

CONTROL OF BLOOD PRESSURE IN HYPERTENSIVE PATIENTS WITH DIABETES MELLITUS TYPE 2

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Contribution

All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

Objective: To determine the frequency of hypertension and proportion of patients achieving good control of blood pressure (BP) and to examine the relationship of BP control with different variables in type 2 diabetes.

Methodology: This prospective observational study was conducted at Department of Medicine, 1 Mountain Medical Battalion (Bagh, Azad Kashmir) from April to December 2013. This study was done on diabetic patients. History of previously diagnosed hypertension/ use of any antihypertensive medicines was obtained. BP was measured twice in an upright position and the mean calculated; values <140/90 mmHg reflected good control. Data analysis was carried out with STATA version 12.

Results: Out of 178 patients, 72 (40.45%) had hypertension which was more common in females than males (48.51% vs. 29.87%; $p=0.012$). A single antihypertensive was used in 37 and two drugs in 35 patients but BP was at goal in only 33 (45.83%) patients. Plasma glucose fasting was ≤ 7.0 mmol/l in 46 (25.84%) patients. HbA1c was <7% in 14 (20.29%) out of 69 patients. Amongst the two groups with good and poor control of BP, there was no difference in proportions of elderly ($p=0.705$), males ($p=0.212$), more educated patients ($p=0.316$) or smokers ($p=0.868$). Proportions of patients with diabetes or hypertension of more than 5 years duration were also similar as were fractions of patients with increased BMI ($p=0.339$) or waist circumference ($p=0.077$), elevated fasting plasma glucose ($p=0.488$) or HbA1c ($p=0.509$).

Conclusion: Hypertension is frequently encountered in diabetics. A more aggressive treatment approach is required to achieve a better control of blood pressure.

Key Words: Diabetes Mellitus, Hypertension, Blood Pressure, Antihypertensives

INTRODUCTION

Diabetes mellitus type 2 is a major public health problem of the 21st century. An estimated 371 million people across the globe have diabetes and people from our part of the world are four times more likely to be affected as compared to other ethnic groups.¹ The disease has already started taking its toll in terms of an enormous impact on both morbidity and mortality and thus the cost of care. During 2010, 4% of annual United Kingdom National Health Service budget was spent on managing diabetes.² Not only does the growing epidemic already seem to be getting out of control, the situation is expected to worsen in the times to come. It is expected that by 2025, Pakistan will attain fourth highest prevalence of diabetes amongst the global community (in sharp contrast to the eighth position at present).³ Being one of the components of metabolic syndrome adds to the importance of the disease. Hypertension, obesity and dyslipidemia are the other constituents. Hypertension is 1.5 to 3 times more common in diabetics as compared to patients without diabetes.⁴ The prevalence of coexistent hypertension and diabetes varies in different races.⁵ It is essential to achieve a good control of blood pressure in diabetes because this reduces the risk of micro- and macro-vascular complications.⁶ However, it is widely believed that only about 25% of hypertensive patients have a good control of blood pressure.⁷

Despite the importance of the subject, only a few similar studies have been conducted in Pakistan to highlight the issue and thus encourage the development of strategies to tackle this growing threat. This study was therefore carried out to document the frequency of hypertension in Pakistani patients with diabetes mellitus type 2. It also aimed at determining the proportion of patients achieving good control of blood pressure and to examine the relationship of blood pressure control with glycemic control in such patients.

