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A correlative study of glycosylated hemoglobin in normal and Type 2 Diabeteic patients

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ABSTRACT

Obesity is a positive risk factor in the development of type 2 diabetes mellitus. For the last few years estimation of glycosylated hemoglobin & fructosamine has been increasingly used to achieve better monitoring of long term glycemic control in diabetics.The present study was undertaken to correlate glycosylated hemoglobin in normal and type 2 diabetes mellitus patients.The study group was divided into Control (non diabetic subjects, N=57), Group 1 (Diabetic only patients, N=58), and Group 2 (Diabetic with hypertension patients, N=58). Glycosylated hemoglobin was measured by auto analyzer method. Any value >7% were considered as increased $HbA_{1c.}$ HbA_{1c} was measured after one month of recording FBS & PPBS levels. The mean value of FBS in Controls, Group1 and Group2 were 87.82 ± 1.21, 125.18 ± 4.82 and 127.25 ± 4.30 respectively. The mean value of PPBS in Controls, Group1 and Group2 were 126.10 ± 5.46, 186.03 ± 7.36 and 186.76 ± 6.55 respectively. The mean value of HbA_{1c} in Controls, Group1 and Group2 were 7.08 ± 0.22, 8.01 ± 0.16 and 8.34 ± 0.15 respectively. When the inter comparison of Controls, Group1 and Group 2 for FBS, PPBS and HbA_{1c} shows a significant increase in the level of all the three parameters (Tukey's test, $P<0.001$) in Group1 and Group2. The present data indicate that significant increase in FBS, PPBS and HbA_{1c} levels in diabetics and diabetes with hypertension patients, the increase in HbA_{1c} levels could be due to an increase in non enzymatic glycation of hemoglobin.

Key words: Glycosylated hemoglobin, diabetes with hypertension, glycosylation.

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INTRODUCTION

Diabetes mellitus, once regarded as a single disease entity, is now seen as a heterogeneous group of diseases, characterized by a state of chronic hyperglycemia, resulting from a diversity of aetiologies, environmental and genetic, acting jointly. Type 2 diabetes mellitus (NIDDM) is much more common than type 1 diabetes mellitus (IDDM). Type 2 diabetes mellitus is typically gradual in onset and occurs mainly in the middle-aged and elderly, frequently mild, slow to progress, and is compatible with long survival if given adequate treatment. Diabetic patients, if undiagnosed or inadequately treated develop multiple chronic complications [1].

The estimation of urine and blood sugar levels are done commonly for diagnosis and monitoring of glycemic control, and they are subjected to various physiological and pathological fluctuations. They represent the current glycemic status of the patient and they are poor indicators of long-term control of diabetes. For the last few years, estimation of glycosylated hemoglobin and fructosamine has been increasingly used to achieve better monitoring of long-term glycemic control in diabetics. When plasma glucose is consistently elevated, there is an increase in non-enzymatic glycation of hemoglobin. This alteration reflects the glycemic history over the previous 2 to 3 months, since erythrocytes have an average life span of 120 days [2].

Formation of glycated hemoglobin is irreversible, and the blood level depends on both the life span of the red blood cell (average 120 days) and the blood glucose concentration. The amount of HbA_{1c} therefore represents the integrated values for glucose over the preceding 6 to 8 weeks and provides an additional criterion for assessing glucose control. Values are free of day-to-day glucose fluctuations and unaffected by exercise or recent food ingestion. The interpretation of glycated hemoglobin depends on the red blood cells having a normal life span. Patients with hemolytic disease or other conditions with shortened red blood cell survival exhibit a significant reduction in HbA_{1c}. High HbA_{1c} levels have been reported in iron deficiency anemia, probably because of the high proportion of old erythrocytes [3].

The present study was undertaken to correlate glycosylated hemoglobin in normal and type 2 diabetes mellitus patients.

