Relationship of Glycosylated Hemoglobin with Fasting and Postprandial Plasma Glucose in Nondiabetic, Pre-diabetic and Newly Diagnosed Diabetic Subjects

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Abstract

Glycosylated hemoglobin (HbA1c) is considered as an index of glycemic status of previous 2 to 3 months. HbA1c in diabetic subjects is translated to average glucose (eAG) and well correlated to mean plasma glucose (MPG). This study was performed to assess the relationship of fasting plasma glucose (FPG) and postprandial plasma glucose (PPG) with HbA1c in nondiabetic, pre-diabetic and newly diagnosed diabetic subjects. Seven hundred subjects of both sexes were included conveniently in this study. Fasting and 2 hours postprandial plasma glucose concentrations were measured by hexokinase method. HbA1c was measured by high performance liquid chromatyography (HPLC) based hemoglobin assay system.

Keywords: Glycosylated hemoglobin, Diabetes mellitus, Fasting plasma glucose, Postprandial plasma glucose.

Introduction

Measurement of glycosylated hemoglobin (HbA1c) is a fundamental component of the management of patients with diabetes mellitus, i. e, to monitor long-term glycemic status, to judge the adequacy of diabetes management and to adjust therapies.[1] Epidemiologic studies and clinical trial established the association of HbA1c with the risk for long-term complications of hyperglycemia.[2,3,4] The A1c Derived Average Glucose (ADAG) Study defined the mathematical relationship between HbA1c and average glucose (AG), similar to the mathematical relationship of HbA1c and Mean Plasma glucose (MPG) in the Diabetes Control and Complication Trial (DCCT).[5,6] The DCCT trial included only 1439 type 1 diabetic subjects whereas ADAG study included 507 subjects including 268 type 1, 159 type 2 diabetic subjects and 80 nondiabetic subjects. The correlation coefficient of HbA1c with AG is higher than the correlation coefficient of HbA1c with MPG (0.92 vs 0.82). The ADAG study included stable hyperglycemic subjects. But this study included lower number of participants from

Subjects were classified into three groups according to WHO criteria. The correlation coefficient between FPG and HbA1c were 0.2495 (P<0.001), 0.2665 (P<0.001) and 0.8010 (P<0.001) in the nondiabetic, pre-diabetic and newly diagnosed diabetic subjects respectively. The correlation coefficient between PPG and HbA1c were -0.0661 (P>0.05), 0.2447 (P<0.01) and 0.7812 (P<0.001) in the nondiabetic, pre-diabetic and newly diagnosed diabetic subjects respectively. This study revealed that fasting plasma glucose had a modest higher relation with HbA1c than 2 hours postprandial plasma glucose in the newly diagnosed diabetic subjects. It can be concluded that evaluation of FPG may provide better outcome than PPG in the newly diagnosed never treated diabetic subjects.

Asia. In this study we aimed to determine the correlation coefficient of HbA1c with FPG and PPG in newly diagnosed never treated diabetic subjects as well as pre-diabetic and nondiabetic subject in a Bangladeshi population.

Methods

The study was carried out in the Department of Biochemistry and Cell Biology, Bangladesh Institute of Health Sciences, Dhaka, Bangladesh during September 2009 to August 2010. A total of seven hundred subjects of both sexes were included conveniently. Fasting and 2 hours postprandial (after oral glucose load) plasma glucose was measured by hexokinase method using kits manufactured by Siemens Health Care Ltd by Dimension RxL Max automated chemistry analyzer. HbA1c was measured by cation-exchange high-pressure liquid chromatography (HPLC) using D-10™ (BioRad, USA) hemoglobin assay system. Subjects were classified into three groups, i e, nodiabetic, pre-diabetic (IGT and IFG) and diabetic according to WHO criteria.[7] Results are expressed as mean±SD. Pearson's correlation coefficients of FPG and PPG with HbA1c in total and different groups were determined by STATISTICA version 8

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for Windows.