METHODOLOGY

This prospective observational study was carried out at Department of Medicine, 1 Mountain Medical Battalion (Bagh, Azad Kashmir) from April to December 2013 after approval by hospital ethics review committee. Patients being treated for diabetes mellitus type 2 were enrolled after obtaining informed written consent. Unwilling patients, those with diabetes treated for less than 6 months, those not yet started on antihypertensive medicines despite being indicated and patients with secondary hypertension were excluded. Demographic data was recorded and history was taken, focusing especially on whether a diagnosis of hypertension had been established in the past and the use of any antihypertensive medicines. Height, weight and waist circumference of the patients were recorded. Blood pressure was measured in an upright position with a

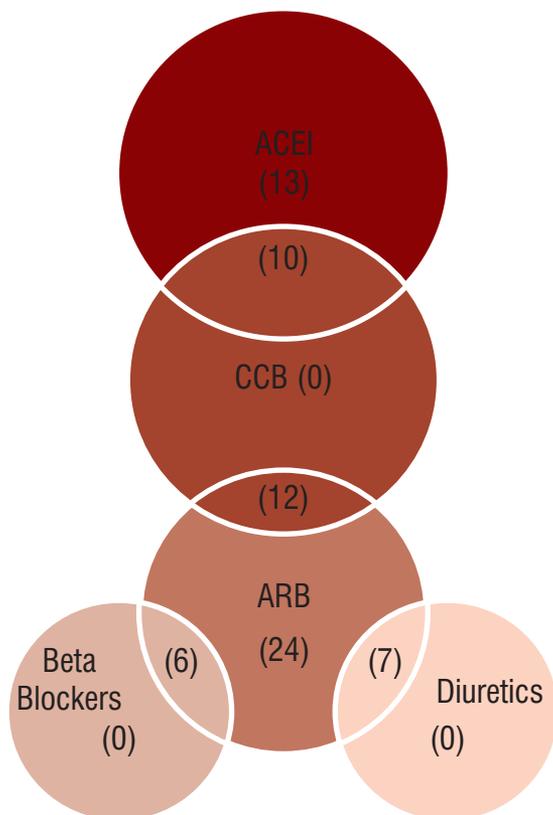
mercury sphygmomanometer after the patient had sit in a chair for at least 5 minutes in the clinic. The measurement was repeated after another five minutes and the mean of the two was calculated. Old medical records were also reviewed for previously recorded blood pressure readings. Hypertension was defined by the use of antihypertensive medicines or labeling of diagnosis on old medical documents. Blood pressure <140/90 mmHg was considered good whereas readings above this threshold were consistent with a poor control. Plasma glucose was measured in a fasting state with Merck Microlab 300 Automated Clinical Chemistry analyzer. HbA1c was measured in affording patients only since no specific grant was obtained from any agency. Data analysis was carried out with STATA version 12. Means of different quantitative variables were calculated and compared amongst patients with good control of blood pressure and those with poor control of blood pressure using independent samples t-test with a significance level of 5%. Chi square test was used to compare different proportions between the two groups using the same level of significance.

RESULTS

One hundred and seventy eight diabetics were seen during the study period, including 77 males and 101 females, whose baseline characteristics are shown in Table 1. Out of these, 72 (40.45%) had hypertension. This was seen more commonly in females as compared to males (48.51% vs. 29.87%; $p=0.012$). A single antihypertensive was used in 37 patients and two drugs in 35 patients. As shown in Figure 1, a vast majority of these patients were on ACE inhibitors or angiotensin 2 receptor blockers, used in combination with calcium channel blockers. Amongst the hypertensive patients, 33 (45.83%) had good control of blood pressure, whereas in 39 (54.17%) patients, the blood pressure was not at goal despite the use of antihypertensive medicines. Plasma glucose fasting was ≤ 7.0 mmol/l in 46 (25.84%)

Table 1: Baseline Characteristics of Study Population (N = 607)

S.No	Parameter	Values
1	Age (years)	52.06 ± 11.62
2	Education (years)	4.75 ± 4.98
3	Duration of diabetes (years)	6.11 ± 5.73
4	Duration of hypertension (years)	5.85 ± 5.09
5	Systolic blood pressure (mmHg)	135.67 ± 23.81
6	Diastolic blood pressure (mmHg)	84.01 ± 11.85
7	Fasting plasma glucose (mmol/l)	9.86 ± 4.18
8	HbA1c (%)	8.97 ± 2.54

