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Risk Factors and Clinical Profile of Hypertensive Patients with Type 2 Diabetes Mellitus: A Hospital-based Cross-sectional Study

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Abstract

Objective: Hypertension and Type 2 Diabetes Mellitus (T2DM) often coexist, significantly increasing the risk of cardiovascular complications and mortality. Understanding the risk factors and clinical profile of hypertensive patients with T2DM is crucial for early intervention and effective disease management. Therefore, this study assessed the clinical symptoms associated with T2DM among hypertensive and non-hypertensive groups.

Methodology: This cross-sectional study, conducted at a secondary care hospital, enrolled 400 type 2 diabetic patients (200 with hypertension and 200 without) using non-probability convenience sampling. The study duration was 6 months, from March 1st, 2024, to August 31st, 2024. Patients aged 40-70 years with a diabetes history of at least six months were included, while those with type 1 diabetes, pregnancy, secondary hypertension, major surgeries, or severe complications were excluded. Data were collected using a structured questionnaire and clinical assessments, including BMI, blood pressure, and laboratory tests. The Chi-square and t-tests were applied to assess group differences, considering $p<0.05$ statistically significant.

Results: The study results indicated that the mean age was notably higher in hypertensive group (59.29 ± 15.54 years) than in non-hypertensive group (54.13 ± 14.83 years, $p = 0.001$). Psychological and gastrointestinal symptoms revealed that muscular pain or cramps in the legs or feet were significantly more prevalent in non-hypertensive group 193(96.5%) than in hypertensive group 169(84.5%), ($p < 0.001$). Increased thirst was observed more often in non-hypertensive group 109(54.5%) compared to hypertensive group 80(40.0%), ($p = 0.004$), and feelings of fatigue and weakness were also more frequent in non-hypertensive group 162(81.0%) than in hypertensive group 142(71.0%), ($p = 0.019$). Frequent urination was significantly more common in hypertensive group 112(56.0%) than in non-hypertensive group 40(20.0%), ($p < 0.001$).

Conclusion: This study concluded that hypertensive patients with type 2 diabetes were generally older, heavier, and predominantly male, with higher BMI and mild edema compared to non-hypertensive patients. Significant differences were observed in urinary patterns, respiratory symptoms, and musculoskeletal complaints, while several neurological symptoms showed no significant differences between the groups.

Keywords: Hypertension, Type 2 diabetes mellitus, urinary and respiratory symptoms.

Introduction

Hypertension and Type 2 Diabetes Mellitus (T2DM) frequently coexist, presenting a significant global health challenge. The coexistence of these conditions substantially increases the risk of cardiovascular complications and mortality.(1) Studies indicate that approximately 60-80% of diabetic patients develop hypertension, leading to increased healthcare burden and compromised quality of life.(2)The relationship between hypertension and T2DM has been extensively studied over the past decades. Several epidemiological studies have demonstrated a strong association between these conditions. The Framingham Heart Study, revealed that diabetic patients have a 2-3 times higher likelihood of developing hypertension compared to non-diabetic individuals.(3) Furthermore, research has shown that the presence of hypertension in diabetic patients significantly accelerates the progression of both micro and macrovascular complications.(4)

Recent studies have highlighted that effective blood pressure control in diabetic patients can reduce cardiovascular events by 30-50%.(5) The American Diabetes Association (ADA) guidelines (2023) emphasize the importance of maintaining blood pressure below 140/90 mmHg in diabetic patients to minimize cardiovascular risk. However, achieving these targets remains challenging in clinical practice.(6)

Demographic factors play a crucial role in the development of hypertension among diabetic patients. Studies have shown that age, gender, BMI, and lifestyle factors significantly influence the prevalence of hypertension in this population.(7) The International Diabetes Federation (IDF) Report (2023) indicates that older age, obesity, and physical inactivity are major contributors to the development of hypertension in diabetic patients.(8)