Results

The mean±SD of age of the total study subjects were 43.66±12.33 years (range: 11-85 years). Of the total, 279 (39.86%) were male with mean age of 47.08±11.60 years and 421 (60.14%) were female with mean age of 41.39±12.30 years. Mean±SD of age, number of subjects, FPG, PPG and HbA1c of the four groups are presented in table I. The correlation coefficient of FPG and PPG with HbA1c in the total study subjects were 0.8623 (P<0.001), 0.8574 (P<0.001) respectively. In the nondiabetic group, the correlation coefficient of FPG and PPG with HbA1c were 0.2495 (P<0.001) and -0.0661 (P>0.05) respectively. In the pre-diabetic group the correlation coefficient of FPG and PPG with HbA1c were 0.2665 (P<0.001) and 0.2447 (P<0.01) respectively. The Pearson's correlation coefficient of FPG and PPG with HbA1c in the diabetic subjects were 0.8012 (P<0.001) and 0.7812 (P<0.001).

Table I. Characteristics of the diabetic, pre-diabetic and nondiabetic groups.

Parameters	Mean±SD		
	Diabetic (n=347)	Prediabetic (n=157)	Nondiabetic (n=196)
Age (years)	44.44±11.60	43.83±12.61	42.14±13.27
FPG (mmol/L)	9.79±4.25	5.56±0.68	4.93±0.55
PPG (mmol/L)	17.41±5.52	8.99±1.31	5.99±1.03
HbA $_{1c}$ (%)	9.51±2.81	6.36±0.94	5.80±0.55
N, number of subjects			

Discussion

Our results indicate that the correlation coefficient between FPG and HbA1c is statistically highly significant (P<0.001) and slightly higher than the statistically significant (P<0.001) correlation coefficient between PPG and HbA1c in the newly diagnosed diabetic subjects (0.8010 vs 0.7812). In the pre-diabetic group, the correlation coefficient of FPG and PPG with HbA1c are statistically significant (P<0.001, P<0.01), but the correlation coefficient between FPG and HbA1c is stronger than the correlation coefficient between PPG and HbA1c (0.2665 vs 0.2447). The correlation coefficient of plasma glucose with HbA1c in the pre-diabetic group are weaker than the correlation coefficient of plasma glucose with HbA1c in newly diagnosed diabetic subjects. It is also found that only FPG showed significant correlation with HbA1c in nondiabetic subjects.

HbA1c is now considered as the best index for the control of diabetes as well as for preventing complications of diabetes. The correlation of FPG with HbA1c is slightly higher than the correlation of PPG with HbA1c in the newly diagnosed diabetic subjects in this study. Moreover, the correlation coefficient of FPG with HbA1c is closer to DCCT[6] (0.80 vs 0.82). So evaluation of FPG may be a better tool than PPG for the diagnosis, management and prognosis in the newly diagnosed never treated diabetic subjects.

Conclusion

This study revealed that fasting plasma glucose had a modest higher relation with HbA1c than 2 hours postprandial plasma glucose in the newly diagnosed diabetic subjects. It can be concluded that evaluation of FPG may be a better tool than PPG for the diagnosis, management and prognosis in the newly diagnosed never treated diabetic subjects.

References

1. Sacks DB, Bruns DE, Goldstein DE, Maclaren NK, McDonald JM, Parrott M. Guidelines and recommendations for laboratory analysis in the diagnosis and management of diabetes mellitus. Clin Chem 2002;48:436-72.

2. Diabetes Control and Complications Trial Research Group. The effect of intensive diabetes treatment on the development and progression of long-term compl ications in insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. N Eng J Med 1993;329:978-86.

3. DCCT Research Group. The association between glyceamic exposure and long-term diabetic complications in the Diabetes Control and Complications Trial. Diabetes 1995;44:968-83.

4. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in type 2 diabetes (UKPDS 33). Lancet 1988;352:837-53.

5. ADAG Study Group. Translating the hemoglobin A1c assay into estimated average glucose values. Diabetes Care 2008;31:1473-8.

6. Rohlfing CL, Wiedmeyer HM, Little R, England JD, Tennill A, Goldstein DE. Defining the relationship between plasma glucose and HbA1c in the Diabetes Control and Complications Trial. Diabetes Care 2002;25:275-8.

7. Frier BM, Fisher M. Diabetes Mellitus. In NA Boon, NR Colledge, BR Walker (eds). Davidson's Principles & Practice of Medicine. 20th edn. Churchill Livingstone. Philadelphia 2006;805-47.