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Assessing The Glycemic Control in Type 2 Diabetic Patients By Comparing Glycosylated Hemoglobin Levels (Hba1c) With Fasting And Postprandial Glucose

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Abstract
Background: *Diabetes Mellitus (DM) is a metabolic disorder characterized by the presence of chronic hyperglycemia accompanied by greater or lesser impairment in the metabolism of carbohydrates, lipids and proteins resulting from insulin resistance, and relative insulin deficiency.*
Objectives: *This study was conducted to assess the correlation of glycosylated hemoglobin levels with fasting and postprandial glucose in type 2 diabetic patients attending Mahavir institute of Medical Sciences (MIMS) – hospital, (Central Laboratory) Vikarabad, Telangana State, India.*
Method: *A Retrospective observational study was undertaken at MIMS after obtaining clearance from the Institutional Ethical Committee. A simple random sampling technique was adopted, over a period of six months. Data was collected on the Subjects attended the different In-patient departments of MIMS, diagnosed with type 2 diabetes mellitus (T2DM), that fasting blood sugar (FBS), postprandial blood sugar (PPBS) and HbA1c measured during previous follow-ups were included in the study. The study population was divided into two groups based on the HbA1c values i.e. Group 1 Controlled (<6.55) Group 2 Uncontrolled (6.56 >7.9).*
Result: *Both postprandial blood glucose and fasting blood glucose significantly correlated with HbA1c. Postprandial blood glucose showed better correlation to HbA1c than fasting blood glucose (r= 0.33, P=0.001* vs r=0.206 P=0.04*).*
Conclusion: *These results show that postprandial blood glucose predicted overall glycemic control better than fasting blood glucose. In conditions with limitations for using HbA1c, FBS & PPBS can be used to monitor the glyceic control.*
Keywords: *Fasting blood sugar (FBS), Glucose, Glycated hemoglobin (HbA1c), Postprandial blood sugar (PPBS), Glycemic control,*

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I. Introduction

Diabetes mellitus is one of the most prevalent noncommunicable diseases and has become a modern epidemic. [1] Globally, it is among the top ten leading causes of death in most high-income countries, and there is a substantial evidence for it being an epidemic in many developing countries. Patients with diabetes mellitus are at higher risk to develop both micro vascular and macro vascular complication. [2] Moreover, the Asian Indian phenotype is more prone to diabetes mellitus than rest ofthe world's population, and most of the people with diabetes are between 40 and 59 years of age. [3, 4]For decades, the diagnosis of diabetes was based on plasma glucose criteria, either the fasting blood glucose (FBG) or a 2-h value in the 75-g oral glucose tolerance test (OGTT). The special requirements for the OGTT, fasting and 2-h postprandial plasma glucose, limit the clinical application of these methods. In 2009, an International Expert Committee that included representatives of the American Diabetes Association (ADA), the International Diabetes Federation and the European Association for the Study of Diabetes recommended the use of glycated hemoglobin (HbA1c) test to diagnose diabetes with a threshold of ≥6.5% and this criterion was adopted by ADA in 2010. [5] HbA1c test is convenient and easy to do irrespective to the time elapsed since the previous meal, has low day to day variability, greater stability and reflects the average blood glucose over the previous 8-12 weeks. [6,7,8]

HbA1c, a form of glycated hemoglobin, is one of the tools, used primarily to assess control of blood glucose over prolonged period of time in diabetic patients, especially with DM type 2. [9] It accounts for about 3-6% of total hemoglobin(Hb).[11] Level of glycated hemoglobin (Hb) depends upon lifespan of Red blood cell (average 120 days) and the blood glucose concentration. It is the best single way for evaluating risk for glycemic damage to tissues including nerves and small blood vessels in eyes and kidneys. Improving HbA1c measurement decreases development and progression of eye, kidney and nerve complication in both DM type 1 and DM type 2. A total of 30-35% of reduction in micro vascular complications occurs per 1% absolute reduction in glycated hemoglobin(Hb). It is found that a 14 to 16% decrease in macro vascular complication occurs for every 1% absolute reductions in glycated Hb [12]. However, HbA1c is not used for diagnosis as it is not sufficiently sensitive[13].ccording to revised ADA guidelines, people with HbA1c levels in the range of 5.7-6.4% are "at very high risk" for developing diabetes mellitus over 5 years. Henceforth, the range of 5.5-6.0% is the appropriate level to initiate preventive measures. [5]

II. Objective

To assess the correlation of glycosylated hemoglobin levels with fasting and postprandial glucose in type 2 diabetic patients attending MIMS.

III. Methods And Materials

A Retrospective observational study was undertaken at Mahavir institute of Medical Sciences– hospital, (Central Laboratory) Vikarabad, Telangana State, India, after obtaining clearance from the Institutional Ethical Committee. A simple random sampling technique was adopted, over a period of six months, case files and laboratory records will be retrieved of the patients attended the different In-patient departments of Mahavir institute of medical Sciences – hospital diagnosed with type 2 diabetes mellitus (T2DM), and advised investigations HbA1c, fasting blood sugar (FBS), and postprandial blood sugar (PPBS) will be included in the study.

3.1Inclusion criteria:

Subjects diagnosed with type 2 diabetes mellitus (T2DM).

3.2 Exclusion criteria:

1. Subjects with known diabetes mellitus (type 1)
2. Subjects with, Hypothyroidism, Cushing's syndrome, chronic systemic illness, Hepatic, impairment, renal disorder, will not be recruited.

