Correlation Between HbA_1c Values And Lipid Profile In Type 2 Diabetes Mellitus

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Abstract: Background: Patients with type 2 diabetes have an increased prevalence of lipid abnormalities. A timely intervention to normalize circulating lipids could reduce the chances of cardiovascular complications. Glycated hemoglobin (HbA1c) is the indicator of glycemic status over long term. This study was designed to evaluate the correlation between levels of HbA1c and lipid profile. Method: 150 non obese, non hypertensive type 2 diabetic patients (74 males & 76 females) attending the Diabetic OPD, Civil hospital Ahmedabad were enrolled in the study. After obtaining informed consent from patients, detailed history was taken followed by thorough physical examination and investigations like fasting and post prandial blood sugar, HbA1c and lipid profile (Cholesterol, Triglycerides, HDL, LDL & VLDL). The patients were classified into two groups depending on their HbA1c; Good Glycemic Control (GGC) group having HbA1c < 7.0% (n=70) and Poor Glycemic Control (PGC) group having HbA1c>7.0% (n=80). Result: HbA1c showed direct and significant correlations with cholesterol, triglycerides, LDL & VLDL and inverse correlation with HDL. Conclusion: These findings suggest that HbA1c level can be used as good parameter for predicting the lipid profile of both male and female diabetic patients.

Key Words: Glycemic control, HbA1c, Serum lipid profile, Type 2 diabetes.

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Introduction: In the ancient Sanskrit literature, diabetes mellitus was described as "honey-urine disease," associated with gross emaciation and wasting. Diabetes Mellitus (DM) comprises a group of common metabolic disorders that share the phenotype of hyperglycemia. It is a global endemic with rapidly increasing prevalence in both developing and developed countries[1]. WHO has declared India as "Diabetic Capital of the world" [2]. Although the prevalence of both type 1 and type 2 DM is going to increase, type 2 DM is expected to rise more rapidly in future because of increased obesity and reduced activity levels. The chronic complications of DM affect many organ systems and are responsible for the majority of morbidity and mortality associated with the disease. The risk of chronic complications increases as a function of the duration of hyperglycemia; they usually become apparent in the second decade of hyperglycemia.

Glycated hemoglobin (HbA1c) is routinely used as a diagnostic tool for measuring long term glycemic control. In accordance with its function as an indicator for the mean blood glucose level, HbA1c predicts the risk for the development of diabetic complication in diabetes patients. The UKPDS study has shown that in patients with type 2 diabetes, the risk of diabetic complications were strongly associated with previous hyperglycemia. Glycemic control with decreased level of HbA1c is likely to reduce the risk of complications[3]. Estimated risk of Cardio Vascular Diseases (CVD) has shown to be increased by 18% for each 1% increase in absolute HbA1c value in diabetic[4]. Even in non diabetic cases with HbA1c levels within normal range, positive relationship between HbA1c and CVD has been demonstrated[5,6]. A few studies have previously tried to find the correlation between HbA1c levels and lipid profile. Some of these have shown that all the parameters of lipid profile have significant correlation with glycemic control[7]. On the other hand, some studies do not report significant correlation between glycemic control and all parameters of lipid profile[8]. These controversies inspired us to take forward this study which was aimed to find out association between glycemic control (HbA1c) and serum lipid profile in non obese, non hypertensive type 2 diabetic patients attending the Diabetic OPD, Civil hospital Ahmedabad.

Material and Method: A total of 150 non obese, non hypertensive patients of DM type II with no other cardiovascular, renal or thyroid ailments reporting to Diabetic OPD, Civil

hospital Ahmedabad meeting the following criteria were enrolled in the study.

Inclusion Criteria

Patients of age ≥30 years of both genders

Patients with known diagnosis of type- 2 DM

Exclusion Criteria

- Patients with known diagnosis of type-1 DM
- Hypothyroidism
- Chronic renal failure, Nephrotic syndrome
- Familial hypercholesteremic syndromes.
- Cholestatic jaundice
- Patients already on lipid lowering drugs.
- Hypertensive using beta blockers or thiazide diuretics
- BMI more than 30 & Patients using Alcohol

After obtaining informed consent from patients, detailed history was taken followed by thorough physical examination and laboratory investigations as under –

•Estimation of serum glucose by Glucose oxidase-peroxidase method.
•Estimation of glycated haemoglobin (HbA1c) by Ion Exchange Resin method Principle.
•Estimation of serum total cholesterol (TC) by cholesterol oxidase / phenol aminoantipyrine method.
•Estimation of serum triglycerides (TG) by glycerol phosphate oxidase – phenol aminoantipyrine method.
•Estimation of serum High density lipoprotein (HDL) by cholesterol oxidase / phenol aminoantipyrine method
•Estimation of serum Low density lipoprotein (LDL) by Friedewald formula.
•Estimation of Very low density lipoprotein (VLDL) using Friedewald's equation.

