Relation between Glycemic Control among the Patients with Type 2 DM and Level of Blood Pressure

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Abstract:

Introduction*: Inadequate glycemic control among patients with type 2 diabetes constitutes a major public health problem and risk factor for the development of diabetes related complications. Hypertension is a common co-morbid condition of diabetes. Hypertension as a factor for poor glycemic control in diabetes patients has not been properly evaluated in Bangladesh. The aim of the study was to assess status of glycemic control among patients with Type 2 DM depending on the level of blood pressure in a tertiary care hospital.*

Method: *This cross sectional study was carried out among 200 adult patients of either gender with type 2 diabetes mellitus, in the Department of Medicine and endocrinology, Dhaka Medical College Hospital from January to June 2015.*

Results: *The mean age of the respondents were 56.85(±10.84) years, ranging from 35 to 77 years. Among 200 patients, 129 (64.5%) were hypertensive and 71 (35.5%) were normotensive with a mean duration of hypertension was 10.03 (±3.39) years. The mean HbA1c for all diabetic, hypertensive and normotensive patients were 7.41% (±1.35), 7.63% (±1.30) and 7.02% (±1.37) respectively. The mean HbA1c was significantly higher in hypertensive than normotensive group (p=0.002). The mean HbA1c was also significantly higher in patients with duration of hypertension (p=0.03) for more than 10 years and in patients who used beta blocker (p=0.005) and diuretics (p=0.02) as hypertensive medication. Among the patients with normal BMI and on dietary modification, those who were hypertensive had significantly higher (p=0.00008) mean HbA1c (7.12(±0.99)) than those were normotensive (5.01(±0.01)).*

Conclusion: *The glycemic control in type 2 DM is found to be poor among the hypertensive patients. There is a complex association of multiple factors like age, gender, duration of hypertension and medications strongly influence the glycemic control of type 2 diabetics with hypertension.*

Keywords: *Type 2 DM, Hypertension, HbA1c*

Introduction:

Diabetes Mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin. In both of the common types of diabetes, environmental factors interact with genetic susceptibility to determine which people develop the clinical syndrome and the timing of its onset. The prevalence of diabetes for all age groups worldwide was estimated 2.8% in 2000 and will be 4.4% in 2030.[1] Prevalence of type 2 diabetes in Bangladesh is 10%.[2] Type 2 diabetes is a common disease with substantial associated morbidity and mortality. Most adverse diabetes outcomes are a result of vascular complications, both at macro vascular level (Coronary artery disease, Cerebrovascular disease, Peripheral neuropathy) and microvascular level (Retinopathy, Nephropathy, Neuropathy).[3] Hypertension is a common co-morbidity of diabetes, affecting the majority of patients, with prevalence depending on type of diabetes, age, obesity and ethnicity. Numerous studies have shown the efficacy of controlling individual cardiovascular risk factors in preventing or slowing CVD in people with diabetes. Large benefits are seen when multiple risk factors are addressed globally.[4,5]

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Using data from the United Kingdom Prospective Diabetes Study (UKPDS), Molyneaus et al. and Stratton et al., found that good glycemic control in patients with type 2 diabetes reduce the occurrence and progression of complications. Any reduction in glycosylated hemoglobin (HbA1c) is likely to reduce the risk of complications, with the lowest risk being in those with HbA1c values in the normal range (<6.0%).[6]Hypertension is a major risk factor for both CVD and microvascular complications. Hypertension and diabetes are commonly associated diseases. A Hong Kong study found that about 68% of type 2 diabetic patients were hypertensive. In a general outpatient clinic in Hong Kong, glycemic control was found worse in patients with type 2 diabetes alone than in those with type 2 diabetes combined with hypertension.[7]Adham et al,[8] Benoit et al,[9]Mwere et al[10] found majority of their diabetic study population were hypertensive. In context of glycemic control of hypertensive and normotensive patients Basit et al[11] found that hypertension were significantly associated with poor glycemic control [OR: 1.65, 95% CI(1.13-2.41)]. Camara et al[12] also found that systolic pressure >140 mmhg was significantly associated with poor glycemic control [OR: 1.18, 95% CI(0.89-1.56)].

