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Original Article

CORRELATION OF GLYCOSYLATED HEMOGLOBIN LEVELS WITH FASTING AND POSTPRANDIAL GLUCOSE IN SOUTH INDIAN TYPE 2 DIABETIC PATIENTS

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ABSTRACT

Objective: To assess the correlation of glycosylated hemoglobin levels with fasting and postprandial glucose in South Indian type 2 diabetic patients.

Methods: This retrospective observational study was carried out as per the protocol approved by the institutional ethics committee (IEC) and case records of patients (≧ 4 0 y old) diagnosed with type 2 diabetes mellitus (T2DM) and complications, that fasting blood sugar (FBS), postprandial blood sugar (PPBS) and HbA1c measured during previous follow-ups were included in the study. Statistical analyses were carried out using SPSS Ver.20 and p ≤ 0.05 were considered statistically significant.

Results: Based on the study criteria, 633 case profiles were selected and enrolled in the study. Most of the patients were males 488 (77.1%) and the mean age of patients was 59.7 y (SD=9.6). The mean fasting glucose and postprandial glucose were 9.42 mmol/l (SD=4.2), 13.39 mmol/l (SD=5.2) respectively. Patients were suffering from different type of diabetes complications, and most of them had poor glycemic control as the mean HbA1c was found to be 8.7 % (SD=2.2). The FBS and PPBS were plotted against HbA1c values showed moderate correlation and the sensitivity, specificity, positive predictive value and negative predictive value of postprandial glucose level was better than the fasting blood glucose level.

Conclusion: This present study showed that there is the significant correlation between PPBS and HbA1c values. Since PPBS is performed routinely, its interpretation in terms of long term glycemic control will help clinicians to tailor their therapeutic strategies.

Keywords: Glycosylated Hemoglobin, Fasting blood sugar, Postprandial blood sugar, Correlation

INTRODUCTION

Diabetes is a group of metabolic diseases characterized by elevated plasma glucose level [1].

Glucose intolerance and high level of blood glucose can eventually lead to other health problems. Uncontrolled diabetes can eventually lead to macrovascular and microvascular complication like nephropathy, retinopathy and neuropathy [2, 3].

Type 2 diabetes is associated with a marked increase in the fasting blood sugar (FBS), postprandial blood sugar (PPBS) and glycosylated hemoglobin A1C (HbA1c) level of the blood test [1, 4].

Optimal glycemic control is fundamental and still is the main therapeutic objective for the managing and prevention of target organ damage and other complications arising from diabetes that can impact on quality of life, morbidity and early death in these Patients [5-7]. Controlling FBS, PPBS and HbA1c is the strategy for achieving optimal glycemic control and preventing or reducing the risk of diabetic complications [8-11].

The glycosylated hemoglobin A1C (HbA1c), has become the gold standard for measuring chronic glycemic [12] and is the clinical marker for predicting and managing long-term complications, and any reduction in HbA1c is likely to reduce the risk of complications [13-16]. HbA1c is most commonly measured as an indicator of glycemic control during the preceding 2 to 3 mo because it comprises the majority of glycosylated hemoglobin and is the least affected by the recent fluctuations in blood glucose [17].

Many investigations have demonstrated the correlations between HbA1C levels, fasting blood sugar and postprandial blood sugar, although the effects were not significant [18, 19]. The elevated PPBS level has been associated with cardiovascular complications. [20] Control of FBS is necessary but usually insufficient for achieving optimal control of PPBS is essential for achieving recommended HbA1c goals [21].

Since during the consultation encounters FBS and PPBS was usually assessed and if this data could give an idea of the overall glycemic control of the patient, it would be relevant for monitoring patients. The present study was aimed to assess the correlation between Since fluctuations of fasting plasma glucose and postprandial could affect HbA1c [22], this study was performed to assess the correlation of glycosylated hemoglobin levels with fasting and postprandial glucose in South Indian type 2 diabetic patients.

