Estimation of Hba1c, Fbs, TC And TG in Subjects With Type Ii Diabetes Mellitus

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ABSTRACT *Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Venous blood samples were collected from all known cases of diabetes and controls to analyze Glycated hemoglobin, fasting blood sugar, total cholesterol, triglyceride. The HbA1c showed positive correlation with TC, TG, and FBS. These findings suggest that HbA1c level can be used as good parameter for predictor of dyslipidemia in type II diabetics in addition to as glycemic control.*

INTRODUCTION: Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Diabetes causes about 5% of all deaths globally each year. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. About 50% of people with diabetes die of cardiovascular disease (CVD).[1,2] In Indian population, 61.3 million people had diabetes in 2011, which is expected to reach 101.2 million by 2030 (International Diabetes Federation) now placing India at second position in world diabetic prevalence.[3]

Triglyceridemia is associated with increased risk of coronary heart disease, both in nondiabetic and type 2 diabetic subjects.[4,5] Diabetic patients with dyslipidemia are targets of cardiovascular deaths. Patients with type 2 diabetes often exhibit an atherogenic lipid profile, which greatly increases their risk for cardiovascular disease compared with people without diabetes.[6,7] The combination of hyperglycemia, diabetic dyslipidemia, insulin resistance and hypertension produces an enhanced atherogenic environment within the circulation.[8] Severe hyperlipidemia in diabetes may also lead to lipid infiltration into the retina, causing macular edema and retinal hard exudates and blindness.[9]

Glycated hemoglobin (HbA1c) is a routinely used marker for long-term glycemic control as an indicator for the mean blood glucose level. HbA1c predicts the risk for the development of diabetic complications in diabetes patients.[2] Apart from classical risk factors like dyslipidemia, elevated HbA1c has now been regarded as an independent risk factor for CVD in subjects with or without diabetes. Estimated risk of CVD has shown to be increased by 18% for each 1% increase in absolute HbA1c value in diabetic population.[10] Positive relationship between HbA1c and CVD has been demonstrated in non-diabetic cases even within normal range of HbA1c.[11-14]

The Diabetes Complications and Control Trial (DCCT) established glycosylated hemoglobin (HbA1c) are the gold standard of glycemic control, with levels ≤7% reducing the risk of vascular complications.[15] Elevated HbA1c has been regarded as an independent risk factor for coronary heart disease (CHD)[16] and stroke[17] in subjects with or without diabetes. Ravipati et al.[18] observed a direct correlation between HbA1c and the severity of coronary artery disease (CAD) in diabetic patients. Whereas, improving the glycemic control can substantially reduce the risk of cardiovascular events in diabetics.[19,20] Moreover, attempts to reduce cardiovascular risks resulted in the improvement of HbA1c even in the absence of any specific intervention targeted at improving glycemic control.[21]

Materials and Methods:
The present study was conducted in Department of Biochemistry, RohilKhand Medical College, Bareilly. Randomly selected, 100 patients with type II diabetic patients with an age & sex matched along with 100 healthy controls. Venous blood samples were collected for following parameters:

1. Fasting Blood Glucose by GOD-POD methods.[22]
2. Glycated Haemoglobin (HbA1c) by cation exchange resin methods.[23]
3. Total Cholesterol(TC) by enzymatic end point CHOD-POD methods.[24]
4. Triglyceride (TG) by enzymatic glycerol phosphate oxidase/peroxidase methods.[25]

All the parameters under investigation were determined in the serum of the subjects using commercially available reagent kits. The glycated hemoglobin (HbA1c) was estimated by appropriate standard kits. The data were evaluated by SPSS statistical package version 13.0. Pearson's correlation test was performed to examine various correlations. Independent samples t-test (2-tailed) was used to compare means of different parameters. Value of HbA1c were given as % of total hemoglobin and values of all other parameters were given in mg/dl. All values were expressed as mean±SD. We used student t-test and pearson's correlation coefficient to find the statistical significance. A P-value <0.05 was to be considered statistically significant.