Figure 1: Classes of Antihypertensive Medicines Used by the Patients

Note: Numbers in parathesis refer to the number of patients using a drug. CCB= calcium channel blockers; ACEI= angiotensin converting enzyme inhibitors; ARB= angiotensin receptor blockers

patients. Amongst the 69 patients who opted to get HbA1c checked, levels consistent with a good long term glycemic control (HbA1c<7%) were seen in only 14 (20.29%) individuals. There was no difference in the level of education, duration of diabetes and hypertension and the BMI of the hypertensive patients achieving good or bad control of blood pressure (Table 2). Amongst the two groups with good and poor control of blood pressure, there was no difference in proportions of young and old patients, males or females,

more and less educated patients, smokers or non-smokers, patients having normal or increased BMI or waist circumference, as well as patients with normal or elevated fasting plasma glucose or HbA1c. Details are shown in Table 3. Proportions of patients with diabetes or hypertension of more than 5 years duration was also similar in the two groups. Since all these factors did not have a significant predictive value for control of hypertension in diabetics, further data analysis especially binary logistic regression and calculation of odds ratios was not carried out.

DISCUSSION

Essential hypertension and diabetes mellitus type 2 are two of the most common diseases affecting a large proportion of adults all over the globe. Both are recognized as important risk factors for atherosclerotic cardiovascular diseases including myocardial infarction and stroke. In addition, disease related complications related to other organs such as kidney are very well known. The two diseases often co-exist, multiplying the risk for complications. It is generally believed that 20-60% of diabetics have elevated blood pressures.⁸ Benefits of a tight control of blood pressure are very much obvious. Previously, the target blood pressures varied with the presence or absence of diabetic nephropathy (albuminuria) but the latest JNC 8 guidelines suggest a uniform goal of 140/90 mmHg for all diabetics, which is applicable to non-diabetics as well.⁹ Though the data for this study was collected earlier, data analysis was modified accordingly once the new guidelines were released.

In this study, 40% of diabetics had hypertension. Some of the studies done previously in Pakistan have quoted figures ranging from 37% to 70%.^{10,11} The frequency is somewhat lesser than that described in international studies e.g. 57% in a Nigerian study.¹² Hypertension has been reported in 71.9% of American adult diabetics, though this survey was on patients older than 60 years.¹³ In contrast, the mean age of patients in this study was only 52 years, which justifies the lower rates of co-existent diabetes and hypertension. Apart from age, other factors such as the ethnic background of the population being studied as well as the prevalence of obesity may affect the frequency of hypertension in a diabetic

Table 2: Comparison Between Patients with Good and Poor Control of Blood Pressure

Parameter	Good control group (n=33)	Poor control group (n=39)	P-value
Education (years)	4.61±4.67	3.15±4.70	0.194
Duration of hypertension (years)	5.79±5.16	6.03±5.10	0.845
Duration of diabetes (years)	5.39±4.17	6.24±5.90	0.478
Number of smokers	3 (9.09%)	4 (10.26%)	0.868
BMI (kg/m ²)	26.93±5.52	27.17±4.60	0.863
Waist circumference (cm)	99.96±13.03	101.89±10.90	0.555

Table 3: Cross Tabulation of Various Variables With Blood Pressure Control

Variable		Good control group (n)	Poor control group (n)	P-value
Age (years)	≤52	15	16	0.705
	>52	18	23	
Gender	Male	13	10	0.212
	Female	20	29	
Education (years)	≤5	20	28	0.316
	>5	13	11	
Smoking	Yes	30	35	0.868
	No	3	4	
Duration of hypertension (years)	≤5	17	22	0.678
	>5	16	17	
Duration of diabetes (years)	≤5	18	23	0.705
	>5	15	16	
BMI (kg/m²)	≤25	10	8	0.339
	>25	23	31	
Waist Circumference (cm)*	Increased	12	7	0.077
	Normal	21	32	
Fasting plasma glucose (mmol/l)	≤7.0	10	9	0.488
	>7.0	23	30	
HbA1c (%)	≤7.0	5	2	0.509
	>7.0	15	11	