Data was collected on the Subjects attended the different In-patient departments of Mahavir institute of medical Sciences– hospital diagnosed with type 2 diabetes mellitus (T2DM), that fasting blood sugar (FBS), postprandial blood sugar (PPBS) and HbA1c measured during previous follow-ups were included in the study. The study population was divided into two groups based on the HbA1c values i.e. Group 1 Controlled (<6.55) Group 2 Uncontrolled (6.56 >7.9). In the study population Normal values for sugars will be considered as fasting <110mg/dl, post prandia< 140mg/dl, FBS>110 and <126mg/dl predibetic and FBS >126 is diabetic.
Two milliliters of venous blood sample were taken after 8 h of fasting as per the standard guidelines and protocol, under all aseptic precautions. Glucose oxidase-peroxidase method was used for the estimation of FBG and 2 h postprandial blood glucose (PPBG) [10] analyzed on automated chemistry analyzer ERBA 200 and HbA1c was estimated by taking blood sample in an ethylenediamine tetraacetic acid vial and was estimated by modified Ion-exchange high-performance liquid chromatography [11] analyzed on semi automated chemistry analyzer.

Data Analysis

Statistical methods SPSS will be employed for statistical analysis. Descriptive statistics was used to determine frequency, percentages, mean and standard deviation. Comparisons of the differences between genders will be carried out by Student's *t*-test For measuring the correlation between two variables, (HbA1c Vs Fasting / HbA1c vs. Postprandial) Karl Pearson.s coefficient of correlation (r) will be used. A two-tailed test $P < 0.05$ will be considered as statistically significant.

IV. Results

A total of 129 patients were enrolled in this study, of which 69 were male and 60 were female. The mean age was 49.5±9.5 years and the duration of diabetes averaged 7±6.80 years.

Mean plasma glucose **in (Controlled Group)** averaged 100.73 mg/dl in the fasting and **postprandial** state most subjects had blood glucose level 145.83 mg/dl (Table 1). ean plasma glucose **in (Uncontrolled Group)**

averaged 143.96 mg/dl in the fasting and **postprandial** state most subjects had blood glucose level 239.07 mg/dl (Table 2.HbA1c averged mean is 5.7003 in (Controlled Group) and 8.7065 in (uncontrolled Group) (Table 1 & 2)Our results showed that there was significant correlation between HbA1c & FBS, PPBS ('p'value- <0.010) in the study population. However PPBS showed better correlation than FBS . (r= 0.001* vs 0.04*).

Table:1 Distribution of diabetic patients by fasting and postprandial glucose levels in (Controlled Group):

	N	Minimum	Maximum	Mean	Std. Deviation
HbA1C	30	4.40	6.50	5.7003	.63550
FBS	30	38	236	100.73	40.813
PPBS	30	89	440	145.83	71.647

Table: 2 Distribution of diabetic patients by fasting and postprandial glucose levels in (Un controlled Group) :

	N	Minimum	Maximum	Mean	Std. Deviation
HbA1C	99	6.60	14.00	8.7065	1.75630
FBS	99	68	426	143.96	65.716
PPBS	99	10	483	239.07	101.947

V. Correlations

TABLE:3 Correlation between HbA1c, with FBS & PPBS in (Controlled Group)

	Coefficient of correlation (r)	**p value**
HbA1c vs Post prandial	0.257	0.1
HbA1c vs Fasting	0.147	0.4

TABLE:4 Correlation between HbA1c, with FBS & PPBS (Un controlled Group**)**

	Coefficient of correlation (r)	**p value**
HbA1c vs Post prandial	0.33	0.001*
HbA1c vs Fasting	0.206	0.04*

*statistically significant

VI. Discussion

Our present study results showed that both FBG and PPBG correlated significantly with HbA1c values. PPBG correlated more strongly with HbA1c in comparison with FBG. These findings have strong potential implication in treatment of DM-2. It is known fact that reducing HbA1c values can lower risks associated with DM-2, e.g. retinopathy, neuropathy, cardiovascular risks etc, knowing whether FBG or PPBG is independent predictor of HbA1c, aids in choosing effective medication in lowering HbA1c value, i.e., targeting PPBG or FBG to lower HbA1These result are in accordance with Rosediani et al, 2006 that found that PPBG correlated better to HbA1c than FBG. [14]. This result is also consistent with various other studies that have found in their studies that postprandial and post challenge glucose levels correlate better with HbA1c values than fasting blood glucose.[15-18] . On the other hand, a study by Bonora et al, 2001, has stated that HbA1c correlated more closely to pre-prandial than postprandial blood sugar. [19] Similar conclusions has been reached by Peter et al, 2006 and Goudswaard et al, 2004.[20-21] Lot of evidences has also shown a strong association between PPG and cardiovascular risk and outcomes [22], oxidative stress, carotid intimal thickness and endothelial dysfunction [23]. A recent diabetes complications trial study concluded that PPG, but not FPG, was an independent predictor of mortality and cardiovascular complications in diabetes [24,25, 26]. It is also probable that humans spend half of their lives in postprandial states and thus, to achieve better long-term metabolic control (HbA1c) and minimize the risk of chronic diabetic complications, glucose monitoring in postprandial state will be absolutely necessary.

VI. Conclusion

The result of our study showed that PPBG strongly correlate with HbA1c and significantly contributes to overall glycemic control. Hence monitoring of PPBS will be more helpful to achieve optimal glycemic control and prevent long term diabetes complications than FBS alone in the absence of HbA1c, especially in developing countries. However in developing countries FBS & PPBS can be used to monitor the glycemic control where they have limitations for using HbA1c.

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