The patients were classified into two groups depending on their glycated hemoglobin (HbA1c); Good Glycemic Control (GGC) group having HbA1c < 7.0% and Poor Glycemic Control (PGC) group having HbA1c>7.0%. For serum lipid reference level, National Cholesterol Education Programme (NCEP) Adult Treatment Panel III (ATP III) guideline was referred[9]. According to NCEP-ATP III guidelines, hypercholesterolemia is defined as TC > 200 mg/dl, high LDL when value > 100 mg / dl, hypertriglyceridemia as TG > 150 mg/dl and low HDL when value < 40 mg/dl. Dyslipidemia was defined by presence of one or more than one abnormal serum lipid concentration[10].

Finally, Statistical analysis was carried out by using student's unpaired 't' test using Graph pad software[11]. Pearson's correlation coefficient was also calculated using online calculator to find the correlation between HbA1c and lipid parameters[12]. Value of HbA1c was given as percentage of total haemoglobin and values of all other parameters were given in mg/dl. All Values are expressed as mean ± SD. The results were considered non-significant when P > 0.05.

Result: Among total 150 type 2 diabetic individuals included in this study, 74 were male and 76 were female. The mean age ± SD of male and female subjects were 52.14±6.40 and 51.46 ± 5.62 years respectively. The mean value of HbA1c and FBG were slightly higher in females in comparison to male patients but the differences were not significant. When lipid profiles were taken in to consideration, 62 patients (41.3%) had TG levels > 150 mg/dl; 27 patients (18%) had LDL > 100 mg/dl; 16 patients (10.6%) had TC > 200 mg/dl & 1 (0.7%) patient had HDL < 40 mg/dl. There was no statistically significant difference in Total cholesterol, Serum Triglyceride, LDL or VLDL levels among both the genders though HDL levels in females were significantly more than males.(Table 1)

Table 1: Male and female lipid parameters results of Male and Female type 2 Diabetic patients

Parameter	Males (n=74)	Females (n=76)	Total (n=150)
FBG (mg/dl)	122.65 ± 33.81	131.06 ± 38.71	126.94 ± 36.51
HbA1c (%)	7.29 ± 1.40	7.69 ± 1.45	7.50 ± 1.44
TC (mg/dl)	147.37 ± 35.40	156.25 ± 30.43	153.91 ± 34.08
TG (mg/dl)	144.33 ± 51.33	160.43 ± 66.20	152.81 ± 59.59
LDL (mg/dl)	65.89 ±	72.81 ±	71.40 ±

	34.64	29.78	32.05
VLDL (mg/dl)	28.87 ± 10.87	32.09 ± 13.24	30.56 ± 11.92
HDL (mg/dl)	45.79 ± 4.12	54.34 ± 3.23	51.95 ± 7.22

Table 2: Lipid parameters categorized by patient's glycemic control (HbA1c)

Parameter	HbA1c < 7 (GGC)	HbA1c > 7 (PGC)	P value
FBG (mg/dl)	108.20 ± 22.26	143.55 ± 38.68	P < 0.0001
HbA1c (%)	6.30 ± 0.48	8.55 ± 1.14	P < 0.0001
TC (mg/dl)	142.95 ± 27.01	158.31 ± 29.58	P = 0.0012
TG (mg/dl)	138.61 ± 45.77	165.39 ± 67.40	P = 0.0057
LDL (mg/dl)	65.59 ± 20.88	73.88 ± 22.61	P = 0.0216
VLDL (mg/dl)	27.72 ± 9.15	33.08 ± 13.48	P = 0.0057
HDL (mg/dl)	52.63 ± 7.28	50.01 ± 7.5	P = 0.0321

Out of 150 patients, 70 patients had HbA1c values less than or equal to seven (GGC) while rest of 80 patients had HbA1c values more than seven (PGC). A very strong positive correlation was observed between FBG and HbA1c as shown by pearson's correlation coeffecient. Similarly, values of TC, TG, LDL & VLDL in GGC group were significantly lower than PGC group. Values of TG had Moderate positive correlation with HbA1c values while TC, LDL & VLDL values had only weak positive relationship. HDL levels were significantly high in GGC group as compared to PGC group and demonstrated a weak negative correlation.

Discussion: In this study we have evaluated the correlation between glycemic control (HbA1c) and lipid profile among diabetic patients. Gender wise evaluation of the data shows that there is no significant difference in glycemic parameters as well as lipid profile between males and females except in HDL values which are significantly higher in females. This warrants the need for more critical monitoring of lipid profile in diabetic males so as to prevent cardiovascular complications in them.

