Chattagram Maa-O-Shishu Hospital Medical College Journal
Volume 12, Number 1, January 2013 • DOI: 10.11566/cmosh.2013.1201.4

Original Article

Glycemic Control in Type 2 Diabetes Mellitus Patients

Siddiqui SRA[1]
Rahman MZ[2*]
Alam ASMT[1]
Hoque M[1]

[1]Department of Biochemistry, Chittagong Medical College, Chittagong, Bangladesh

[2]Department of Pathology, Chittagong Medical College, Chittagong, Bangladesh

Abstract

Background: Some population-based studies conducted in Bangladesh at different time points have revealed an increasing trend of diabetes prevalence ranging from 1.5% to 3.8% in the rural communities. The diagnosis of diabetes mellitus must be made with care since it has far reaching medical and social consequences. A number of biochemical tests are used in association with clinical assessment both for the initial diagnosis of this condition and the long-term monitoring of patients. Glycated hemoglobin provides an accurate and objective measure of glycemic control over a period of weeks to months. This study was designed to find the status of glycemic control in diabetic patients. **Materials and Methods:** A total number of 60 diabetic patients of various duration from >20 years were included in the study group and 40 non-diabetic individuals in the control group. Biochemical parameters fasting plasma glucose (FPG), 2 hours post-prandial plasma glucose (PPPG) and HbA_1c were studied. All the data were analyzed by using SPSS (Statistical Product and Service Solutions) version 12.0 for Windows software with a 95% confidence limit. **Results:** In the study group with mean FPG 8.28 mmol/L and mean 2 hours PPPG 12.09 mmol/L and mean HbA_1c was 7.41%. All the parameters showed significant difference between study group and control group. FPG, PPPG and HbA_1c were all increased in diabetic patients when compared to that of control group. **Conclusion:** Glycemic control is impaired in diabetic patients. Longer duration of diabetes mellitus shows less glycemic control.

Key words: Diabetes; glycemic control; HbA_1c, duration.

INTRODUCTION

Recent epidemiological reports indicated an increased prevalence of Type-2 diabetes in Turkey (7.2%), India (8.2%), Pakistan (11.1%), and Hawaii (20.4%). It is estimated that the developing countries will bear the brunt of diabetes epidemics in the 21st century. Some population-based studies conducted in Bangladesh at different time points have revealed an increasing trend of diabetes prevalence ranging from 1.5% to 3.8% in the rural communities. Bangladeshis are more susceptible to develop diabetes, hyperinsulinemia, and coronary heart disease (CHD) compared with other South Asian migrants (Indians, Pakistani) settled in the UK. The risk factors related to these disorders were more prevalent in the population of Bangladesh than in the native population. Also, in Bangladesh these diseases are emerging as major health problems, and the government has given them high research priority. It may be mentioned that a vast majority (77.6%) of the national population lives

***Correspondence to:**
Dr Md. Zillur Rahman
Associate Professor, Department of Pathology, Chittagong Medical College, Chittagong, Bangladesh
E-mail: drzillur@gmail.com
Mobile: +88-01819-315116

How to cite this article:
Siddiqui SRA, Rahman MZ, Alam ASMT Hoque M, Glycemic control in type 2 diabetes mellitus patients. Chatt Maa Shi Hosp Med Coll J 2013; 12(1): 4.

in the rural areas. Only two studies were conducted in rural areas, but these studies contained small samples.[1]

The diagnosis of diabetes mellitus must be made with care since it has far reaching medical and social consequences. A number of biochemical tests are used in association with clinical assessment both for the initial diagnosis of this condition and the long-term monitoring of patients.[2]

Glycated haemoglobin provides an accurate and objective measure of glycaemic control over a period of weeks to months and these haemoglobin moieties are increased in diabetes by the slow non-enzymatic covalent attachment of glucose and other sugars. A rise of 1% in glycated-Hb corresponds to an approximate increase of 2 mmol/L in average blood glucose.[3] Each 1% decrease in A_{1C} translates into a 35%–40% decrease in the frequency of microvascular complications.[4]

