

PREVALENCE OF HYPERTENSION ACCORDING TO NEW GUIDELINES IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: Hypertension and type 2 diabetes mellitus are among the most common co-morbidities. In diabetic patients, hypertension is more prevalent than in the general population. The present study aimed to apply the blood pressure guidelines of American College of Cardiology (ACC)/American Heart Association (AHA) 2017 on Type 2 diabetes mellitus patients for initiation and intensification of treatment.

Methods: This is a prospective observational study, designed to study the prevalence of hypertension in patients with Type 2 diabetes mellitus according to new guidelines. One hundred cases of Type 2 diabetes mellitus patients are included in the study. For all the patients, history, clinical examination including blood pressure examination and biochemical tests were performed.

Results: The study Categorized (49%) of the patients as hypertension stage 1, (39%) as stage 2. The study highlighted a statistically significant positive correlation between hypertension (different stages) and poor glycemic control ($P=0.062$). The well-known hypertensive patients who were already taking antihypertensive drugs, they were more likely categorized as hypertension stage 1 and 2; 51.02% and 87.18%, respectively; $P<0.001$, even though they were taking antihypertensive drugs and that (48.98%) of the patients had hypertension stage 1 and (12.82%) had hypertension stage 2 but they were unaware of their elevated blood pressure.

Conclusions: The prevalence of hypertension according to the new categories is much higher for patients with Type 2 diabetes mellitus than previously recorded. Early evaluation for hypertension and periodic evaluation of patient with pre hypertension, applying life style modifications and prompt treatment of hypertension and hyperglycemia favors better outcome.

KEYWORDS: Hypertension, Type 2 diabetes Mellitus, New guidelines of hypertension.

INTRODUCTION

Worldwide hypertension (HT) and diabetes mellitus (DM) rank among the most prevalent chronic diseases and both are multifactorial disorders (Shah and Afzal, 2013).

Type-2 diabetes mellitus (T2DM) is much more prevalent than type I diabetes and globally accounting for 90% of cases. The estimated prevalence for diabetes is 2.8% and 4.4% in 2000 and 2030 respectively for all ages (Venugopal and Mohammed, 2014).

Hypertension is commonly associated with T2DM. HT has higher prevalence in diabetic patients than non-diabetic population. Current studies show that approximately 74% of adult diabetics have systolic blood pressure (SBP) of approximately 140 mmHg or diastolic blood pressure (DBP) of approximately 90 mmHg or are on high blood pressure (BP) prescription medication (Passarella *et al.*, 2018). The

prevalence of coexisting HT and diabetes in industrialized nations appears to be increasing more because increase aging of populations and the increase incidence of both HT and T2DM with aging (Epstein and Sowers, 1992, Program and Hypertension, 1993).

Elevated BP values are a common finding in T2DM patients and they reflect at least in part, the vasculature and kidney impact of the underlying insulin resistance; this will suggest that the pathogenic relationship between DM and HT is generally bidirectional (Tsimihodimos *et al.*, 2018).

Hypertension raises the risk of long-term T2DM complications, including cerebrovascular accident, chronic renal disease, cardiac failure, peripheral artery diseases and death (Colosia *et al.*, 2013). While a substantial reduction in cardiovascular and microvascular morbidity and mortality is accomplished by BP reduction, a

large proportion of diabetic subjects have poorly regulated HT (Tsimihodimos *et al.*, 2018).

The detection of progenitors — prediabetes and prehypertension — by periodic surveillance can allow early intervention and delay the progression of diseases (Joshi *et al.*, 2012).

The American Heart Association (AHA), the American College of Cardiology (ACC) and other societies issued new guidelines for HT management in 2017. They recommend initiation of antihypertensive therapy in patients with diabetes at a BP of $\geq 130/80$ mmHg with a target BP of $< 130/80$ mmHg. (Passarella *et al.*, 2018, Kabakov *et al.*, 2006). The objective of the ACC / AHA guidelines for lowering BP $< 130/80$ mmHg for all diabetic patients is based on the fact that diabetic patients are at high risk of cardiovascular diseases and on the results of two meta-analysis studies that showed a greater reduction in cardiovascular and microvascular risk if the SBP is maintained at a level of < 130 mmHg (Lv *et al.*, 2013, Xie *et al.*, 2016).

