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RELATION OF CALCULATED HbA_{1C} WITH FASTING PLASMA GLUCOSE AND DURATION OF DIABETES

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ABSTRACT

Background and objectives

Glycosylated hemoglobin (HbA_{1c}) is a marker of evaluation of long-term glycemic control in diabetic patients and predict risks for the development and/or progression of diabetic complications. Glycosylation process depends on the exposure to glucose. Studies on chronic complications of diabetes established the role of glycosylated hemoglobin (HbA_{1c}) as a marker of evaluation of long term glycemic control and risk for chronic complications. The aim of this study is to evaluate the significance of calculated HbA_{1c} by using fasting plasma glucose levels and comparison with duration of diabetes mellitus.

Materials and methods

The present study has 2 groups of subjects, 27 normal and 32 diabetic subjects. The diabetic subjects were divided into 2 groups based on complication i,e cataract and nephropathy with duration of diabetes. Plasma glucose was estimated by GOD – POD method. Estimation of glycated hemoglobin was done by calculation.

Results and conclusion

We found the significance in the duration of diabetes and the levels of glycated hemoglobin and fasting glucose levels were significantly increased in diabetic group as compared to normal subjects (p<0.001). Thus, calculated HbA_{1c} levels can be used with regular checkups of FPG and HbA_{1c} levels in diabetic patients at lesser cost.

Key words: Glycated hemoglobin (HbA_{1c}), Diabetes mellitus, Fasting plasma glucose (FPG).

INTRODUCTION

Studies on chronic complications of diabetes established the role of glycosylated hemoglobin (HbA_{1c}) as a marker of evaluation of long term glycemic control and risk for chronic complications (1). The diabetes Control and Complication Trial (DCCT) study, has demonstrated that the 10% stable reduction in HbA_{1c} determines a 35% risk reduction for retinopathy, a 25-44% risk reduction for nephropathy (2-4).

In normoglycemic subjects a small proportion of hemoglobin A is attached to a carbohydrate moiety thus creating what is called glycated hemoglobin (3). In conditions of sustained hyperglycemia, such as in diabetes mellitus, the proportion of hemoglobin that is glycated is increased substantially (5,6). Studies conducted by Arnetz *et al* (7) and Kilpatrick *et al* (8) in diabetic patients have shown a significant positive correlation between HbA1c and age as well as duration of diabetes. In contradiction to this Kabadi (9) found no significant relationship between age, duration of diabetes and fasting blood glucose (FBG), glycated hemoglobin.

The aim of this study is to evaluate the significance of calculated HbA_{1c} by using fasting plasma glucose levels and comparing it with duration of diabetes mellitus.

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MATERIALS AND METHODS

The present study has 2 groups of subjects, 27 normal and 32 diabetic subjects. The diabetic subjects were divided into 2 groups based on complication i,e cataract and nephropathy with duration of diabetes. The study was approved by the Institutional Time Bound Research committee. A written informed consent was taken from the subjects.

Sample collection

2ml of fasting venous blood samples were collected in sodium fluoride vacutainers under aseptic precautions from all subjects. Age, sex and duration of diabetes were noted. The blood was analyzed for glucose.

Biochemical estimations

Plasma glucose was estimated by GOD – POD method (10). Estimation of glycated hemoglobin was done by calculation (11). HbA_{1c} = 2.6 + 0.03 Plasma glucose (mg/dl), mean blood glucose level of 130 mg/dl(=7.2 mmol/L) would be equivalent to 6.5% HbA_{1c}. Any additional 10 mg/dl (=0.56 mmol/L) translate to an additional 0.3% HbA_{1c}.

Statistical analysis

Results were subjected to statistical analysis by Analysis of variance (ANOVA)(Kruskal Wallis test) and the values expressed as mean SD. Since the data showed a skewed distribution median & inter quartile range were given. Wherever the Kruskal Wallis test was significant pair wise comparison was done using Mann Whitney test adjusting for type 1 error.

RESULTS

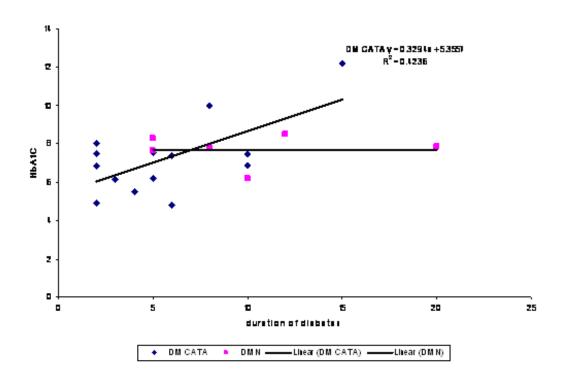
The results of the study are shown in table 1. We found significance in the duration of diabetes. The levels of glycated hemoglobin and fasting glucose levels were significantly increased in diabetic group as compared to normal subjects. The correlation study has no significance with respect to duration with glycated hemoglobin as shown in graph 1. We also found no significance in HbA_{1c} levels between diabetic groups.

	Normal subjects (27)	Diabetic with cataract (20)	Diabetic with nephropathy (12)	
Duration of	-	5.00	9.00 °*	
diabetes(Yrs)		(2.25-7.5)	(5.75-11.5)	
Glucose (mg/dl)	91.50 ^{a***}	142.17 ^{b***}	174.53 °*	
	(79.59-99.48)	(103.2-168.6)	(168.55-197.51)	
HbA _{1c}	5.3 ^{a***}	6.86 ^{b***}	7.81	
	(4.98-5.5)	(5.7-7.66)	(7.29-8.32)	
<pre>* = Significant (p < 0.05) ** = Highly Significant (p < 0.01) *** = Very Highly Significant (p < 0.001)</pre>		a= Comparison between group 1 & 3 b= Comparison between group 1 & 2 c= Comparison between group 2 & 3		

Table 1: Duration,	Glucose and	HbA _{1c} levels	in	study subjects

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Graph 1: Correlation of HbA_{1c} with duration of diabetes

DISCUSSION

 HbA_{1c} is the product of non-enzymatic reaction between glucose and free amino groups of hemoglobin. This reaction, called glycosylation, involves lots of other proteins, too and it is the principal mechanism through which glucotoxicity is formed. In the last 20 years improved techniques in laboratory and new electrophoretical, chromatographic and immunological methods available, gave us a greater reliability on our results. However the use of different methods, the lack of a common calibration concerning the same method and the variability of instrumentation do not make reproducible results yet in different laboratories. The liquid chromatography ionic exchange is now the most reliable methodology. It allows to measure with precision all sub-fractions of HbA_{1c} and anomalous hemoglobins. Its cost is high and it is not available in all the laboratories (12, 13). In the present study we observed a positive correlation of glucose with HbA_{1c} in each of 3 groups (r = 0.999, 0.975 & 1.000).

A positive correlation of glucose with duration of diabetes was seen between group 2 & 3 (r = 0.998). Studies of Kilpatrick *et al* (14) in diabetic patients showed significant +ve correlation between HbA_{1c} & age as well as duration of diabetes. In contrast Kabadi *et al* (15) found no significant relation between age, duration of diabetes, fasting glucose & HbA_{1c}.

In the above study we calculated the HbA_{1c} values using FPG levels in all the subjects, but we couldn't estimate its level using laboratory technique. Hence we would like to do this study in larger group comparing calculated value with that of laboratory determined value.

The basic concept of this study is to make regular checkups of FPG and HbA_{1c} levels in diabetic patients with less cost.

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