Bangladesh is one of the poorest countries in the world and has the lowest health care spending per capita. The prevalence of diabetes in Bangladesh is estimated to be 5.2% among the adult population. It is estimated that almost 3 million people in Bangladesh have diabetes. The majority has type-2 diabetes. Because the current state of diabetes care in the country is poor, the benefits of greater investment in diabetes care were particularly striking. In an improved scenario, assuming free access to the current level of diabetes care for the estimated 3 million people who currently have type-2 diabetes in Bangladesh, the number would double to 5.8 million and the production value almost triple. Achieving these gains for all people with diabetes would require 7–8 times the current investment in diabetes care in Bangladesh.[1] This study was designed to find the status of glycemic control in diabetic patients.

MATERIALS AND METHODS

A cross sectional comparative study was carried out in the Department of Biochemistry of Chittagong Medical College with joint collaboration of Chittagong Diabetic Hospital from November 2004 to May 2005. Previously diagnosed 60 diabetic patients treated with either hypoglycaemic drugs or insulin within 30–70 years of age were included in the study group. Forty healthy adult volunteers of different age with no evidence of diabetes mellitus or impaired glucose tolerance were included as control subjects.

After overnight (minimum 8 hours) fasting, 5 ml of whole blood was collected both from diabetic patients and healthy controls with all aseptic precautions, using a 5 cc disposable syringe at fasting and 2 hours after breakfast with or without oral hypoglycemic drug or insulin as they were prescribed earlier. The plasma was separated and kept to measure fasting plasma glucose (FPG). The 2 hours post-prandial samples were used 2 measure 2 hours postprandial plasma glucose (PPPG) and HbA_{1C}.

FPG and 2 hours PPPG were analyzed by glucose oxidase method, HbA1c was analyzed by Nycocard in vitro test. Clear plasma obtained after centrifugation of both fasting and 2 hours postprandial blood samples were transferred to eppendorf tubes and preserved at –35°C in a refrigerator till analysis was completed.

Detailed history and clinical findings of the subjects were recorded. All the analysis was done using the SPSS (Statistical Package for Social Science) 12-version software package for windows. Parameters were expressed as mean±SD (standard deviation) as appropriate. Pearson correlation coefficient was analyzed to show the correlation between different parameters in the study group. The P value of <0.05 was considered as statistically significant.

RESULTS AND OBSERVATIONS

Among the 60 cases the mean age is 54.52 years ranging from 35–74 years. Forty individuals of control group have mean age of 51.8 years ranging from 34–77 years. Majority of the study individuals were within 51–60 years of age. Male patients are more in number in relation to female patients. Control individuals also show male predominance. Among the study group of 60 individuals 32 male and 28 female diabetic patients were included and among control group 23 male and 17 female individuals were included. In this study, a total of 55 males and 45 females were included (Table 1).

Mean FPG of 60 individuals of study group is 8.28 ± 2.72 mmol/L ranging from 4.6 to 17.3 mmol/L, whereas mean FPG of 40 control individuals is 4.75 ± 0.68 ranging from 3.9

Table 1: Age distribution

	Age distribution				Sex distribution	
Group	N	Mean±SD	T	P	Male (%)	Female (%)
Study	60	54.52 ± 8.949	1.33	0.185	32 (53.3)	28 (46.7)
Control	40	51.80 ± 11.34			23 (57.5)	17 (42.5)

to 6.3 mmol/L. Unpaired T test shows highly significant difference (P< 0.001). Mean 2 hours PPPG with drug or insulin of 60 diabetic individuals of study group is 12.09 ± 3.92 mmol/L ranging from 5.4 to 24.5 mmol/L. Whereas the mean 2 hours PPPG of 40 control individuals is 6.56 ± 0.58 ranging from 5.3 to 7.7 mmol/L. Unpaired T test shows significant difference between case and control (P< 0.001). Again, the mean glycated hemoglobin level of study group was found 7.41 ± 1.51% ranging from 4.6%–11.9%, whereas the mean HbA_1c in control group is 5.63% ± 0.66% ranging from 4%–6%. Unpaired T test was done and found highly significant difference between study and control groups for glycated hemoglobin level (Table 2).