MATERIALS AND METHODS

In the present study, type 2 diabetes mellitus patients coming for regular check-up in KMC Attavar hospital were included as subjects, irrespective of their sex and duration of illness. 116 consecutive cases were taken and 57 age-matched, non-diabetic subjects were included as controls in this study. Out of the 116 diabetic patients, 58 were diabetic only and 58 were diabetic with hypertension.

The study group was divided into:

- Controls: - Non-diabetic subjects (N = 57)

- Group 1:- Diabetic only patients (N = 58)
- Group 2:- Diabetic with hypertension patients (N = 58)

A detailed history was taken. General physical examination including height, body weight, waist-hip ratio, blood pressure, pulse rate, respiratory rate and complete systemic examination was done. Fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycosylated hemoglobin (HbA_{1c}) and lipid profile were studied. Drug history was taken. The patients diagnosed for Type 2 diabetes were included in the study whereas; patients with Type 1 diabetes were excluded in the present study.

Patients were classified as having diabetes on the basis of history, regardless of the duration of disease or need for anti diabetic agents. Major selection criteria for diabetes included: a random plasma glucose level of 200mg/dL or greater when the symptoms of diabetes were present and a fasting plasma glucose level of 126 mg/dL or greater. Major selection criteria for hypertension included: all the untreated hypertensives with systolic blood pressure above 140 mmHg and diastolic blood pressure above 90 mmHg or treated hypertensives on anti hypertensive drug.

STATISTICAL ANALYSIS

Data are expressed as Mean±SEM. Statistical analysis was done by using "ANOVA"; students't' test. Tukey's test was used in intercomparison of the three groups. P value was taken as significant at 5 percent confidence level ($P<0.05$).

RESULTS

The mean value of FBS in Controls, Group1 and Group2 were 87.82 ± 1.21, 125.18 ± 4.82 and 127.25 ± 4.30 respectively. The mean value of PPBS in Controls, Group1 and Group2 were 126.10 ± 5.46, 186.03 ± 7.36 and 186.76 ± 6.55 respectively. The mean value of HbA_{1c} in Controls, Group1 and Group2 were 7.08 ± 0.22, 8.01 ± 0.16 and 8.34 ± 0.15 respectively. When the inter comparison of non diabetic subjects, diabetic only patients and diabetic with hypertension patients for FBS, PPBS and HbA1c shows a significant increase in the level of all the three parameters (Tukey's test $P<0.001$) in diabetic only patients and diabetic with hypertension patients (Table-1& 2, and Fig-1&2).

DISCUSSION

In normoglycemic subjects, a small proportion of HbA is attached to carbohydrate moiety, and forms glycosylated hemoglobin. In conditions of sustained hyperglycemia, such as diabetes mellitus, the proportion of hemoglobin that is glycosylated is increased substantially. This glycosylation is the result of post-translational modification of HbA molecules. The binding of glucose is a non-enzymatic process that occurs continuously during the life of the red blood cell. Thus the amount of glycosylated hemoglobin reflects the glycemic control of a patient during the 6-8 week period before the blood sample was obtained [4].

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The present data indicate that significant increase in FBS, PPBS and HbA_{1c} levels in diabetics and diabetes with hypertension patients, the increase in HbA_{1c} levels could be due to an increase in non enzymatic glycation of hemoglobin.

Since most of the type 2 diabetes mellitus patients are obese, weight loss and exercise of moderate degree, are associated with insulin sensitivity, and often improve glucose control (significant improvement in glycosylated hemoglobin levels) in diabetics[3]. Improvement of glycemic control can lower serum triglyceride levels and have a modest beneficial effect on rising HDL-cholesterol [2].

TABLE -1. Fasting Blood Sugar (FBS), Post Prandial Blood Sugar (PPBS) levels in control and study groups. Data were expressed as Mean ± SEM.

Parameters	Controls (N=57)	Group 1 (N=58)	Group 2 (N=58)	P value
FBS (mg/dL)	87.82 ± 1.21	125.18 ± 4.82	127.25 ± 4.30	0.001
PPBS (mg/dL)	126.10 ± 5.46	186.03 ± 7.36	186.76 ± 6.55	0.001

Note: Controls- Non-diabetic subjects, Group 1- Diabetic only patients, Group 2- Diabetic with hypertension patients. P<0.05 was considered as the level of significance.

