/HDL-cholesterol), atherogenic index of plasma (AIP) (log [TAG/HDL-cholesterol]), as well as the ratio of triglycerides (TAG) to HDL-cholesterol were calculated.

Statistical Analysis

NCSS software version 12 was used for data analysis. The results of the parametric quantitative data are shown as mean and standard deviation. Independent T-test was used to compare the quantitative variables between two groups and chi-square test was used for qualitative data. Pearson's correlation test was used to find correlation between quantitative variables. P-value <0.05 is considered as significant.

Results

Table 1: Dyslipidemia prevalence in study groups

	Cases (n=50)	Controls (n=50)	P-value
Dyslipidemia	42	27	< 0.001
Normal lipid profile	8	23	

84% of cases had dyslipidemia whereas only 54% controls were found to have dyslipidemia and the difference between the two was statistically significant (P < 0.05).

Table 2: Comparison of various parameters between cases and control groups

Parameters (mean± SD)	Cases (n=50)	Controls (n=50)	P-value
Age (yrs)	48.2±8.2	49.2±9.0	0.76
HbA1c (%)	8.72±1.6	6.84±0.6	0.0001
FBS (mg/dl)	154.06±34.6	108.42±7.3	0.0000
PPBS (mg/dl)	264.36±60.5	168.8±10.5	0.0000
Serum Total Cholesterol (mg/dl)	234.16±45.5	206.82±30.4	0.0002
Serum Triglyceride (mg/dl)	199.23±58.2	162.18±30.8	0.0001
Serum LDL-C (mg/dl)	158.82±38.2	136.74±36.4	0.0001
Serum HDL-C(mg/dl)	38.02±7.8	43.07±7.3	0.001

The difference of mean age between two groups was not statistically significant (p> 0.05). Statistically significant difference (p<0.05) was found when the mean values of HbA1c, FBS, PPBS, S. Total Cholesterol, S. Triglycerides, LDL-C, HDL-C of cases and control groups, were compared.

Table 3: Frequency of parameters of raised blood sugar and dyslipidemia in cases and controls

Parameters	Cases (n=50)	Controls (n=50)	P-value
HbA1c (>6.5%)	50	0	0.0000
FBS (>126mg/dl)	42	0	0.0000
PPBS (>200mg/dl)	48	2	0.0000
Serum Total Cholesterol (>200mg/dl)	32	22	0.002
Serum Triglycerides (>150mg/dl)	38	20	0.001
Serum LDL-C (>130mg/dl)	32	21	0.0001
Serum HDL-C(<40mg/dl)	35	30	0.001

The frequency of raised blood sugar parameters (HbA1c>6.5, FBS>126mg/dl, PPBS>200mg/dl) and dyslipidemia (S. Cholesterol-total, S. Triglycerides, LDL-C, HDL-C) in cases and control groups were noted. The statistically significant (p<0.05) difference was found between the two groups, when compared.

Table 4: Correlation of lipid profile with diabetic parameters

Lipid profile Parameters	HbA1c		FBS		PPBS	
	R	p	r	p	r	p
Serum Total Cholesterol	0.642	<0.001	0.618	<0.001	0.648	<0.001
Serum Triglycerides	0.674	<0.001	0.608	<0.001	0.668	<0.001
Serum LDL-C	0.488	<0.001	0.488	<0.001	0.512	<0.001
Serum HDL-C	0.026	>0.05	0.068	>0.05	0.034	>0.05

A significant positive correlation was found between glycemic parameters (HbA1c, FBS and PPBS) and lipid profile parameters (Serum Triglyceride, Serum Total Cholesterol, Serum LDL Cholesterol) with p<0.05. But insignificant correlation was found with Serum HDL-Cholesterol (p>0.05).

Discussion

Chronic hyperglycemia occurs due to deficiency of insulin along with disturbances of metabolism of carbohydrate, protein, and fat. [15] Frequency of T2DM is higher than T1DM which accounts for more than 90% of all diabetic patients. [16] In both high and low- income countries the prevalence and incidences of T2DM are rapidly increasing. [17] According to the International Diabetes Federation (IDF) Atlas guideline report- 2017, it was estimated that 425 million people (20–79 years of age) suffered from DM, and it is expected to increase to 629 million people by 2045. As per IDF Atlas there were 72.9 million people with diabetes in India (2017) and is expected to increase to 134.3 million by 2045. [18] In India dyslipidemia in diabetic patients is one of the main causes for Coronary Artery Disease (CAD) mortality. [19] Dyslipidemia in diabetes patients is characterized by increased serum levels of Low Density Lipoprotein Cholesterol (LDL-C), Very Low Density Lipoprotein Cholesterol (VLDL-C), Triglycerides