Pearson correlation test shows that there is significant correlation among FPG and 2 hours PPPG (P< 0.001), FPG and HbA1c (P< 0.01) and 2 hours PPPG and HbA1c (P< 0.001) (Table 3).

Mean duration of diabetes in study group is 11.13 years where minimum duration of diabetes is 1 year and maximum duration is 30 years. According to the duration of diabetes mellitus, the study group was divided into five sub-group as (1) up to 5 years, (2) 6–10 years, (3) 11–15 years, (4) 16–20 years and (5) > 20 years. The frequency distribution was 13 in group-1, 21 in group-2, 15 in group-3, 6 in group-4 and 5 in group-5. suffering from diabetes mellitus were in the group 2 ranging 6 to 10 years. All the other variables i.e. FPG, PPPG, HbA1c were correlated with duration groups to see whether there is any increase or decrease of these variables along the increasing duration of diabetes. It was seen that FPG is almost similar in duration groups 1 and 2. FPG increases in duration groups 3, 4 and 5. But in group 4, FPG is relatively low. Similar result was seen in 2 hours PPPG also. This result indicates that FPG and 2 hours PPPG gradually increase along with the duration of diabetes. Glycated hemoglobin was also seen to be increasing gradually along with the increased duration of diabetes. But group 4 shows a relative reduction of HbA_1c. (Table 4)

It was seen that there is a gradual rise in FPG, 2 hours PPPG and HbA1c levels in relation to duration of diabetes.

Table 2: FPG, 2 hour's PPPG and HbA1c

Variables	Group	N	Mean±SD	T	P	Sig.
FBG	Study	60	8.28 ± 2.72	8.046	< 0.001	Sig.
	Control	40	4.75 ± 0.68			
PPBG	Study	60	12.09 ±3.92	8.827	< 0.001	Sig.
	Control	40	6.56 ± 0.58			
HbA_1c	Study	60	7.41 ± 1.51	7.004	< 0.001	Sig.
	Control	40	5.63 ± 0.66			

Table 3: Pearson Correlations among FPG, PPPG and HbA1c

Correlation between	Variable	Mean±SD	r	P value
FPG & PPPG	FPG	8.28 ± 2.72	0.696	< 0.001
	PPPG	12.09 ± 3.92		
FPG & HbA1c	FPG	8.28 ± 2.72	0.391	< 0.01
	HbA1c	7.41 ± 1.51		
PPPG & HbA1c	PPPG	12.09 ± 3.92	0.432	< 0.001
	HbA1c	7.41 ± 1.51		

Table 4: Mean FPG and PPPG in different duration groups

Duration (duration groups)	Duration (years)	N (%)	Mean FPG	Mean PPPG	Mean HbA1c (%)
1	Upto 5	14 (23.3)	7.9	11.3	7.13
2	6–10	20 (33.3)	7.7	11.8	7.31
3	11–15	15 (25.0)	9.2	13.6	8.11
4	16–20	06 (10.0)	8.8	10.2	6.9
5	> 20	05 (08.3)	9.5	13.2	7.1

But Pearson correlation gives no significant result in relation to duration of diabetes. (Table 5)

Table 5: Pearson Correlation of FPG with duration groups

Variable	Mean±SD	r	P value
Duration	54.52 ± 8.95		
(Duration group)	(2.78 ± 0.94)		
FPG	8.28 ± 2.72	0.188	0.150
PPPG	12.09 ± 3.92	0.101	0.444
Glycated haemoglobin	7.41 ± 1.51	0.035	0.790

In 60 individuals of diabetic cases the HbA1c% level was again graded in to good (intensive), average (acceptable) and poor control according to their glycemic control as <6, 6–7 and >7% respectively.[5] (On analysis, the frequency distribution was found that 15% (9 cases) were in good, 25% (36 cases) in average and 60% (36 cases) in poor glycemic control. (Table 6)

Table 6: Groups on glycaemic control of HbA1c%

Glycaemic control (%)	Frequency	Percent (%)
Good (<6)	9	15
Average (6-7)	15	25
Poor (>7)	36	60
Total	60	100

DISCUSSION

The present study investigated the status glycemic control among 60 type-2 diabetic patients of various durations from <5 to >20 years in study group and 40 non-diabetic individuals as control group as well as the effect of duration of diabetes on FPG, 2 hours PPPG and HbA1c. Correlations of FPG, 2 hours PPPG and HbA1c were also seen. Mean duration of diabetes in study group was 11.1 years. Majority of them were within 6–10 years duration, followed by 11–15 years duration group. This observation indicated that diabetic patients have raised FPG. 2 hours PPPG and HbA1c indicated poor glycaemic control.