The pathophysiological mechanisms linking diabetes and hypertension are complex and multifaceted. Research has identified several common pathways, including insulin resistance, inflammation, oxidative stress, and endothelial dysfunction.(9) These mechanisms often work synergistically, creating a vicious cycle that complicates disease management.(10)

Clinical studies have also emphasized the importance of early detection and management of hypertension in diabetic patients. The United Kingdom Prospective Diabetes Study (UKPDS) (11) demonstrated that tight blood pressure control significantly reduces diabetes-related deaths, strokes, and microvascular complications. However, research suggests that a significant proportion of diabetic patients remain undiagnosed or inadequately treated for hypertension.(12)

Despite extensive research, gaps remain in our understanding of the clinical characteristics and associated factors of hypertension in T2DM patients. While previous studies have examined various aspects of this relationship, comprehensive analyses of clinical parameters, complications, and risk factors in specific populations are limited. This understanding is crucial for developing targeted interventions and improving patient outcomes.

Methodology

This cross-sectional study was conducted at secondary care hospital, using non-probability convenience sampling technique, after approval of the concerned hospital. The study duration was 6 months, from March 1st, 2024, to August 31st, 2024. A total of 400 type 2 diabetic patients were enrolled and categorized into two groups based on their history of hypertension: 200 patients with hypertension and 200 without hypertension. The study included type 2 diabetic patients aged 40-70 years of both genders who had been diagnosed with diabetes for at least 6 months and were willing to participate. Patients with type 1 diabetes, pregnant women, those with secondary hypertension, severe cardiac, renal, or hepatic complications, patients who underwent major surgery in the past 3 months, and those on immunosuppressive therapy were excluded from the study.

A structured questionnaire was used to collect demographic information including age, gender, weight, height, and socioeconomic status. Clinical parameters such as blood pressure, heart rate, respiratory rate, and temperature were measured using standard protocols. Blood pressure was measured using a calibrated sphygmomanometer after the patient had rested for at least 5 minutes. Weight was measured using a digital scale, and height was measured using a stadiometer. Body Mass Index (BMI) was calculated using the standard formula (weight in kg/height in m^2). Detailed medical history regarding duration of diabetes, smoking status, physical activity, and current medications was recorded. The presence of complications and symptoms was assessed through comprehensive history and clinical examination, including visual disturbances, cardiovascular symptoms, edema, neurological symptoms, dental health, skin manifestations, and urinary symptoms. Laboratory parameters including Random Blood Sugar (RBS) were measured using standard hospital protocols.

Data analysis was performed using SPSS version 26.0. Descriptive statistics were presented as frequencies and percentages for categorical variables, while means and standard deviations were calculated for continuous variables. The association between categorical variables in hypertensive and non-hypertensive groups was analyzed using Chi-square test, while independent t-test was employed to compare means of continuous variables between the two groups. A p-value of

<0.05 was considered statistically significant. The study was conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from all participants before enrollment in the study.

Results

Table I: Demographic characteristics of type 2 diabetes patients (n=400).

Variable	History of Hypertension Yes Mean±SD	History of Hypertension No Mean±SD	P-value
Age (Years)	59.29±15.54	54.13±14.83	0.001
Weight (kg)	72.27±13.62	65.01±15.06	<0.001
Height (Inch)	67.35±10.76	66.59±8.50	0.433
BMI (kg/m^2)	26.89±11.95	24.21±10.37	0.017
Heart rate (beats/min)	87.12±10.50	84.31±12.24	0.014
Random blood sugar (RBS) (mg/dL)	332.78±96.38	290.09±116.75	<0.001

The analysis of the medical data tables reveals several significant patterns among patients with and without hypertension. Demographically, hypertensive patients were notably older (59.29±15.54 vs 54.13±14.83 years, p=0.001) and had higher body weight (72.27±13.62 vs 65.01±15.06 kg, p<0.001), resulting in elevated BMI measurements (26.89±11.95 vs 24.21±10.37 kg/m^2, p=0.017), as presented in Table I.

