
Predictors of Blood Pressure Control in Patients with Type2 Diabetes and Hypertension

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Abstract

Background: The overall prevalence of hypertension (HT) in diabetic patients is greater than 70%, and elevated blood pressure (BP) significantly increases the risk of complications of diabetes mellitus (DM). BP is not well controlled in the majority of patients with both DM & HT. Randomized clinical trials have demonstrated that strict BP control in DM reduces cardiovascular morbidity and mortality.

Objective: This clinical study was conducted to determine predictors of BP control in patients with both Type2 DM&HT who attend National Diabetic Centre (NDC).

Methods: This study is an observational prospective study enrolled 100 patients with type2 DM&HT who had been randomly selected from those attending the NDC Al-Mustansiriya University during the period of the 1st of March 2006 to 1st of September 2006. Detailed history had been recorded and thorough physical examination had been performed for each one of them. Readings of fasting and postprandial plasma glucose, HbA1c, body mass index (BMI=Wt./Ht.²) had been recorded.

Results: This study revealed that age group between 50-59 yrs. had higher frequency of uncontrolled BP 77.77% than the age group 30-39yrs 33.33% (p value=0.04). High percentage of uncontrolled BP was in males 80% compared with females 58.33 % (p value=0.04). 71.42% of those with longstanding DM (11-15yrs.) had uncontrolled HT. 78.12% of patients who use more than one drug to control their BP had uncontrolled HT as compared to 61.76% of those who use monotherapy (p value=0.001). Good control of BP in patients who use insulin as part of their treatment or use insulin alone as compared to other modalities of therapy (p value=0.01).

Conclusion: Predictors of poor BP control in type2 DM were as follows: 1) older age vs younger age group 2) male sex vs. female 3) use of oral hypoglycemic drugs vs. insulin 4) use of more than one drug to control BP vs single antihypertensive drug.

Keywords: Hypertension, Type2 Diabetes

Introduction:

Hypertension is twice as prevalent in diabetic as in non-diabetic individuals^[1]. Furthermore, it has been clearly shown that hypertension in diabetic patients is associated with accelerated progression of both microvascular (retinopathy and Nephropathy)^[2] and macrovascular (atherosclerotic) complications^[3]. Macrovascular disease accounts for the majority of deaths in patients with type2 diabetes mellitus. The presence of hypertension in this type of diabetes is associated with a 4-5-fold increase in mortality, predominantly from coronary artery disease and stroke.^[4]

Good blood pressure control is essential in diabetic patients to prevent morbidity and mortality associated with cardiovascular diseases.^[5]

Sixth Report of the Joint National Committee (JNC-VI) on Prevention, detection, education, and Treatment of high blood pressure recommended a blood pressure goal of <130/85 mmHg in diabetic patients as compared with <140/90 mmHg in non diabetic patients.^[6]

British hypertension society guidelines recommend that optimal target blood pressure during anti hypertension treatment in diabetics <140/80.^[7]

Nearly 40% of patients diagnosed with type 2 diabetes have coexisting hypertension.^[8]

The development of type 2 DM was almost 2.5 times as likely in persons with hypertension as in

their normotensive counterparts.^[9] This, in conjunction with considerable evidence of the increased prevalence of hypertension in diabetic persons.^[10]

In this study we try to find the predictors of poor control and good control of blood pressure in type 2 diabetic patients.

Patients & Methods:

This prospective study enrolled 100 patients with type2 DM and HT. The patients had been randomly selected from those who attended the NDC for regular follow up during the period between the 1st of March 2006 to 1st of September 2006. All patients underwent thorough history taking & physical examination (age, sex, level of education, duration of diabetes, duration of HT, treatment of hypertension, treatment of diabetes, compliance to treatment and cause of non compliance, smoking status(mild, moderate or heavy)^[11], self reported alcohol intake,(all were less than three times/week and around 2-3 drink/day, no case was reported as heavy drinking)(12), complications, BP measured in a quiet environment with mercury sphygmomanometer with patient in a sitting position after a 5 minutes of rest, the measurement was done by the same person, same instrument and the same room, and measurement of body mass index (BMI=Wt./Ht.²). Patients had been investigated for assessing their fasting blood glucose, 2hours post prandial blood glucose,

hemoglobin A1C, and renal function test (blood urea and serum creatinine).

The mean age of patients was 57.1 year (range 32-74 years). 60 out of 100 (60%) were females and 40 out of 100 (40%) were males, all patients were type2 diabetics and hypertensive on treatment for diabetes and hypertension.

Diabetes treatment regimen (sulphonylurea alone, metformin alone, sulphonylurea and metformin, sulphonylurea and insulin, metformin and insulin, sulphonylurea and metformin and insulin and insulin alone).

Patients with systolic blood pressure <130 mmHg and diastolic blood pressure <85 mmHg were considered as having their BP controlled [6]. HbA1c ≤7% considered optimal and >7% considered uncontrolled diabetes mellitus[13].

Statistical analysis is done using Chi-square test and p-probability (p value <0.05) was considered to be statistically significant.