In this study, FPG of study group (mean 8.28 mmol/L) shows highly significant difference (P value <0.001) with FPG of control group (mean 4.75 mmol/L). And 2 hours PPPG with or without drug or insulin of study group (mean 12.09 mmol/L) also shows significant difference (P<0.001) with PPPG of control group (mean 6.56 mmol/L). Similar results were obtained in a study carried out on insulin resistance and insulin secretory dysfunction in obese Bangladeshi type 2 diabetic subjects.[6]

Glycated hemoglobin (HbA_1c%) level of study group (mean 7.41%) showed highly significant difference (P<0.001) with that of control group (mean 5.63%). This observation is consistent with a study on HbA1c in diagnosis of diabetes mellitus without ketonuria in young adult.[7]

When FPG, PPPG and HbA1c were analyzed with Pearson's correlation, it was found that there are significant correlation among FPG, PPPG and HbA1c. This observation is also consistent with a previous study that showed a positive correlation between fasting blood glucose and HbA1c level.[7]

FPG, PPPG and HbA1c did not show any significant correlation with duration of diabetes indicating that glycemia is not proportional to duration and may be controlled if necessary measures are taken in time. This result does not conform to the observation of Mobede and Masoomi.[8] They worked on 312 patients and found a positive correlation of HbA1c with longer duration of diabetes. This discrepancy was possibly due to the smaller sample size of this study.

Again HbA1c% level was sub-classified to good (<6%), average (6%–7%) and poor (>7%) according to their glycemic control.[5] It was found that the majority of the diabetic patients in study group are in poor (HbA1c >7%) glycemic control. It indicates unawareness and carless attitude of diabetic patients in our country.

CONCLUSION

Bangladeshi type 2 diabetes patients are unaware of their glycemic control. But this raised glycemic status does not correlate with duration of diabetes. All the parameters like FPG, 2 hours PPPG and HbA1c correlate and thus HbA1c can be considered as a diagnostic parameter.

The limitation of this study is a relatively smaller sample size and spot analysis of biochemical parameters. A study with a larger sample size for a long duration with multiple timed sampling of biochemical parameters is suggested.

REFERENCES

1. Sayeed MA, Mahtab H, Khanam PA, Latif Z A, Ali SMK, Banu A, et al. Diabetes and impaired fasting glycemia in a rural population of Bangladesh. Diabetes Care. 2003;26:1034–39.
2. Gaw A, Cowan RA, O'Reilly DSJ, Stewart MJ, Shepherd J, editors. Clinical biochemistry. New York: Churchill Livingstone Inc., 1995. pp. 58–59.
3. Hauslett C, Chilvers ER, Hunter JAA, Boon NA. Davidson's principles and practice of medicine. 18th ed. 1999. pp. 489–90.
4. Abbate SL. Expanded ABCs of Diabetes. Clin Diabetes. 2003;21(3):128–133.
5. Defranzo RA. Diabetic nephropathy. In: Becker KL, editor. Principles and practice of endocrinology and metabolism. 3rd ed. PA: Lippincott Williams and Wilkins; 2002. pp. 1403–18.
6. Tobe SW, McFarlane PA, Naimark DM. Microalbuminuria in diabetes mellitus. CMAJ. 2002;167(5):499.
7. Nazimuddin K, Ahmed, T, Hoque MS, Musa AKM, Sarker RSC. HbA1c in diagnosis of diabetes mellitus without ketonuria in young adult. JBCPS. 2004;22(3):100–3.
8. Mobede O, Masoomi M. Microalbuminuria and associated factors in Bahraini patients with type-2 diabetes mellitus. Annals of Saudi Medicine. 2000;20:157–60.