The Seventh Report of the Joint National Committee (NJC 7) on the prevention, detection, evaluation and treatment of high BP, also redefined normal BP as less than 120/80 mm Hg and created a new BP category called "Prehypertension" for those with a SBP of 120 - 139 mm Hg and a DBP of 80 - 89 mm Hg. This new category of BP was developed to recognize adults who are deemed at risk of developing HT and to alert both patients and health care professionals to the importance of lifestyle changes. Prehypertension awareness offers valuable opportunities for HT and cardiovascular disease prevention (Miller III and Jehn, 2004).

The objectives of the present study were:

- 1- To apply the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) guidelines on BP in T2DM patients to initiate and intensify treatment.
- 2- Report new hypertensive cases according to these new guidelines.
- 3- For reevaluation and intensification of antihypertensive treatment of the well-known HT cases, still recording high BP according to these guidelines.
- 4- To reassess the correlation between uncontrolled diabetes and HT according to these guidelines.

Patients and Methods

The Study Design:

This is a prospective observational study, designed to study the prevalence of HT

according to the new guidelines in T2DM patients.

Study participants:

The study included 100 known cases of T2DM patients, (67 %) female and (33 %) male. The duration of the study was 3 months. It was conducted from December, 2017 until March, 2018. Cases were collected from the endocrine department in Azadi Teaching Hospital in Duhok, and private endocrine clinics in Duhok city.

Inclusion & exclusion criteria:

Patients with T2DM were the main participants of the study.

Exclusion Criteria: Newly diagnosed diabetes, pregnant patients, Type-1 diabetes mellitus.

A trained staff was administering a standard questionnaire to obtain information on demographic data including name, age, sex, occupation, residence, smoking status, the duration of diabetes and HT (if present) and drug history, family history (FH) of diabetes and HT, in this study FH of diabetes has been defined as positive if the subject has at least one parent or children, up to the second degree relative diagnosed with T2DM. A written consent form was obtained, and privacy was assured.

All participants underwent clinical exams, including BP, pulse rate, (body weight and height) was determined by standard practice, and BMI was calculated as weight in kilograms divided by height in square meters (kg / m^2). BP was recorded in both arms in sitting position, after having rest for 10 minutes using a standard mercury sphygmomanometer with an appropriate cuff size.

BMI values have been categorized as underweight (less than 18.5), normal (18.5-24.9), overweight (25–29.9), and obese (equal or more than 30).

Biochemical tests performed:

HbA1c was assessed.

Reference Ranges of HbA1c:

- Normal range: 4.2-6.2 %
- **for DM:**
- Good control < 6.8 %
- Fair control 6.8-7.6 %
- Poor control > 7.6 %

The categories of blood pressure were estimated according to the new ACC / AHA High Blood Pressure Guidelines (Lower Hypertension Definition);

Normal BP: $< 120/80$ mm Hg;

Elevated BP: Systolic from 120-129mm Hg and diastolic less than 80 mm Hg

Stage 1 HT: Systolic between 130-139 mm Hg or 80-89 mm Hg in diastolic

Stage 2 HT: At least 140 mm Hg systolic, or at least 90 mm Hg diastolic

Hypertensive crisis: Systolic over 180 mm Hg and/or diastolic over 120 mm Hg

Ethical considerations:

The Local Research Ethics Committee approved the Duhok Health Directorate-General study registered as the 26062018-5 reference number on June 26th 2018. Throughout the study steps the confidentiality of the subjects' personal information has been protected.

Statistical analysis:

The general information of the patients was presented in number and percentage and mean and Standard deviation. The descriptive purposes of the study were determined in number and percentage, including BMI categories, glycemic control, and hypertension stages. The association of blood pressure with

glycemic control were performed in Fishers' exact test.

The blood pressure categories were considered dependent variable, and Smoking, Diabetes duration, BMI categories, HbA1c categories, and antihypertensive drugs as independent variables with adjustment for age and gender in univariate variance analysis. The predictor association (antihypertensive drugs) with BP was examined in the exact Fishers test. The difference in P-value below 0.05 was considered statistically significant. Statistical Package for Social Sciences 24 (SPSS 24; IBM Corp; USA) was used for statistical calculations.