Results and Discussion:
The present study shows significant increase in total cholesterol, fasting blood glucose, triglycerides and HbA1c in type 2 diabetic patients compared with non diabetic control subjects (P < 0.0001), as shown in table 1. There was a significant increase in total cholesterol, triglycerides and fasting blood glucose in diabetic patients compared to controls in reference to HbA1c, as shown in table 2.

Table 1: The mean of TC, TG, FBS, and HbA1c in type II diabetes and Controls:

Parameters	Type II Diabetes (n=100)	Controls (n=100)
	Mean ± SD	Mean ± SD
TC (mg/dl)	253.36±36.72	166.06±20.69
TG (mg/dl)	202.97±55.44	117.56±23.39
FBS(mg/dl)	165 ± 45.172	106 ± 17.106
HbA1c (%)	9.507 ± 1.742	6.065 ± 0.349

Statistically Significant at p value <0.0001

Table 2: Comparison of Mean of TC, TG and FBS in type II diabetes among Glycemic Control (HbA1c):

Parameters	(HbA1c)≤7.0 (n=100)	(HbA1c)>7.0 (n=100)
FBS	108.20 ± 22.26	143.55 ± 38.68
TC	142.95 ± 27.01	158.31 ± 29.58
TG	138.61 ± 45.77	165.39 ± 67.40

Statistically Significant at p value <0.0001

Table 3: Correlation between HbA1c and FBS, TC & TG of with type II diabetes:

Parameters	Correlation Coefficient(r)	P- value
FBS	+ 0.554	<0.0001
TC	+0.409	<0.001
TG	+0.316	<0.001

Further, it was found that glycated hemoglobin (HbA1c) was positively and significantly related with Total Cholesterol, Triglycerides and fasting blood sugar as shown in table 3.

In the present study, triglycerides and total cholesterol were increased in diabetic patients when compared with that of the control group. These findings are in agreement with reports of Abdella NA et al.,[26] Hayden JM and Reaven PS,[27] Smaoui M et al.,[28] and Wexler, D.J et al.[29]

A significant correlation between HbA1c and FBG found in this study is in agreement with earlier reports by Rosediani M et al.,[30] Ito C et al.,[31] and Ko GT et al.[32]

In this study, correlating HbA1c with total cholesterol and triglycerides suggested the importance of glycemic control in normalizing dyslipidemia in diabetic patients. This is in agreement with reports of Ladeia AM et al.,[33] Faulkner MS et al.,[34] and Chan WB et al.[35]

The significant increase in total cholesterol and triglycerides in patients with higher HbA1c value indicates that severity of dyslipidemia increases in patients with increased HbA1c value. This is found in agreement with findings of Khan, H.A et al.[36] and Rohlfing, C.L. et al.[15]

CONCLUSION:

The HbA1c showed positive correlation with TC, TG, and FBS. These findings suggest that HbA1c level can be used as good parameter for predictor of dyslipidemia in type II diabetics in addition to as glycemic control. Thus, early diagnosis of dyslipidemia can be used as a preventive measure for the development of cardiovascular disease in type-2 diabetics. So, HbA1c may be utilized for screening diabetic patient for risk of cardiovascular events and also for timely intervention with lipid lowering drugs.

Abbreviations used: Glycated hemoglobin(HbA1c), Total Cholesterol(TC), Triglyceride(TG), Fasting Blood Sugar (FBS), Cardio Vascular Disease (CVD) Diabetes Complications and Control Trial (DCCT) and Coronary Heart Disease (CHD).