MATERIALS AND METHODS

This retrospective observational study was carried out as per the protocol approved by the institutional ethics committee (IEC: 561/2015) and conducted based on in-patient and out-patient medical records of patients admitted in Kasturba Hospital, Manipal. Case records of patients (≥ 40 y old) diagnosed with type 2 diabetes mellitus (T2DM) and complications, that fasting blood sugar (FBS), postprandial blood sugar (PPBS) and HbA1c measured during previous follow-ups were included into the study. All case profile meeting study criteria during the 6-month period of review were included.

All demographic and clinical data of patients were collected and documented in a suitably designed case report form. Patients were divided into two groups according to the HbA1c level as a good control group (HbA1c ≤7%, FBS<6.94 mmol/l, PPBS<11.02 mmol/l) and poor control group (HbA1c>7%, FBS>6.94 mmol/l, PPBS>11.02 mmol/l).

Statistical analyses were carried out using SPSS Ver.20 and p ≤ 0.05 were considered statistically significant. All demographic data were expressed using descriptive statistics. Mean HbA1C values were compared with demographic variables using student t-test and one-way ANOVA. The correlation between the parameters was carried out using Pearson's correlation.

Regression analysis was carried out relation between FBS, PPBS and HbA1c by dividing the groups into good and poor control.

RESULTS

Based on the study criteria, 633 case profiles were selected and enrolled in the study. The mean age of patients was 59.7 y (SD=9.6) and mean duration of diabetes illness was 12.6 y (SD=7.8). The mean fasting glucose and postprandial glucose were 9.42 mmol/l (SD=4.2), 13.39 mmol/l (SD=5.2) respectively. Most of the patients had poor glycemic control as the mean HbA1c was found to be 8.7 % (SD=2.2).

Most of the patients were males 488 (77.1%). Patients were suffering from different type of diabetes complications. The majority of patients, 171 (27%) had peripheral neuropathy as a complication and 155 (24.5%) diabetic retinopathy. Most of patients 506 (79.9%) had at least one diabetic complication and 127 (20%) of patients had two complications. The higher mean HbA1c values were observed in patients with two complications (table 1).

When prescription patterns were studied, most of the patients 401 (63.3%) used insulin or oral anti-diabetics as monotherapy to control their blood glucose level and a combination of insulin and oral hypoglycemic agents was prescribed for 232 (36.7%) patients to manage their condition (table 1).

Table 1: HbA1c values according to demographic factors

Variable	Total patient N (%)	HbA1c (mean±SD)	p value
Gender			
Male	488 (77.1)	8.6±2.1	0.013*
Female	145 (22.9)	9.1±2.4	
Type of complication			
Ketoacidosis	22 (3.5)	8.5±2.2	0.175
Nephropathy	69 (10.9)	8.5±2.1	
Retinopathy	155 (24.5)	9±2.4	
Neuropathy	89 (14.1)	8.9±2.3	
Peripheral	171 (27)	8.5±2.1	
Nephropathy+Neuropathy	7 (1.1)	9.6±1.9	
Neuropathy+Peripheral	4 (0.6)	8.4±2.5	
Neuropathy+Retionapthy	10 (1.6)	10±0.9	
Nephropathy+Peripheral	18 (2.8)	8.5±1.9	
Nephropathy+Retionapthy	83 (13.1)	8.3±2.1	
Peripheral+Retionapthy	5 (0.8)	8.7±3.3	
Type of medication			
OHA	145(22.9)	7.7±1.7	<0.001*
Insulin	256(40.4)	8.8±2.2	
Insulin+OHA	232(36.7)	9.2±2.3	

OHA: Oral hypoglycemic agent; *p value<0.05(significant)

The FBS and PPBS were plotted against HbA1C values showed moderate correlation. Pearson's correlation co-efficient was 0.528, p<0.001 for FBS and 0.510, p<0.001 for PPBS. Regression analysis showed a significant relation between fasting and postprandial sugar level with glycosylated hemoglobin levels (p<0.001). For validating this regression test, Receiver operating characteristic (ROC) curve was plotted (fig. 1). The results showed that the sensitivity, specificity, positive predictive value and negative predictive value of postprandial glucose level were better than the fasting blood glucose level (table 2).