Results:

This study had enrolled 100 patients with type2 diabetes and hypertension, age of the sample range from 32-74 years (mean 57.1year). The study revealed that, age group between 50-59 years had higher frequency of uncontrolled BP (77.77%) while the age group 30-39 years with lesser frequency of uncontrolled BP (33.33%) as shown in table1.

In this study, 60% of patients were females and 40% were males with male: female ratio 2:3. High percentage of uncontrolled BP was in males (80%) compared with (58.33%) in females with uncontrolled HT as shown in table 2.

Table1: Age distribution of patients with controlled and uncontrolled hypertension and type2 diabetes mellitus.

Age groups (years)	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
30-39	2	66.66	1	33.33
40-49	5	35.71	9	64.28
50-59	8	22.22	28	77.77
60-69	15	39.47	23	60.52
70-79	3	44.44	6	55.55

Chi square=9.80 P value=0.043

Table2: sex distribution of patients with hypertension and type2 diabetes mellitus.

BP		Controlled HT	Uncontrolled HT
male	No.	8	32
	%	20	80
female	No.	25	35
	%	41.66	58.33

Chi square=4.16 p value=0.041

High percentage of uncontrolled HT was seen in those patients with recent and longstanding HT (80%, 64.1%, 67.64%, 60%, 63.63% and 100%) in patients with HT duration of (<1yr.,1-5yrs.,6-

10yrs.,11-15yrs.,16-20yrs.and >20yrs.) respectively as shown in table 3.

High percentage (71.42%) of those with longstanding diabetes (11-15yrs.) had uncontrolled HT as shown in table 4.

Table3: shows the distribution of patients with hypertension and its duration.

HT duration (years)	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
<1	2	20	8	80
1-5	14	35.89	25	64.10
6-10	11	32.35	23	67.64
11-15	2	40	3	60
16-20	4	36.36	7	63.63
>20	0	0	1	100

Chi square=0.18

p value=0.98

Table4: shows the distribution of patients with hypertension and the duration of diabetes mellitus.

Duration of diabetes(years)	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
<1	3	42.85	4	57.14
1-5	13	30.95	29	69.04
6-10	8	32	17	68
11-15	2	28.57	5	71.42
16-20	6	40	9	60
21-25	1	33.33	2	66.66
>25	0	0	1	100

Chi square=0.58

p value=0.96

78.12 % of the patients using more than one drug to control their BP had uncontrolled HT as shown in table 5.

High percentages of those patients who use insulin as part of their treatment or use insulin alone

had their BP controlled (100%, 66.66%, 66.66% and 53.84%) of patients using (sulphonylurea and metformin and insulin, sulphonylurea and insulin, metformin and insulin and insulin alone) respectively as shown in table 6.

Table5: shows the distribution of patients with hypertension and whether they use monotherapy or multiple therapies for hypertension.

Treatment of hypertension	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
Mono-therapy	26	38.23	42	61.76
Multi- therapy	7	21.87	25	78.12

Chi square=10.09 p value=0.001

Table6: shows the distribution of patient with HT and various treatments of type 2 diabetes

BP		Controlled ht	Uncontrolled ht
SU	No.	2	16
	%	10	90
M.	No.	4	11
	%	26.66	73.33
SU+M	No.	12	31
	%	27.9	72.02
SU+I	No.	2	1
	%	66.66	33.33
M+I	No.	4	2
	%	66.66	33.33
SU+M+I	No.	2	0
	%	100	0
I	No.	7	6
	%	53.84	46.15

SU=sulphonylurea M=metformin
 I=insulin Chi square=12.47
 P value=0.01

66.66% of patients who were non compliant to treatment had uncontrolled HT and 67.03% of compliant with uncontrolled BP as shown in table 7.

High percentage (75%) of uncontrolled HT was observed in smokers and ex-smokers as shown in table 8.

Table7: shows the distribution of patients with HT and compliance to treatment.

Compliance to treatment	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
Compliant	30	32.96	61	67.03
Noncompliant	3	33.33	6	66.66

Chi square=0.12 P value=0.7

Table 8: shows the distribution of patients with hypertension and smoking

Smoking status	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
Non-Smokers	29	34.52	55	65.42
smokers	2	25	6	75
Ex-smokers	2	25	6	75

Chi square=0.55 P value=0.75

High percentage (75%) of alcohol drinkers had their BP uncontrolled as shown in table 9.

76.11% of uncontrolled HT were not complicated (chronic diabetes related complication)

while 60.6% of controlled HT with no complications as shown in table 10.

Table 9: shows the distribution of patients with hypertension and alcohol drinking.

Alcohol drinking	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
Alcoholics	2	25	6	75
Non-Alcoholics	31	33.69	61	66.30

Chi square=0.01 p value=0.91

Table 10: shows the distribution of patients with hypertension and the appearance of complications.