* Increased waist circumference defined as >102 cm in males and >88cm in females

cohort. This explains the different statistics described in various studies, including the ones quoted above. A large number of studies done previously have assessed gender based differences in the prevalence of hypertension in different ethnic groups and in different geographical areas. Results are conflicting, with an almost equal number of studies in favour of both genders. There is no plausible explanation for a greater number of hypertensive females in this specific cohort. Though ischaemic cardiac events are commoner in males, hypertension in females should not be taken lightly because of its strong association with coronary heart disease.¹⁴

It is said that blood pressure is well controlled in less than one third of hypertensive diabetics only.¹⁵ In the Third US National Health and Nutrition Examination Survey carried out from 1998 to 94, 31% of such patients had blood pressure at goal.¹⁶ Data collected during this study has revealed that less than half of the treated patients managed to have their blood pressure at goal. The situation would have been even worse had the lower blood pressure targets recommended for

diabetics in the past were applied during data analysis. There are multiple reasons for this finding. First and foremost is a poor compliance to treatment, partially attributable to financial constraints. Compliance is an issue even in the western world, as Brodalko et al found that only 17.5% of their diabetic patients in Poland were compliant with antihypertensive treatment.¹⁷ This issue was not addressed in the present study. Other patient related factors include lack of motivation, lack of education and awareness as well as logistic difficulties in accessing health care facilities. At times, physicians err by not adjusting antihypertensive medications despite elevated blood pressure, since they are concentrating more on glycemic control as already highlighted by Berlowitz et al.¹⁸ Many a times, we also fail to educate our patients about the nature of the disease and the need for tight blood pressure control.

American Diabetes Association has defined an HbA1c cut-off limit of 7% for optimal glucose control and the same definition was used in this study. Though all patients did not get HbA1c levels checked, long term glycemic control was

adequate in a very small proportion (one fifth) of the patients. Even if we consider fasting plasma glucose levels, targets were achieved in one fourth of the patients only. This is not a good number, but similar figures have been described elsewhere.¹⁹ Various factors discussed in the preceding paragraph play a role in achievement of a poor glycemic control as well.

The ability of different variables to predict a good or bad control of blood pressure in diabetic patients was evaluated in this study. Most of these have already been subjected to a number of trials. As an example, Chew et al, concluded that older age and obesity were associated with poorly controlled hypertension in Malaysian diabetics.²⁰ A similar association with increasing age was seen in a Bangladeshi population of 406 hypertensive diabetics.²¹ These results are in contrast to this study. However, analogous to the results of this study, an association of gender, level of education or smoking with control of blood pressure could not be established in the Bangladeshi study.

There are a couple of shortcomings of this study. Sample size is a bit small but is in keeping with the patient influx at the health care setup where this study was carried out. Cross sectional design of this study is also a limitation as, of course, it can't prove a definite causal relationship between two factors such as the degree of hypertension control and the different variables studied. This study is also limited by the fact that data regarding compliance to treatment, physical activity and socioeconomic status of patients was not recorded. I would suggest that similar studies may be carried out at hospitals looking after a larger population so as to increase the sample size and reliability of results.

CONCLUSION

Quite a significant proportion of patients with diabetes mellitus type 2 have coexistent hypertension. Unfortunately, nearly half of such patients do not attain an acceptable blood pressure control despite the use of antihypertensive drugs. Moreover, the degree of blood pressure control is not related to the level of glycemic control attained by the patients. This calls for a review of medicines prescribed to all such patients as well as ascertaining compliance to treatment. Educating patients about the nature of their illness and the dangers associated with poor control would also help improve the goals of treatment.

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