Original article:

“Glycosylated hemoglobin and fasting blood glucose levels in type 2 diabetes mellitus”

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Abstract

Background: Diabetes is a growing public health problem throughout the world. It is now among the five leading causes of death to disease in most countries. As a consequence of hyperglycemia in diabetes every tissue and organ of the body undergoes biochemical and structural alterations which accounts for major diabetes complications. Our aim was to determine the levels of glycosylated hemoglobin (HbA1C) and fasting blood glucose (FBG) in patients with type 2 diabetes mellitus and to compare with healthy controls and also the study of correlation between Fasting blood glucose and HbA1c levels in diabetic patients.

Material and Methods: In this study total 80 subjects were included above 40 years of age. 40 clinically diagnosed type 2 diabetic patients and 40 normal subjects were recruited as control. HbA1C and fasting blood glucose levels were measured by the methods of Parker K. M. et al.and Trinder P respectively.

Results: The mean value of HbA1C in type 2 diabetic patients was significantly higher than in the controls. The mean fasting blood glucose levels were significantly higher in type 2 diabetics when compared with controls and the significant correlation was observed between levels of fasting blood glucose and HbA1c in diabetic patients.

Conclusions: HbA1c can be used as a monitor of diabetic control and thus useful in assessing the status and the therapeutic progress of diabetes mellitus.

Key-words: Type 2 diabetes mellitus, HbA1c, fasting blood glucose, diabetic control

Introduction

Diabetes is a chronic disease which affects virtually every organ in the human system. There are an estimated 246 million people with diabetes in the world, of whom about 80% reside in developing countries. India is the country that currently has the largest number of people with diabetes (40.9 million), and this number is expected to increase to 69.9 million by the year 2025. [1] Although the prevalence of type 2 diabetes mellitus is rising much more rapidly because of increasing obesity and reduced activity levels as countries, become more Industrialized. This is true in most countries, and 6 of the top 10 countries with the highest rates are in Asia. [2] The most disturbing trend is a shift in age of onset of diabetes to a younger age in recent years. This presents a serious challenge to the healthcare system because, at the peak of their working career, people with diabetes have an excess risk of mortality and morbidity compared with those without diabetes. [1]
Glycosylated hemoglobin (HbA1c) is a naturally occurring, non-enzymatic product from exposure of hemoglobin to glucose. HbA1c circulate within red blood cells whose like span lasts up to 120 days, they generally reflect the state of glycemia over the preceding 8-12 weeks, and its formation is thus greatly enhanced in the individuals with chronic hyperglycemia. The higher HbA1c concentration are strongly associated with an increased risk for the development and progression of micro vascular complications. Therefore, the present study was planned to determine the glycosylated hemoglobin and fasting blood glucose levels and its correlation in type 2 diabetic patients.

**Material and Methods**

Present study was conducted in the Department of Biochemistry, Government Medical College, Miraj. Study group included 40 patients above 40 years of age and diagnosed by clinicians as type 2 diabetes mellitus based on performing fasting blood glucose determination. Control group included 40 health controls without any family history of diabetes and no abnormal clinical findings and matching in age with study group. The institutional Ethics Committee approved the study and consent was obtained from each participant in the study. Patients with myocardial infarction, renal diseases, coronary heart disease and type 1 diabetes mellitus were excluded from this study.

Blood samples were collected from control group and study group under aseptic conditions. For the determination of glycosylated hemoglobin (HbA1c) blood was collected in an EDTA bulb. The samples were centrifuged at 800 x 9 for 10 minutes. Plasma was removed and packed cells were washed twice with five times of normal saline. The packed cells were lysed, with approximately two volumes of water and one volume of carbontetrachloride was added to the hemolysate, mixed and refrigerated at 4°C overnight. The hemolysate were centrifuged at 2700 x 9 for 10 minutes and the aqueous supernatant was stored at 4°C until analysis. Appropriate aqueous dilutions were prepared by colorimetric method.

Fasting blood glucose levels were determined immediately by Glucose oxidase method. Statistical analysis was performed using Minitab software. The data of patients and controls was analyzed by students ‘t’ test.
Table No. 1: Fasting blood Glucose Level (FBGL) and Glycosylated hemoglobin (HbA1c) and in diabetic patients and controls

<table>
<thead>
<tr>
<th>Subjects</th>
<th>FBGL mg/dl Mean ± SD</th>
<th>HbA1c n moles of fructose equivalent /10 mg of Hb Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>169.0 ± 35.4*</td>
<td>70.84 ± 4.88*</td>
</tr>
<tr>
<td>Controls</td>
<td>75.8 ±12.9</td>
<td>35.17 ± 2.77</td>
</tr>
</tbody>
</table>

[The statistical method used to compare data was ‘t’ test. * P<0.001 – highly significant.]

![Correlation between Fasting blood glucose level and HbA1c in diabetic patients](image-url)
Results and Discussion
The mean fasting blood glucose levels in diabetic patients were 169.0 ± 35.4 mg/dL and that of control group were 75.8 ± 12.9 mg/dL. The fasting blood glucose level in diabetic patients showed hyperglycemia and highly significant (P < 0.001) increase when compared with controls. Hyperglycemia is a characteristic feature of diabetes mellitus, this is due to relative or absolute deficiency of insulin secretion response which translates into impaired carbohydrate metabolism. The mean glycosylated hemoglobin level in diabetic patients showed highly significant increase (P < 0.001) as compared to control group. In diabetic patients HbA1c level was 70.84 ± 4.88 n moles of fructose equivalent / 10 mg of Hb and in controls it was 35.17 ± 2.77 n moles of fructose equivalent / 10 mg of Hb.
Correlation between fasting blood glucose and glycosylated hemoglobin levels:
In our study, positive and significant correlation was observed between levels of fasting blood glucose and HbA1c in diabetic patients (r=0.322, P < 0.05) as shown in Graph No.1. Arye L.V et al (1979) also found a good correlation between levels of fasting blood glucose and HbA1c and supported by Rahman M. A et al (1990).
This is seen, because glycation starts with non enzymatic reversible condensation which depends upon the concentration of glucose and occurs at a high rate in diabetes.
To conclude, the glycosylated hemoglobin level provides a reliable measure of chronic glycemia and correlates well with the risk of long term diabetes complications. Thus, the determination of HbA1c is a useful indicator of glycemic control and should be used to monitor the effects of diet, exercise and drug therapy on blood glucose in diabetic patients and our results document its tight correlation with concentration of blood glucose average overtime.

References