Complications	Controlled hypertension		Uncontrolled hypertension	
	No.	%	No.	%
With complications	13	39.39	16	23.88
With no complications	20	60.6	51	76.11

Chi square=1.89 p value=0.16

According to body mass index (BMI), high percentages of overweight (68.85%), obese (68.96%) and morbidly obese (68.42%) patients had their BP uncontrolled as shown in table 11

High percentage (59.7%) of uncontrolled HT had their HbA1c higher than 7% while 54.55% of controlled HT had their HbA1c more than 7% as shown in table 12.

Table 11: shows distribution of patients with hypertension and body mass index (BMI).

BP		Controlled ht	Uncontrolled ht
Normal (18.5-24.9)	No.	7	10
	%	41.17	58.82
Over weight(25-29.9)	No.	11	24
	%	31.42	68.58
Obese(30-34.9)	No.	9	20
	%	31.03	68.96
Morbid obesity(>35)	No.	6	13
	%	31.57	68.42

Chi square=1.89 p value=0.16

Table12: shows the distribution of patients with hypertension and level of control of type2 diabetes mellitus.

BP		Controlled Ht	Uncontrolled Ht
A1c=<7%	No.	15	27
	%	45.45	40.30
A1c>7%	No.	18	40
	%	54.55	59.70

Chi square=0.08 p value=0.78

Discussion:

This clinical study had identified several important clinical predictors of blood pressure control in subjects with both type2 diabetes mellitus and hypertension who were enrolled in this study.

The overall blood pressure control rate in this study was 33% which is higher than National Health and Nutrition Examination Survey (NHANES3) (1994-1999) rate of 17.2% or the most recent NHANES (1999-2000) rate of 25.4%.^[14,15] Blood pressure control rate in this study was lower than the target of 50% recommended by United states department of Health and Human Services (Healthy people2010).^[16]

According to age group distribution, uncontrolled hypertension was higher among age group 50-59 years (77.77%) this is consistent with previous studies of hypertensive patients, which observed that patients with diabetes who were older, patients with lower educational levels were more likely to have uncontrolled HT.^[17] In this study, the finding in younger age group is that they had lesser frequency of uncontrolled HT.

We observed that gender difference in BP control and prior research has suggested gender differences in BP control indicating less favorable control in diabetic women compared with men.^[18] The reverse was demonstrated in this study where males with uncontrolled HT was higher (80%) than females (58.33%) p value 0.04 which is statistically significant. This may be explained by the fact that, female patients tend to be more compliant with drug medication than male patients.

With increasing duration of HT in type 2 DM patients, BP tends to be uncontrolled. In this study it has been shown that patients with longstanding HT their BP control become very poor. The same thing is applicable to longstanding DM also their BP tends to be uncontrolled. The decreased number of patients in the age group 70-79 years is probably because of high mortality rate in elderly diabetic

and hypertensive patients and decreased life expectancy.

Regarding types of treatments of type2 DM, we found that variable effect on BP with different use of antidiabetic drugs. Patients taking any oral hypoglycemic drug had significantly poorer BP control compared with those being treated with insulin. This is consistent with Murali K. Duggirala study^[19] which found that treatment with sulfonylurea might increase BP.

Observation in this study about treatment of HT is that, patients receiving more than one anti-hypertensive drug had poorer BP control compared with those receiving one anti-hypertensive therapy whose BP is significantly controlled. This is consistent with Murali K. study which found that poorer BP control in patients receiving three or more anti-hypertensive treatment compared with those receiving two or less.^[19] The fact that patients on multiple antihypertensive medications are not controlled well as those on single therapy is because of the nature of their BP hard to control.

Smoking status tended to be more prevalent among uncontrolled HT (75%) vs. (25%) in controlled HT group. This seems widely different from Nisha Bansal study^[20] which found that smoking in 23% of uncontrolled HT vs.12% in the controlled HT group. While it is not clear why treatment of hypertension in smokers may be more difficult, prior studies have shown that smoking may affect the bioavailability of some antihypertensive drugs, especially beta adrenoreceptor blockers,^[21] or may increase BP^[22] or be marker for noncompliance with medications or other hypertension promoting risk behaviors.

In this study, we found that alcohol drinkers with type2 DM had high percentage of uncontrolled HT (75%) compared to 66.3% in non alcoholic patients which is statistically not significant (p value 0.91) , this is probably because the alcoholic patient were not heavy drinker to the extent that

will affect significantly their compliance to therapy

Patients with type 2 DM and overweight, obese and morbidly obese all had high frequency of uncontrolled HT and they are statistically not significant (p value 0.15).

Patients with uncontrolled DM (HbA1c > 7%) had high percentage of uncontrolled HT (59.7%) but statistically not significant (p value 0.78). This would be expected as some of the factors causing poor diabetes control will themselves cause poor hypertension control.

So in conclusion predictors of poor BP control in type 2 DM were as follows:

1. Older age.
 2. Male sex.
 3. Use of oral hypoglycemic drugs.
 4. Use of more than one drug to control BP.
- While predictors of good control were:
1. Younger age.
 2. Female sex.
 3. Use of insulin.
 4. Use of single antihypertensive drug.

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