TABLE-2 Glycosylated hemoglobin (HbA1c) levels in control and study groups. Data were expressed as Mean ± SEM.

Parameters	Controls (N=57)	Group 1 (N=58)	Group 2 (N=58)	P value
HbA_{1c} (%)	7.08 ± 0.22	8.01 ± 0.16	8.34 ± 0.15	0.001

Note: Controls:- Non-diabetic subjects, Group 1- Diabetic only patients, Group 2- Diabetic with hypertension patients. P<0.05 was considered as the level of significance.

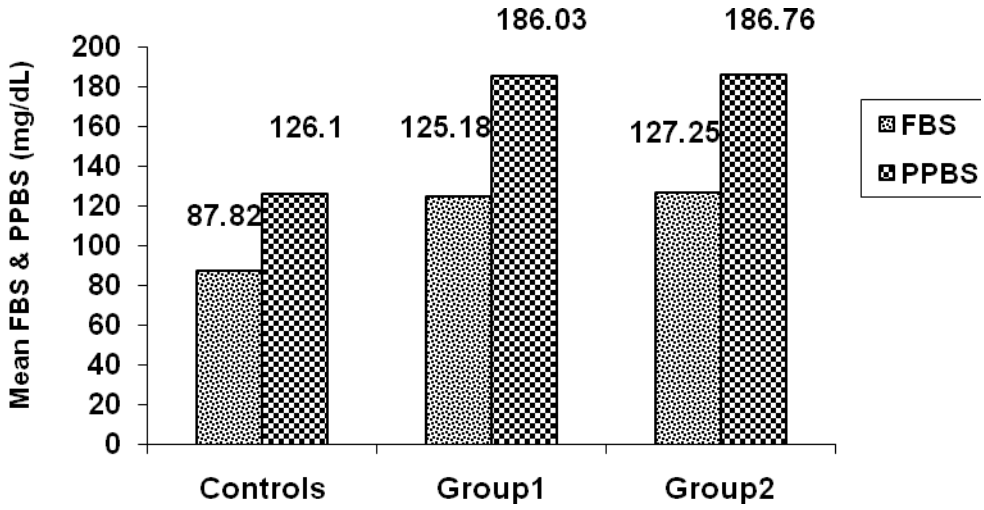

FIG - 1. Mean FBS & PPBS (mg/dL) levels in non-diabetic subjects, diabetic only patients and diabetic with hypertension patients.

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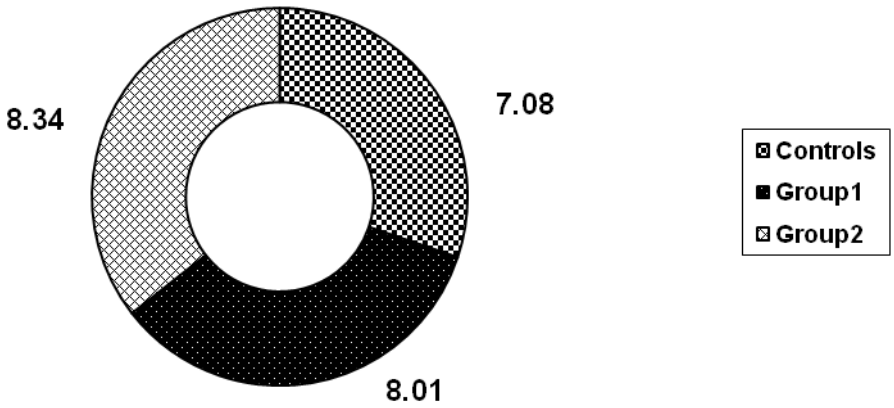

FIG - 2. Mean HbA1c (%) levels in non-diabetic subjects, diabetic only patients (Group-1) and diabetic with hypertension patients (Group-2).

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