Table II: The association of gender, comorbidities, and socioeconomic status in T2DM patients among hypertensive and non-hypertensive group.

Variable		History of Hypertension Yes n(%)	History of Hypertension No n(%)	P-value
History of Dyslipidemia	**Yes**	150(75.0%)	145(72.5%)	0.570
	No	50(25.0%)	55(27.5%)	
History of Depression	**Yes**	85(42.5%)	76(38.0%)	0.359
	No	115(57.5%)	124(62.0%)	
Gender	**Male**	186(93.0%)	58(29.0%)	<0.001
	Female	14(7.0%)	142(71.0%)	
Socioeconomic Status	**Low**	34(17.0%)	31(15.5%)	0.011
	Middle	104(52.0%)	131(65.5%)	
	High	62(31.0%)	38(19.0%)	

A striking gender disparity emerged, with males comprising 186(93.0%) of the hypertensive group compared to only 58(29.0%) in the non-hypertensive group. Socioeconomic distribution showed significant variations, with middle-class representation predominant overall but high socioeconomic status more prevalent in the hypertensive group. Interestingly, several factors showed no significant differences between groups, including history of dyslipidemia, and depression prevalence, as presented in Table II.

Table III: The association of renal, ocular, and respiratory symptoms in T2DM patients among hypertensive and non-hypertensive group.

Variable		History of Hypertension Yes n(%)	History of Hypertension No n(%)	P-value
Frequent urination	Yes	112(56.0%)	40(20.0%)	<0.001
	No	88(44.0%)	160(80.0%)	
Urination at night	Three times at night	97(48.5%)	145(72.5%)	<0.001
	Two times at night	92(46.0%)	51(25.5%)	
	Every night	11(5.5%)	4(2.0%)	
Blurry vision	Yes	59(29.5%)	93(46.5%)	<0.001
	No	141(70.5%)	107(53.5%)	
Poor night vision	Yes	71(35.5%)	68(34.0%)	0.753
	No	129(64.5%)	132(66.0%)	
Dry cracked skin	Yes	117(58.5%)	147(73.5%)	0.002
	No	83(41.5%)	53(26.5%)	
Darker area of skin that feels like velvet	Yes	121(60.5%)	101(50.5%)	0.044
	No	79(39.5%)	99(49.5%)	
Edema if yes then	Bilateral	91(45.5%)	91(45.5%)	1.000
	Unilateral	109(54.5%)	109(54.5%)	
If bilateral then	1+ Mild (Both ankles/ feet)	110(55.0%)	39(19.5%)	<0.001
	2+ Moderate (Both feet, hands, lower arms and lower legs)	72(36.0%)	135(67.5%)	
	3+ Severe (Generalized bilateral pitting edema, including both legs, arms feet and face)"	18(9.0%)	26(13.0%)	
Confusion or difficulty concentrating	Yes	90(45.0%)	74(37.0%)	0.104
	No	110(55.0%)	126(63.0%)	
Shortness of breath	Yes	141(70.5%)	114(57.0%)	0.005
	No	59(29.5%)	86(43.0%)	
Dyspnea grading	While climbing stairs	107(53.5%)	102(51.0%)	0.009
	While walking for more than 6 hours in a day	57(28.5%)	80(40.0%)	
	While walking for less than 6 hours in a day"	21(10.5%)	7(3.5%)	
	While at rest	15(7.5%)	11(5.5%)	
Difficulty breath If Yes	Mild	65(32.5%)	91(45.5%)	0.018
	Moderate	103(51.5%)	77(38.5%)	
	Severe	32(16.0%)	32(16.0%)	
Chest tightness or pressure	Yes	141(70.5%)	145(72.5%)	0.658
	No	59(29.5%)	55(27.5%)	