REFERENCE 1.WHO. Diabetes. http://www.who.int/ nmh/publications/factsheet_diabetes_en. pdf (accessed 30/5/2013). 2.Glycosylated Haemoglobin, HbA1C. hptt:// clinlabnavi-gator.com/ test-interpretations/haemoglobin-a1c. html? Letter=h (Updated on 18 June 2010). 3.MK Yadav, Dr TK Mohapatra, Dr TK Mohapatra et. al. Study on Glycated Hemoglobin & lipid profile in Type-2 Diabetes Mellitus. International Journal of Science & Research (IJSR) 2015;4(6): 1917-19. 4.Frank B, Stampfer J, Steven M. Elevated risk of cardiovascular disease prior to clinical diagnosis of type 2 diabetes. Diabetes Care .2002; 25:1129- 34. 5.Sridhar RG. Diabetes in India: snapshot of a panorama. Current Science .2002; 83:1-2. 6.Haffner SM, Lehto S, Ronnemaa T, Pyorala K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction.. N Engl J Med .1998; 339:229-234. 7.Windler E. What is the consequence of an abnormal lipid profile in patients with type 2 diabetes or the metabolic syndrome? Atheroscler Suppl .2005; 6():11-14. 8.Gotto AM Jr. Cardiologist's role in improving glucose control and global cardiovascular risk in patients with type 2 diabetes mellitus. Am J Cardiol .2007; 99:3–5. 9.Miljanovic B, Glynn RJ, Nathan DM, Manson JE, Schaumberg DA. A prospective study of serum lipids and risk of diabetic macular edema in type 1 diabetes. Diabetes.2004; 53:2883–2892. 10.Selvin E, Marinopoulos S, Berkenblit G, Rami T, Brancati FL, Powe NR, et al. Meta-analysis: glycosy-lated hemoglobin and cardiovascular disease in diabetes mellitus.. Ann Intern Med.2004; 14:421-431. 11.Khaw KT, Wareham N, Bingham S, Luben R, Welch A and Day N. Association of hemoglobin A1c with cardiovascular disease and mortality in adults: the European Prospective Investigation into Cancer in Norfolk. Ann Intern Med .2004; 141:413-420. 12.Hill JB, Kessler G. An automated determination of glucose utilizing a glucose oxidase-peroxidase system. J Lab Clin Med .1961; 57:970-980. 13.Deeg R and Ziegenhorn J. Kinetic enzymatic method for automated determination of total cholesterol in serum. Clin Chem .1983; 29:1798-802. 14.Bucolo G and David H. Quantitative determination of serum triglycerides by the use of enzymes. Clin Chem .1973; 19:476-482. 15.Rohlfing CL, Wiedmeyer HM, Little RR, England JD, Tennill A, Goldstein DE. Defining the relationship between plasma glucose and HbA1c: analysis of glucose profiles and HbA1c in the Diabetes Control and Complications trial. Diabetes Care .2002; 25:275–278. 16.Selvin E, Coresh J, Golden SH, Brancati FL, Folsom AR, Steffes MW. Glycemic control and coronary heart disease risk in persons with and without diabetes: the atherosclerosis risk in communities study. Arch Intern Med .2005; 165:1910–1916. 17.Selvin E, Coresh J, Shahar E, Zhang L, Steffes M, Sharrett AR . Glycemia (haemoglobin A1c) and incident of ischemic stroke: the Atherosclerosis Risk in Communities (ARIC) study. Lancet Neurol .2005; 4:821–826. 18.Ravipati G, Aronow WS, Ahn C, Sujata K, Saulle LN, Weiss MB. Association of hemoglobin A1c level with the severity of coronary artery disease in patients with diabetes mellitus. . Am J Cardiol .2006; 97:968–969. 19.Selvin E, Wattanakit K, Steffens MW, Coresh J, SharrettAR. HbA1c and peripheral arterial disease in diabetes: the Atherosclerosis Risk in Communities study. Diabetes Care .2006; 29:877–882. 