(TG) concentrations and decreased serum levels High Density Lipoprotein Cholesterol (HDL-C) concentration. [20,21]

84% of cases had dyslipidemia whereas only 54% controls were found to have dyslipidemia and the difference between the two was statistically significant ($P < 0.05$). The difference of mean age between two groups was not statistically significant ($p> 0.05$). Statistically significant difference ($p<0.05$) was found when the mean values of HbA1c, FBS, PPBS, S. Total Cholesterol, S. Triglycerides, LDL-C, HDL-C of cases and control groups, were compared. Similarly, a study by Venkatesh et al [22] showed that the mean values of TC, VLDL-C and LDL-C were higher in T2DM patients than the normal range and HDL-C was lower in T2DM patients. Also a study done by Yuthika Agrawal et al showed that the mean plasma glucose levels, HbA1c, TC and TG were significantly raised in the diabetics as compared to those in the controls. [23]

The frequency of raised blood sugar parameters (HbA1c>6.5, FBS>126mg/dl, PPBS>200mg/dl) and dyslipidemia (S. Cholesterol-total, S. Triglycerides, LDL-C, HDL-C) in cases and control groups were noted. The statistically significant ($p<0.05$) difference was found between the two groups, when compared. A significant positive correlation was found between glycemic parameters (HbA1c, FBS and PPBS) and lipid profile parameters (Serum Triglyceride, Serum Total Cholesterol, Serum LDL Cholesterol) with $p<0.05$. But insignificant correlation was found with Serum HDL-Cholesterol ($p>0.05$). Also a case control study done by Yuthika Agrawal et al showed that high TG (56%) was most commonly present in diabetics. [23] Similarly a study done by Gamit DN [24] showed the prevalence rates for high Total Cholesterol (TC) and Triglycerides (TG) were 13.6% and 41.4% respectively. The prevalence rates for high LDL- C, very high LDL-C and low HDL-C in the diabetic subjects were 8.6%, 5.0% and 72.9% respectively. In a study Bali K et al found dyslipidemia in T2DM patients and the most commonly elevated lipid was LDL-C (59.3%) followed by triglycerides (57.2%) and total cholesterol (36.5%). The HDL-C was decreased in 34.4% T2DM patients. [25]

All the diabetics with hypertension had abnormal lipid profiles, similar to dyslipidemia patients. However, for diabetics, only TG, HDL, VLDL, TC:HDL concord with findings in dyslipidemic patients. The prediabetics showed abnormal HDL and TC:HDL levels. There was a high degree of correlation between lipid profiles and glycosylated hemoglobin, especially for diabetics with hypertension. Therefore, for diabetics, it should be mandatory to test the levels of various components of the lipid profile at regular intervals, because they fall in the high-risk category for developing both dyslipidemia and hypertension. However, for non-diabetics and prediabetics, it is not a dependable marker for detecting future diabetic dyslipidemia or hypertension. Our study also showed that HbA1c cannot be used as a marker for dyslipidemia, in agreement with Sultania et al. [26]

Conclusion

Significant positive correlation of HbA1c with lipid profiles in our study suggests that HbA1c can also be used as a predictor of dyslipidemia in addition to a glycemic control parameter for prevention of complication**.** Furthermore, HbA1c shows a significant correlation with TC, TG, LDL, and VLDL, whereas it has a significant negative correlation with HDL. The study showed thatHbA1c might be useful for predicting dyslipidemia in T2DM patients.

References

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes care. 2010 Jan 1;33(Supplement_1): S62-9.
2. Lind M, Odén A, Fahlén M, Eliasson B. The true value of HbA1c as a predictor of diabetic complications: simulations of HbA1c variables. PloS one. 2009 Feb 11;4(2):e4412.
3. Giorgino F, Leonardini A, Laviola L. Cardiovascular disease and glycemic control in type 2 diabetes: now that the dust is settling from large clinical trials. Annals of the New York Academy of Sciences. 2013 Apr;1281 (1):36-50.
4. Vinod Mahato R, Gyawali P, Raut PP, Regmi P, Singh KP, Pandeya DP, et al. Association between glycaemic control and serum lipid profile in type 2 diabetic patients: glycated haemoglobin as a dual biomarker. Biomed Res. 2011; 22:375-380.
5. Taliyan S, Nagtilak S, Parashar P, Rastogi A. Correlation between Glycated hemoglobin and Lipid profile in Type 2 Diabetic population of district Meerut, UP. Int. J. Biomed. Adv. Res. 2016; 7:534-6.
6. Babikr WG, Alshahrani AS, Hamid HG, Abdelraheem AH, Shalayel M. The correlation of HbA1c with body mass index and HDL-cholesterol in type 2 diabetic patients. Biomedical Research (India). 2016;27(4): 1280-3.
7. Alam R, Verma MK, Verma P. Glycated hemoglobin as a dual biomarker in type 2 diabetes mellitus predicting glycemic control and dyslipidemia risk. TC. 2015 Oct;189 (8.07):164-89.
8. Bardini G, Rotella CM, Giannini S. Dyslipidemia and diabetes: reciprocal impact of impaired lipid metabolism and Beta-cell dysfunction on micro-and macrovascular