Frequent urination was significantly more common among hypertensive group (56% vs 20%, p<0.001). While the pattern of urination frequency throughout the day showed significant difference between groups (p< 0.001). Interestingly, while hypertensive patients reported lower rates of blurry vision (29.5% vs 46.5%, p<0.001) compared to non-hypertensive group. However, several visual symptoms showed no significant differences between the groups. These included the poor night vision or night blindness (35.5% vs 34.0%, p=0.753). Regarding skin manifestations, several significant differences were observed. Non-hypertensive group reported higher rates of dry, cracked skin (73.5% vs 58.5%, p=0.002). The distribution of bilateral versus unilateral edema was identical (45.5% bilateral in both groups), the severity of bilateral edema showed significant differences (p<0.001). Hypertensive patients were more likely to present with mild edema (55.0% vs 19.5%), while non-hypertensive

more frequently experienced moderate edema (67.5% vs 36.0%). Severe generalized bilateral pitting edema was slightly more common in non-hypertensive (13.0% vs 9.0%). Confusion or difficulty concentrating showed no significant difference between the groups (45.0% vs 37.0%, p=0.104). Respiratory symptoms demonstrated notable differences between hypertensive and non-hypertensive group. Shortness of breath was significantly more prevalent among non-hypertensive group (70.5% vs 57.0%, p=0.005), with distinct patterns in dyspnea grading (p=0.009). While both groups commonly experienced dyspnea while climbing stairs (53.5% vs 51.0%), hypertensive patients were more likely to experience breathing difficulties with limited activity (10.5% vs 3.5% for walking less than 6 hours). The severity of breathing difficulties also varied significantly (p=0.018), with hypertensive patients showing higher rates of moderate difficulty (51.5% vs 38.5%) while non-hypertensive group more frequently reported mild symptoms (45.5% vs 32.5%). Severe breathing difficulties were equally distributed (16.0% in both groups). Although chest tightness or pressure was similarly prevalent in both groups (70.5% vs 72.5%, p=0.658), the management of chest pain showed significant differences (p=0.021), as presented in Table III.

Table IV: The association of psychological and gastrointestinal symptoms in T2DM patients among hypertensive and non-hypertensive group.

Variable		History of Hypertension Yes n(%)	History of Hypertension No n(%)	P-value
Tingling or numbness in the hands or feet	**Yes**	119(59.5%)	133(66.5%)	0.147
	No	81(40.5%)	67(33.5%)	
Burning pain in your legs or feet	**Yes**	112(56.0%)	128(64.0%)	0.102
	No	88(44.0%)	72(36.0%)	
Too sensitive feet on touch	**Yes**	56(28.0%)	65(32.5%)	0.327
	No	144(72.0%)	135(67.5%)	
Muscular pain or cramps in your legs or feet	**Yes**	169(84.5%)	193(96.5%)	<0.001
	No	31(15.5%)	7(3.5%)	
Loss of appetite	**Yes**	129(64.5%)	114(57.0%)	0.125
	No	71(35.5%)	86(43.0%)	
Insomnia	**Yes**	101(50.5%)	91(45.5%)	0.317
	No	99(49.5%)	109(54.5%)	
Increased thirst	**Yes**	80(40.0%)	109(54.5%)	0.004
	No	120(60.0%)	91(45.5%)	
Fatigue	**Yes**	169(84.5%)	179(89.5%)	0.137
	No	31(15.5%)	21(10.5%)	
Feel tired and weak	**Yes**	142(71.0%)	162(81.0%)	0.019
	No	58(29.0%)	38(19.0%)	
Mood changes	**Yes**	147(73.5%)	165(82.5%)	0.030
	No	53(26.5%)	35(17.5%)	