RESULTS

A total of (100) T2DM patients enrolled in this study, (33%) were male & (67%) were female. The mean age was (57years). Family history of T2DM was positive in (69%) of the patients. Regarding BMI, (43%) of the patients were obese & (42%) were over weights. (Table 1)

Table (1): General information of patients with T2DM

Patients' characteristics (n=100)	Mean	Standard Deviation
Age (32-86 Years)	57.06	10.78
	Number	Percentage
Gender	33	33.0
Male	67	67.0
Female		
Smokers	7	7.0
Family History of Diabetes	69	69.0
Positive FH	31	31.0
Negative FH		
BMI (19.03-39.14); Mean/SD	Mean: 29.15	SD: 4.13
BMI categories (n, %)		
Underweight (<18.5)	1	1.0
Normal Weight (18.5-24.9)	14	14.0
Overweight (25.0-29.9)	42	42.0
Obese (30 And Over)	43	43.0

The study showed that (58%) of the patients were classified as poorly controlled diabetes according to the HbA1c and (33%) as fairly controlled, the mean HbA1c of all the patients were (8.16).

The study demonstrated that (49%) of the patients were categorized as stage 1

hypertension, (39%) as stage 2, only (1%) had hypertensive crises, (7%) of the patients had elevated blood pressure and only 4% of the patients recorded normal blood pressure according to these guidelines (Table 2).

Table (2): Disease-related information of patients with T2DM

Patients' characteristics (n=100)	Mean	Standard Deviation
HbA1c (5.4-11.6); Mean/SD	8.16	1.23
	Number	Percentage
HbA1C Categories		
Normal range (HbA1c: 4.2-6.2%)	4	4.0
Good control (HbA1c: >6.2 - < 6.8%)	5	5.0
Fair control (HbA1c: 6.8-7.6%)	33	33.0
Poor control (HbA1c: >7.6%)	58	58.0
Diabetes medicine	100	100
Antihypertensive medicines		
Yes	61	61.0
No	39	39.0
Blood Pressure Categories		
Normal Blood Pressure	4	4.0
Elevated Blood Pressure	7	7.0
Hypertension Stage 1	49	49.0
Hypertension Stage 2	39	39.0
Hypertensive Crisis	1	1.0

The characteristics were presented in number and percentages except for HbA1c in mean and standard deviation.

The study highlighted a statistically significant positive correlation between HT (different stages) and poor glycaemic control ($P=0.062$) (Table 3).

Table (3): Association of blood pressure with glycaemic control in T2DM

Blood Pressure (n=100)	HbA1C Categories				P-Value (two-sided)
	Normal range	Good control	Fair control	Poor control	
Blood Pressure Categories					0.194
Normal	0 (0.0)	0 (0.0)	0 (0.0)	4 (6.9)	
Elevated	2 (50.0)	0 (0.0)	3 (9.1)	2 (3.4)	
Hypertension Stage 1	2 (50.0)	2 (40.0)	18 (54.5)	27 (46.6)	
Hypertension Stage 2	0 (0.0)	3 (60.0)	12 (36.4)	24 (41.4)	
Hypertensive Crisis	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.7)	
Blood Pressure Categories					0.062
Normal	0 (0.0)	0 (0.0)	0 (0.0)	4 (6.9)	
Elevated	2 (50.0)	0 (0.0)	3 (9.1)	2 (3.4)	
Hypertension (different stages)	2 (50.0)	5 (100)	30 (90.9)	52 (89.7)	

Fishers' exact test was performed for statistical analysis.

The study found a non-significant correlation between hypertension with smoking, duration of diabetes, BMI, age and gender, except for antihypertensive treatment ($P<0.001$) (Table 4, a).

Table (4): Predictors of blood pressure categories in patients with T2DM

a) Predictors

Predictors	Dependent variable: Blood Pressure Categories			
	Mean Square	F Score	P-value	Effect Size
Smoking	1.461	2.895	0.093	0.040
Diabetes duration	0.411	0.815	0.677	0.173
BMI categories	0.050	0.098	0.961	0.004
HbA1c categories	0.690	1.366	0.260	0.055
Antihypertensive	7.683	15.221	<0.001	0.179
Age	0.447	0.886	0.350	0.012
Gender	0.018	0.036	0.850	0.001

Univariate analysis of variance was performed for statistical analysis.
The bold number shows the predictor of blood pressure.