complications. The review of diabetic studies: RDS. 2012;9(2-3):82.
9. Fodor G. Primary prevention of CVD: treating dyslipidemia. American Family Physician. 2011 May 15;83(10):1207-8.
10. Dokken BB. The pathophysiology of cardiovascular disease and diabetes: beyond blood pressure and lipids. Diabetes spectrum. 2008 Jul 1;21(3):160-5.
11. Panjeta E, Jadrić R, Panjeta M, Ćorić J, Dervišević A. Correlation of serum lipid profile and glycemic control parameters in patients with type 2 diabetes mellitus. Journal of Health Sciences. 2018 Sep 10;8(2):110-6.
12. Sarfraz M, Sajid S, Ashraf MA. Prevalence and pattern of dyslipidemia in hyperglycemic patients and its associated factors among Pakistani population. Saudi journal of biological sciences. 2016 Nov 1;23(6):761-6.
13. Verges B. Lipid modification in type 2 diabetes: the role of LDL and HDL. Fundamental & clinical pharmacology. 2009 Dec;23(6):681-5.
14. Nathan DM, DCCT/Edic Research Group. The diabetes control and complications trial/epidemiology of diabetes interventions and complications study at 30 years: overview. Diabetes care. 2014 Jan 1;37(1):9-16.
15. Guyton AC, Hall JE. In: Insulin glucagon and diabetes mellitus Textbook of Medical Physiology. Saunder's Philadelphia, 12th edition; 2013, p. 618-22.
16. Tripathi BK, Srivastava AK. Diabetes mellitus: complications and therapeutics. Med Sci Monit 2006;12:RA130-47.
17. Maruthur NM. The growing prevalence of type 2 diabetes: increased incidence or improved survival? Curr Diab Rep 2013; 13:786-94.
18. International Diabetes Federation Diabetes Atlas, Eighth Edition, 2017.
19. Ambrish Mithal, Debashish Majhi, M. Shunmugavelu, Pradeep G. Talwarkar, Hardik Vasnawala, Ammar S. Raza. Prevalence of dyslipidemia in adult Indian diabetic patients: A cross sectional study (SOLID). Indian J Endocrinol Metab 2014;18(5):642–7.
20. Mooradian AD. Dyslipidemia in type 2 diabetes mellitus. Nat Clin Pract Endocrinol Metab 2009; 5:150-9.
21. Adiels M, Olofsson SO, Taskinen MR, Borén J. Overproduction of very low–density lipoproteins is the hallmark of the dyslipidemia in the metabolic syndrome. Arteriosclerosis, thrombosis, and vascular biology. 2008 Jul 1; 28(7):1225-36.
22. Venkatesh SK, Sudheer K. M. V., Mohana Krishna T. Lipid profile analysis of type 2 diabetic patients in Bengaluru population, India. Int J Res Med Sci 2018;6(6):2049-53.
23. Agrawal Yuthika, Goyal Vipin, Chugh Kiran, Shanker Vijay, Singh Anurag Ambroz. Types of dyslipidemia in Type 2 diabetic patients of Haryana region. Sch J App Med Sci 2014; 2(4D):1385-92.
24. Gamit DN, Mishra A. A lipid profile study amongst the patients of type 2 diabetes mellitus - A cross sectional study. IAIM 201 8;5(2):1-5.
25. Bali K. Pattern of dyslipidemia in Type 2 Diabetes Mellitus in Punjab. Int J Res Med Sci 2016;4(3):809-12.
26. Sultania S, Thakur D, Kulshreshtha M. Study of Lipid Profile in Type 2 Diabetes Mellitus Patients and its Correlation with HbA1c. Int J Contemp Med Res. 2017;4: 2454-7379.