Achieving good glycemic control in diabetes mellitus is important in delaying or even preventing complications. A few studies have investigated glycemic status among of the normotensive and hypertensive patients with type 2 diabetes in Bangladesh. The current study was intended to assess the glycemic status of both normotensive and hypertensive patients with type 2 diabetes.

Materials and Methods:
This study was designed as cross sectional observational study. The study was carried out in department of Medicine and department of Endocrinology, Dhaka Medical College Hospital, Dhaka for the period of six months from January to June, 2015. All adult patients aged over 18 years, suffering from Type 2 diabetes attending at outdoor and admitted in Medicine and Endocrinology department of Dhaka medical college hospital within the study period were included. Those present with medical emergencies end stage renal disease (ESRD), Cirrhosis of liver, Systemic infections, Pregnancy and non compliant to antidiabetic therapy including dietary restrictions, excercise and drugs were excluded from the study. Prior to the commencement of this study, the research protocol was approved by the Dhaka Medical College Ethical Review committee. Demographic information was

prospectively recorded and substantiated by means of inspection of medical record. Information included was the subject's age, gender, medical history, clinical history of T2DM and hypertension followed by evaluation of glycemic control. Statistical analysis was carried out by using the statistical package for social sciences version 20.0 for Windows (SPSS Inc, Chicago, Illinois, USA). A descriptive analysis was performed for all data. The mean values were calculated for continuous variables. The quantitative and qualitative observations were indicated by frequencies, percentage. Chi square test with 95% CI was used to analyze the categorical variables and was shown with cross tabulation. Unpaired t-test and F (ANOVA) test was used to analyze the continuous variable. A p-value will be considered to be statistically non-significant if >0.05 and significant if<0.05.

Results:
Total 200 patients were included in this study. The mean (±SD) HbA1c of study population was 7.36% (±1.97), 7.52% (±1.21), 7.23% (±0.83), 7.73% (±0.73) in<50 years, 51-60 years, 61-70 years, >70 years' age group respectively. The observed difference between age groups was not statistically significant (p> 0.513). According to BMI it is observed that majority of the patients were obese in both groups (male 43.4% and female 44.9%). Among the patients, 129 (64.5%) were hypertensive and 71(35.5%) were normotensive (Table 1). The mean (±SD) BMI was found 25.25 (±4.08) kg/m2 in male and 25.87 (±5.05) in female. The mean (±SD) HbA1c was found 7.26 (±1.24) in male and 7.66 (±1.49) in female (Table 2). Majority of the patients had hypertension for more than 10 years (42.6%) and mean (±SD) duration of hypertension was 10.03 (±3.39) years (Table 1). The mean (±SD) HbA1c for all diabetic, hypertensive and normotensive patients were 7.41%(±1.35), 7.63%(±1.30) and 7.02%(±1.37) respectively (Table 2). Longer duration of diabetes was significantly associated with poor glycemic control (p<0.001). The mean (±SD) HbA1c was significantly higher in hypertensive than normotensive group (p=0.002; Table 2). The mean (±SD) HbA1c was also significantly higher in patients with duration of hypertension (p=0.03) for more than 10 years and in patients who used beta blocker (p=0.005) and diuretics (p=0.02) as hypertensive medication (Table2). Among the patients with normal BMI and on dietary recommendation, those who were hypertensive had higher mean (±SD) HbA1c 7.12 (±0.99) than those were normotensive 5.01 (±0.01) which was statistically significant (p=0.00008; Table3).