The study showed that of the well-known hypertensive patients who were already taking antihypertensive drugs, they were more likely categorized as HT stage 1 and 2; 51.02% and 87.18%, respectively; $P < 0.001$, even though they were taking antihypertensive drugs.

The study discovered that (48.98%) of the patients had HT stage 1 and (12.82%) had HT stage 2 and they were all unaware of their high BP (Table 4, b).

b) Association of blood pressure with antihypertensive drugs using in type 2 diabetic patients

Blood Pressure (N=100)	Antihypertensive		P-Value (Two-Sided)
	Yes	No	
Blood Pressure Categories			<0.001
Normal	0 (0.0)	4 (100)	
Elevated	2 (28.57)	5 (71.43)	
Hypertension Stage 1	25 (51.02)	24 (48.98)	
Hypertension Stage 2	34 (87.18)	5 (12.82)	
Hypertensive Crisis	0 (0.0)	1 (100)	

Fishers' exact test was performed for statistical analysis.

DISCUSSION

Diabetes mellitus and HT are common diseases that frequently coexist. Patients with T2DM have much higher rate of HT than normal population. The co-existence of these two disorders accelerates the development of micro and macrovascular complications and this greatly increases the risk of cardiovascular diseases, stroke and end stage renal disease (Sampanis and Zamboulis, 2008).

Studies found a substantial increase in the probability of T2D development in obese individuals in comparison to the severity of obesity (Freemark and Bursey, 2001), this study revealed that (43%) of patients were obese and (42%) were overweight. Schrauwen-Hinderling *et al.*, compared T2D patients and healthy controls and found that the rate of over weight in males between 45 and 70 years of age of the two groups were $(29.4 \pm 1.0$ and 29.3 ± 0.9 kg/m² respectively, $p = NS$) (Schrauwen-Hinderling *et al.*, 2007).

Family history (FH) of diabetes significantly increases the risk for development of T2DM (van't Riet *et al.*, 2010). This high risk of T2DM is partly mediated by the shared genetic and environmental factors among the family members, and some specific factors that account for the increased risk are poorly understood (Consortium, 2013, Zhao *et al.*, 2017), (69%) of our patients had FH of T2DM.

The vast majority of diabetic patients tend to suffer from HT. The incidence of HT typically increases with declining BP cut-off points in researches. (49 %) of the diabetic patients were categorized as stage 1 HT, (39 %) as stage 2, a cohort study showed a prevalence of HT of 60.2 %, 76.5 %, and 85.8 % at BP thresholds of 140/90, 130/85, and 130/80 mm Hg respectively (Kabakov *et al.*, 2006). A group of researchers in their study on 3202 diabetic patients and follow up for about (1-11 years) recorded an incidence of HT of 20.8 (20.6 male and 20.9 female) per 100 person/years based on 9403 person/years of follow-up (Janghorbani and Amini, 2005). Another researcher depending on Joint National Committee (JNC-VI), reported 11% as high-normal BP (systolic/diastolic, 130 - 139 mm Hg / 85 -89 mm Hg, respectively) or stage-1 HT (140 - 159 mm Hg / 90 to 99 mm Hg), but they were not currently on antihypertensive medication. JNC-VI, but not previous JNC guidelines, specifically recommended drug therapy as initial treatment for these patients (Muntner *et al.*, 2002). Most important changes concerning classification of BP levels and the approaches to drug therapy, is the introduction of the new category "prehypertension" and 2 stages of HT distinguished as: stage I - SBP 140-159 mm Hg or DBP 90-99 mm Hg, and stage II - SBP 160 mm Hg or higher, DBP 100 mm Hg or higher. Diuretics are recommended as drugs of first choice and wider use of drug combinations encouraged (Britov and Bystrova, 2003).

Limitations of the study:

The study's principal limitations were;

- 1- Small sample size.
- 2- Inability to perform biochemical tests to diagnose other causes of secondary HT.

CONCLUSION

The prevalence of HT according to the new categories is much higher in patients with T2DM than that previously reported. Early evaluation

for HT and periodic evaluation of patient with prehypertension, applying life style modifications and prompt treatment of HT and hyperglycemia will potentially favor better outcome.

These findings will help the identification of those patients at particular risk of HT and strongly support the case for vigorous control of BP on T2D patients.

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Conflicts of interest:

No conflicts of interest.

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