20.Kawasumi M, Tanaka Y, Uchino H, Shimizu T, Tamura Y, Sato F, Mita T, Watada K, Sakai K, Hirose T, Kawamori R. Strict glycemic control ameliorates the increase of carotid IMT in patients with type 2 diabetes . Endocr J .2006; 53:45–50. 21.Woodward A, Wallymahmed M, Wilding J, Gill G. Improved glycemic control: an unintended benefit of a nurse-led cardiovascular risk reduction clinic. Diabet Med .2005; 22:1272–1274. 22.Bergmayer H.V. – "Methods of Enzymatic Analysis",A.P., N.Y. 1974, Page 1196. 23.Gabby, K H et al. – J. Clin. End. Met. 44:859,1977. 24.Richmond W. – Preparation and properties of cholesterol oxidase from Nocardia sp. and its application to the enzymatic assay of total cholesterol in serum. Clin Chem. 19: 1350-1356, 1973. 25.Foosati P. and Prencipe L. – Serum triglyceride determined colorimetrically with an enzyme that produce hydrogen peroxide. Clin Chem. 28: 2077-2080, 1982. 26. Abdella NA, Mojiminiyi OA, Akanji AO, Al Mohammadi H, Moussa MAA. Serum lipoprotein (a) concentration as a cardiovascular risk factor in Kuwaiti type 2 diabetic patients. J Diabetes Complications. 2001; 15:270-276. 27. Hayden JM, Reaven PS. Cardiovascular disease in diabetes mellitus type 2: a potential role for novel cardiovascular risk factors. Curr Opin Lipidol .2000; 11:519-528. 28. Smaoui M, Hammami S, Chaaba R, Attia N, Ben Hamda K, Masmoudi AS, Mahjoub S, Bousslama A, Ben Ferhat M, Hammami M. Lipids and Lipoprotein (a) concentrations in Tunisian type 2 diabetic patients relationship to glycemic control and coronary heart disease. J Diabetes Complications.2004; 18:258 - 263. 29. Wexler, D.J., Grant, R.W., Meigs, J.B., Nathan, D.M. and Cagliero, E. Sex disparities in treatment of cardiac risk factors in patients with type 2 diabetes. Diabetes Care.2005; 28:514-520. 30. Rosediani M, Azidah AK, Mafauzy M. Correlation between fasting plasma glucose, post prandial glucose and glycated haemoglobin and fructosamine. . Med J Malaysia .2006; 61:67–71. 31. Ito C, Maeda R, Ishida S, Sasaki H, Harada H . Correlation among fasting plasma glucose, two-hour plasma glucose levels in OGTT and HbA1c. Diabetes Res Clin Pract .2000; 50:225–230 32. Ko GT, Chan JC, Woo J, Lau E, Yeung VT, Chow CC, Li JK, So WY, Chan WB, Cockram CS. Glycated hemoglobin and cardiovascular risk factors in Chinese subjects with normal glucose tolerance. Diabet Med .1998; 15:573–578. 33. Ladeia AM, Adan L, CoutoSilva AC, Hiltner A, Guimaraes AC. Lipid profile correlates with glycemic control in young patients with type 1 diabetes mellitus. . Prev Cardiol .2006; 9:82–88. 34. Faulkner MS, Chao WH, Kamth SK, Quinn L, Fritschi C, Maggiore JA, Williams RH, Reynolds RD . Total homocysteine, diet and lipid profiles in type 1 and type 2 diabetic and nondiabetic adolescents. J Cardiovasc Nurs .2006; 21:47–55. 35. Chan WB, Tong PC, Chow CC, So WY, Ng MC, Ma RC, Osaki R, Cockram CS, Chan JC . Triglyceride predicts cardiovascular mortality and its relationship with glycemia and obesity in Chinese type 2 diabetic patients. Diabetes Metab Res Rev .2005; 21:183–188. 36. Khan, H.A., Sobki, S.H. and Khan, S.A. Association between glycaemic control and serum lipids profile in type 2 diabetic patients: HbA1c predicts dyslipidemia. Clin. Exp. Med.2007; 7:24-29.