Table 1. *Distribution of the study subjects (n=200)*

Characteristics	Number of Patients (%)
Age	
< 50 years	55 (27.5)
51-60 years	74 (37.0)
61-70 Years	56 (28.0)
>70 years	15 (7.5)
Gender	
Male	122 (66.0)
Female	78 (34.0)
BMI(kg/m^2)	
Normal (<23)	47 (23.5)
Overweight (23-24.9)	65 (32.5)
Obese(e—25)	88 (44.0)
Level of BP	
Hypertensive (e"140/90)	129 (64.5)
Normotensive (< 140/90	71 (35.5)
Duration of hypertension	
0-5 years	28 (21.7)
6-10years	46 (35.7)
>10years	55 (42.6)
Antihypertensive drugs	
Beta Blocker	32 (16.0)
Diuretics	25 (12.5)
ACEi/ARB	84 (42.0)
CCB	41 (20.5)
No Treatment/others	8 (4.0)
Duration of DM	
<1 year	43 (21.5)
1-5 years	70 (35.0)
6-10years	32 (16.0)
>10years	45 (22.5)
Treatment modalities of T2 DM	
On dietary recommendation and exercise	32 (16.0)
Medication(OHA, insulin)	168 (84.0)

Table 2. *Mean HbA1c according to age, gender, Level of blood pressure, Duration of hypertension, Antihypertensive drugs*

Characteristics	Mean (±SD) HbA1c	P-value
Age		
<50 years	7.36 (±1.97)	
51-60 years	7.52 (±1.21)	0.513
61-70 years	7.23 (±0.83)	
>70 years	7.73 (±0.70)	
Gender		
Male	7.26 (±1.24)	0.04
Female	7.73 (±1.49)	
Level of blood pressure		
Hypertensive(e"140/90)	7.63 (±1.30)	0.002
Normotensive(<140/90)	7.02 (±1.37)	
Duration of HTN		
<10 years	7.41 (±1.16)	0.03
>10 years	7.91 (±1.40)	
Duration of T2DM		
<1 years	6.66 (±1.16)	
6-10years	7.17 (±1.36)	<0.001
1-5 years	7.65 (±0.70)	
>10 years	8.51 (±1.35)	
Antihypertensive drugs		
Beta blocker	8.22 (±1.70)	0.005
Diuretics	7.22 (±1.59)	0.02
ACEi/ARB	7.30 (±0.99)	0.340
CCB	7.73 (±1.47)	0.94

ACEi= Angiotensin converting enzyme inhibitor, ARB= Angiotensin receptor blocker, CCB= calcium channel blocker
P- value reached from F(ANOVA) test for age and treatment modalities of hypertension and unpaired t-test for sex, presence of hypertension, duration of hypertension.

Table 3. *Mean HbA1c according to level of blood pressure in patients with normal BMI and on dietary recommendation and exercise*

Patients with normal BMI and on dietary recommendation and exercise	Mean ((±SD) HbA1c	p value
Hypertensive (≥140/90)	7.12 (±0.99)	0.00008
Normotensive(<140/90)	5.01 ((±0.01)	

P- value reached from unpaired t-test.

Discussion:

This present cross sectional observational study was carried out with an aim to determine the demographic profile, presence of hypertension, to observe glycemic status in relation to duration and treatment of hypertension in type 2 DM patients. In present study, the mean age (±SD) was 56.85 (±10.84) years with range from 35 to 77 years. Majority (37.0%) of the respondents was found in the age group of 51-60 years. The mean age (±SD) was found 57.62(±11.03) in male and 55.64(±10.57) in female. The mean (±SD) HbA1c found in this study was 7.36% (±1.97), 7.52% (±1.21), 7.23% (±0.83), 7.73% (±0.73) in <50 years,51-60 years, 61-70 years, >70 years' age group respectively. The observed difference between age groups was not statistically significant (p> 0.513). These findings are consistent with several studies which failed to show the association between age and glycemic control. For instance, Shorr et al[12] and Balkkrishnan et al[13] studied the relationship between age and glycemic control and found no significant differences between age groups. However, a study conducted in Myanmar by Nyunt et al[14] reported that age greater or equal to 60 years was associated with poor glycemic control. The observed variation of association between age and poor glycemic control could be explained by the difference in population characteristics and distribution of age in different studies. Hypertension is one of the most frequent co-morbidities among T2DM patients. In this study 64.5% patients were hypertensive. Adham et al,[8] Benoit et al, [9]Khattab et al[15] also found majority of their diabetic study population were hypertensive.The current study showed that longer duration of diabetes was significantly associated with poor glycemic control (p<0.001). The proportion of poor glycemic control was significantly higher in patient who had diabetes for long duration than those with short duration. This finding is consistent with several studies[8-9,15] which showed that the proportion of poor glycemic control was significantly higher in patients who presented with longer duration of more than 10 years. In context of glycemic control of hypertensive and normotensive patient in this study it was found that The mean (±SD) HbA1c is higher in hypertensive patients (7.63%) than that of normotensive diabetic patients (7.05%) which is statistically significant (p-0.002). In this study 65.1% hypertensive patient have poor glycemic control whereas only 47.3% normotensive patients have poor glycemic control. These findings are also statistically significant. Similarly, Basit et al[11] found that hypertension was significantly associated with poor glycemic control [OR: 1.65, 95% CI (1.13-2.41)]. Camara et al[16] also found that systolic pressure >140 mmhg was significantly associated with poor glycemic control [OR: 1.18, 95% CI(0.89-1.56)].