This study shows that quite a good number of diabetic patients have hypercholesterolemia, hypertriglyceridemia, high LDL and low HDL levels which are well established risk factors for car-diovascular diseases.

Insulin impacts the liver apolipoprotein production which regulates the enzymatic activity of lipoprotein lipase and Cholesterol ester transport protein. These could be the likely causes of dyslipidemia in Diabetes mellitus as reported by Goldberg[13]. Over and above this, insulin deficiency also reduces the activity of hepatic lipase and several other steps in the production of biologically active lipoprotein lipase may also be altered in DM[14].

A positive correlation between HbA1c and dyslipidemia was observed in the present study. Positive correlation of HbA1c level with TC and TG in diabetic patients has also been reported in past[15]. Khan et al., also reported that severity of dyslipidaemia increases in patients with higher HbA1c value[16].

Controlling the glycemic levels may significantly decrease the risk of cardiovascular events in diabetics. Khaw et al has reported that reducing the HbA1c level by 0.2% could lower the mortality by 10%[17]. Thus present study suggests the importance of glycemic control in prevention of cardiovascular diseases in type 2 diabetics.

Conclusion: There was no difference in the glycemic status of males and females as measured by Fasting glucose levels and HbA1c. HbA1c showed positive correlations with TC, TG, LDL & VLDL and negative correlations was found between HbA1c and HDL levels. These findings suggest that HbA1c level can be used as good parameter for predicting the lipid profile of both male and female diabetic patients. So, HbA1c may be utilized for screening diabetic patient for risk of cardiovascular events and also for timely intervention with lipid lowering drugs.

Future prospects: Identical non diabetic controls should be added for better comparison of lipid profiles. As the menopausal status of females affect the lipid profiles, this should also be given due consideration while performing any such study.

References:

1. Berry C, Tardif JC, Bourassa MG. Coronary heart disease in patients with diabetes: part I: recent advances in prevention and noninvasive management. J Am Coll Cardiol. 2007; 49:631–642
2. Gupta V, Diabetes in Elderly patients. JK practitioner, 2002; 91(4): 258-259.
3. Irene M Stratton, Amanda I Alder et al., Association of glycemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35); Brit Med J. 2000 Vol 321 : 405-416
4. Selvin E, Marinopoulos S, Berkenblit G, Rami T, Brancati FL, Powe NR, et al. Meta-analysis: glycosy-lated hemoglobin and cardiovascular disease in diabe-tes mellitus. Ann Intern Med 2004; 14: 421-431.
5. Khaw KT, Wareham N, Bingham S, Luben R, Welch A and Day N. Association of hemoglobin A1c with car-diovascular disease and mortality in adults: the Euro-pean Prospective Investigation into Cancer in Norfolk. Ann Intern Med 2004; 141: 413-420.
6. Deeg R, Ziegenhorn J. Kinetic enzymatic method for automated determination of total cholesterol in serum. Clin Chem 1983; 29: 1798-802.
7. Gligor Ramona et al. Relationship between glycosylated hemoglobin and lipid metabolism in patients with type 2 diabetes. Studia Universitatis "Vasile Goldiş", Seria Ştiințele Vieții 2011;21(2): pp. 313-318
8. Zhe Yan, Yang Liu, Hui Huang. Association of glycosylated hemoglobin level with lipid ratio and individual lipids in type 2 diabetic patients. Asian Pacific Journal of Tropical Medicine 2012; 469-471
9. http://www.nhlbi.nih.gov/guidelines/cholesterol/index.htm as visited on 19/8/2013
10. Ram Vinod Mahato et al. Association between glycaemic control and serum lipid profile in type 2 diabetic patients: Glycated haemoglobin as a dual biomarker. Biomedical Research 2011; 22 (3): 375-380
11. http://graphpad.com/quickcalcs/ttest2
12. http://www.wessa.net/corr.wasp
13. Goldberg IJ. Lipoprotein lipase and lipolysis: central roles in lipoprotein metabolism and atherogenesis. J Lipid Res 1996; 37: 693-707
14. Tavangar K, Murata Y, Pedersen ME, Goers JF, Hoff-man AR, Kraemer FB. Regulation of lipoprotein lipase in the diabetic rat. J Clin Invest 1992; 90: 1672-1678
15. Erciyas F et al. Glycemic control, oxidative stress and lipid profile in children with type 1 Diabetes Mellitus. Arch. Med. Res. 2004; 35: 134-140
16. Khan, H.A.et al. Association between glycaemic control and serum lipids profile in type 2 diabetic patients: HbA1c predicts dyslipidaemia. Clin. Exp. Med. 2007; 7: 24-29.
17. Khaw KT et al. Glycated haemoglobin, diabetes, and mortality in men in Norfolk cohort of European prospective investigation of cancer and nutrition. Brit Med J.2001; 332: 15-18

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