Table 2: Comparison of fasting blood sugar (FBS) and postprandial blood sugar (PPBS) to determine glycemic control

	FBS	PPBS	p value
Sensitivity (%)	53.5	66.3	
Specificity (%)	71.9	73.2	<0.001*
Positive predictive value (%)	39.9	48	
Negative predictive value (%)	81.6	85.3	
Area under ROC curve (AUC) (%)	71.7	73.7	

Good glycemic control: HbA1c ≤ 7%; *p value<0.05(significant)

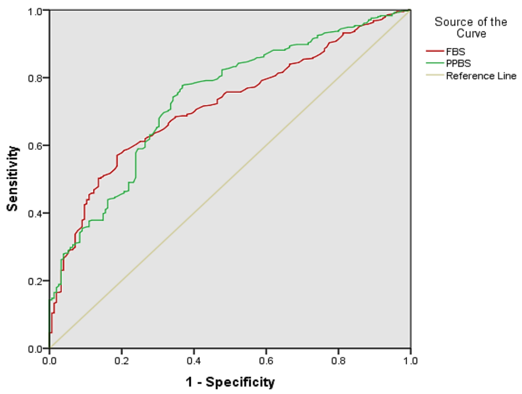

Fig. 1: Receiver operating characteristic (ROC) curve plot for FBS, PPBS and HbA1c (reference line)

DISCUSSION

People with diabetes have a greater risk of developing a number of major health problems. Consistently high blood glucose levels can lead to macrovascular and microvascular complication that will eventually affect patients' quality of life [23]. The costs related to diabetes include increased use of health services, disability and productivity loss, which can be a considerable burden to the patient, families and society [24].

Proper glycemic control is the best strategy to prevent and delay the progression of diabetes complication and improve the quality of life [25].

In our study, it has been observed that the mean HbA1C level was significantly (p<.001) higher in female gender similar to results by Adham *et al.*, which showed that males had been significantly lower mean HbA1c levels than females [26].

When comparing type of diabetic medication, that patient who was treated with insulin and OHA as a combination therapy had significantly (p<.001) higher mean HbA1c value compared to patients who received mono-therapy. Similar findings were reported by Adham *et al.*, Benoit *et al.* and Harrabi *et al.* [26-28].

Many studies have indicated the association between FBS and PPBS with HbA1c level [19, 22, 29, 30],we also found that mean FBS and PPBS level was significantly (p<.001) elevated in patients with poor glycemic control (HbA1c>7%) similar to the study reported by Khattab *et al.* [31].

Patients with poor glycemic control along with lifestyle modification, require more aggressive treatment with multi-dose insulin or a combination of insulin and OHA to achieve the optimal glycemic control [32].

In this study, moderate correlation was observed between HbA1c and fasting plasma glucose (r=0.528) and postprandial glucose (r=0.510), this finding is consistent with other studies reported by Sikaris *et al.* and Ketema *et al.* [33, 34].

The result showed that correlation between PPBS and HbA1c had greater sensitivity, specificity, positive predictive value and negative predictive value compared to fasting blood sugar. Our study revealed that both FBS and PPBS are important to achieve optimal glycemic control, but PPBS has a closer association with HbA1c and better predictor for overall glycemic control compared to FBS, which is similar to the studies reported by Rosediani *et al.*, Abrahamson *et al.* and Monnier *et al.* [19, 35, 36].

CONCLUSION

This present study showed that there is the significant correlation between PPBS and HbA1c values. Validation of these results in the large cohort of patients in multicenter study will make them generalizable. Since PPBS is performed routinely, its interpretation in terms of long term glycemic control will help clinicians to tailor their therapeutic strategies.

Study limitations

The number of patients with good glycemic control and poor glycemic control was not equal.

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CONFLICT OF INTERESTS

Declared none

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