In present study, it is found that the mean (±SD) HbA1c of the patients who had HTN for more than 10 years is 7.91% (±1.40) which is higher than the group who had HTN for less than 10 years whose mean HbA1c is 7.41% (±1.16). This difference shows statistical significance (p=0.03). Similarly, ABCD trial found that, the patients who had blood pressure 156/98 and mean duration of hypertension 11.9 years had mean HbA1c level 11.6%.[17] Regarding treatment of HTN 16% of our study population found taking beta blocker, 12.5% taking diuretics, 42.0% taking ACEi/ARB and 20.5% taking CCB. The patients who took beta blocker alone or combination with other drugs had significantly higher mean HbA1c than those who don't take beta blocker at all (p=0.005). Similarly, the patients who took diuretics alone or combination with other drugs had significantly higher mean HbA1c than those who don't took diuretics at all (p=0.02). On the other hand, no such effect was seen among the patients who took ACEi/ARB and CCB. These findings are consistent with several other studies where it was found that thiazides and beta-blockers have been most commonly linked with adverse glucose metabolism.[18-24]. T2DM is associated with insulin resistance which leads to hyperinsulinemia. This hyperinsulinemia has two important effects, one is increased SNS activity and other is increased sodium retention through kidney. The cumulative effect of which is increased blood pressure[17]. As patients with greater insulin resistance has poorer glycemic control, so poor glycemic control and hypertension invariably co exists in diabetic people, there is another explanation which can be considered. Many other study showed that increased duration of diabetes is associated with poor glycemic control[15]. On the other hand, diabetes has a significant effect on atherosclerotic process of vessels which lead to hypertension[25]. The longer the duration of T2DM the atherosclerotic process become more prominent. That is why majority of diabetic patients has hypertension along with poor glycemic control. More over certain antihypertensive drug has documented adverse effect on glucose metabolism[26]. All these factors together contribute to poor glycemic control of hypertensive diabetic patients. To mitigate the influence of other factors responsible poor glycemic control of a diabetic patients, those who were noncompliant to anti diabetic medication were excluded from the study. Regarding the influence of other factors like obesity, dietary modification and regular excercise it is found that the glycemic status was significantly poor (P=0.00008) in patient with hypertension even they had normal BMI, followed dietary modification and taken regular exercise than those were normotensive. Other studies like GO ETT et al[7] and Khattab et al[15] also finds that hypertension is a

independent factor of poor glycemic control in diabetic patient.

We find that our study is limited with small sample size. Only one center (Dhaka Medical College Hospital) was enrolled in this study, so that the result of the study may not reflect the exact picture of the country.

Conclusion:

The glycemic control in type 2 DM is found to be poor among the hypertensive patients. There is a complex association of multiple factors like age, gender, duration of hypertension and medications strongly influence the glycemic control of type 2 diabetics with hypertension.

Conflict of interest: None

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