Regarding musculoskeletal symptoms, while non-hypertensive group reported higher rates of muscular pain or cramps in legs or feet (96.5% vs 84.5%, p<0.001), hypertensive were more likely to experience worsening of symptoms at night (58.5% vs 44.5%, p=0.005). Other neurological symptoms such as tingling or numbness (59.5% vs 66.5%, p=0.147), burning pain (56.0% vs 64.0%, p=0.102), and touch sensitivity in feet (28.0% vs 32.5%, p=0.327) showed no significant differences between groups. Metabolic and general symptoms showed mixed patterns. Non- hypertensive group reported significantly higher rates of increased thirst (54.5% vs 40.0%, p=0.004), cold sweating (80.0% vs 60.5%, p<0.001), occasional tiredness and weakness (81.0% vs 71.0%, p=0.019), and irritability or mood changes (82.5% vs 73.5%, p=0.030). Several symptoms showed no significant differences between groups, including loss of appetite (64.5% vs 57.0%, p=0.125), insomnia (50.5% vs 45.5%, p=0.317), fatigue (84.5% vs 89.5%, p=0.137), as presented in table IV.

Discussion

The demographic profile of hypertensive patients in this study aligns with established literature, particularly regarding age and BMI. The significantly higher age among hypertensive patients (59.29±15.54 vs 54.13±14.83 years,

p=0.001) corresponds with findings from the Framingham Heart Study, which demonstrated that the risk of developing hypertension increases substantially with age.(13) The marked gender disparity, with males comprising 93% of the hypertensive group, exceeds typical gender distributions reported in most population studies and warrants further investigation.

The association between elevated BMI and hypertension (26.89±11.95 vs 24.21±10.37 kg/m², p=0.017) reinforces the well-documented relationship between obesity and cardiovascular risk factors. This finding aligns with meta-analyses showing that each 5 kg/m² increase in BMI is associated with approximately 30% higher risk of hypertension.(14)

The significantly higher Random Blood Sugar (RBS) levels in hypertensive patients (332.78±96.38 vs 290.09±116.75, p<0.001) suggest potential interactions between glucose metabolism and blood pressure regulation. This relationship is supported by research demonstrating shared pathophysiological mechanisms between diabetes and hypertension, including insulin resistance and endothelial dysfunction.(15)

The striking difference in diabetes classification between both groups (100% diagnosed diabetes in smokers vs. varied distribution in non-smokers) adds to the growing body of evidence linking smoking to increased diabetes risk. This association may be explained by smoking's effects on insulin sensitivity and β-cell function, as demonstrated in longitudinal studies.(16)

The higher prevalence of shortness of breath among both groups (70.5% vs 57.0%, p=0.005) with distinct patterns in dyspnea grading reflects the well-documented effects of smoking on pulmonary function. The observation that smokers required more frequent pain medication for chest discomfort (40.5% vs 27.5%) suggests possible differences in the underlying pathophysiology of cardiovascular symptoms between smokers and non-smokers.

The significantly higher prevalence of vision loss among both groups (52.5% vs 35.0%, p<0.001) and the distinct pattern of visual disturbances provide important insights into the potential acceleration of diabetic retinopathy by smoking. These findings align with prospective studies showing that smoking increases the risk of microvascular complications in diabetes.(17)

The higher prevalence of specific skin manifestations among both groups, particularly darker areas with velvet-like texture (60.5% vs 50.5%, p=0.044), may indicate an interaction between smoking and advanced glycation end-products (AGEs) formation. This relationship has been explored in studies examining the accelerated aging of skin in diabetic smokers (18).

This study had a few limitations. The cross-sectional design restricts the ability to establish causal relationships between hypertension and the observed health patterns. Potential recall bias and self-reported data may affect the accuracy of symptom reporting. Additionally, the sample may not fully represent the broader population due to demographic imbalances. Future studies should employ longitudinal designs to better explore causal links and long-term health outcomes. Public health strategies should focus on early detection and management of hypertension, particularly among high-risk groups.

Conclusion

This study concluded that hypertensive patients with type 2 diabetes were generally older, heavier, and predominantly male, with higher BMI and mild edema compared to non-hypertensive patients. Significant differences were observed in urinary patterns, respiratory symptoms, and musculoskeletal complaints, while several neurological symptoms showed no significant differences between the groups.

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