Original Research Paper

Volume - 14 | Issue - 05 | May - 2024 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

General Medicine

THE PROPORTION OF ORTHOSTATIC HYPOTENSION AND ITS RELATIONSHIP WITH HBA1C LEVELS IN PATIENTS WITH DIABETES MELLITUS

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ABSTRACT

Objective: 1. To determine proportion of "ORTHOSTATIC HYPOTENSION" in diabetic patients.
2. To correlate presence of "ORTHOSTATIC HYPOTENSION" with HbA1c and other factors in diabetic patients.

Materials and Methods: The study, conducted over 18 months from June 2022 to November 2023, will focus on indoor patients admitted to our tertiary care hospital. Using a cross-sectional design, data entry will be meticulously conducted in MS Excel spreadsheets, with thorough checks to ensure accuracy. Informed consent will be obtained, and data will be collected via structured clinical Performa. Analysis will be performed using OpenEpi and SPSS software, presenting descriptive statistics with frequency and percentage. Furthermore, statistical tests like the t-test and chi-square test will be utilized for deeper analysis. **Results:** This study examined orthostatic hypotension (OH) in diabetic patients, involving a sample of 100 individuals. OH prevalence among diabetics was 12%, with 12% attributed to antihypertensive medication use. The mean age was 51.78 years, with 45.83% aged 40-59, and a male predominance (58%). Longer diabetes duration correlated significantly with OH. Elevated HbA1c levels (mean 9.2%) were associated with increased OH risk. Higher mean BMI, fasting blood sugar, and postprandial 2-hour blood sugar were linked to OH. Notably, 12 cases of OH occurred without drug-induced hypotension history. These findings highlight the complex interplay of clinical and biochemical factors in diabetic OH manifestation. **Conclusions:** The findings of the present study shed light on several significant correlations regarding orthostatic hypotension (OH) in diabetic patients. Among the diabetic population studied, OH was observed in 12%, with a notable proportion also concurrently using antihypertensive drugs. Furthermore, OH showed direct associations with elevated levels of HbA1c, fasting blood sugar (FBS), postprandial 2-hour blood sugar (PP2BS), longer durations of diabetes mellitus (DM), and higher body mass index (BMI). Interestingly, gender did not emerge as a factor influencing OH prevalence. Additionally, OH exhibited direct associations with the positivity of other tests for cardiac autonomic neuropathy and non-cardiac autonomic neuropathy, including gastrointestinal, genitourinary, and sudomotor complications, as well as diabetic peripheral neuropathy. These findings underscore the importance of routine measurement of postural blood pressure in diabetic patients, as it serves as a vital diagnostic tool for detecting OH, an early indicator of underlying cardiac autonomic neuropathy.

KEYWORDS : Orthostatic hypotension, HbA1c, Diabetes mellitus

INTRODUCTION

Diabetes mellitus, one of the most important and common comorbidity is associated with phenotype of hyperglycemia. Complex interaction of genetic and environmental factors lead to insulin resistance, increase glucose production and relative insulin deficiency. Ultimately causing hyperglycaemia.1 As a multi organ metabolic disorder different vascular and nonvascular complications leads to approximately 10 years shorter life expectancy.2 Among all complications, diabetic neuropathy is devastating vascular complications. Cardiac involvement in diabetes, related to autonomic neuropathy is unique. As it remains occult many times and leads to sudden cardiac death also. Orthostatic hypotension is one of the signs of cardiac autonomic neuropathy.3 Systolic BP decreased to at least 20 mmHg or diastolic BP decreased to at least 10 mmHg within 3 min of standing is labelled as orthostatic hypotension. Orthostatic hypotension may occur due to reduced intravascular volume, impaired baroreceptor reflex, inadequate sympathetic and cardiovascular responses which may lead to reduced cardiac output.4,5 Orthostatic hypotension in patients with diabetes mellitus is associated with increased risk of fall, syncope, cardiovascular events and sudden cardiac death.6,7 There are many factors that affect the development of orthostatic hypotension in patients with diabetes mellitus such as age, duration of diabetes mellitus, glycemic control, associated hypertension etc., out of which glycemic control measured by HbA1c appears to be the most relavent.8,9

MATERIALS AND METHODS

Using a cross-sectional design, the study will encompass all diabetic patients admitted to the wards of our tertiary care hospital during the one-and-a-half-year period from June 2020 to November 2021. Prior to enrollment, patients will provide informed written consent, following which detailed histories will be obtained and comprehensive general and systemic examinations will be conducted. Key investigations including HbA1c measurements and blood pressure assessments using a standard sphygmomanometer will be performed, with blood pressure measured at the end of 3 minutes after standing. Additionally, Ewing tests, comprising various cardiovascular autonomic function tests, will be conducted. Data from these assessments will be meticulously recorded in patient proformas and entered into MS Excel spreadsheets for analysis using OpenEpi and SPSS software. Statistical analyses, including t-tests and chi-square tests, will be applied to the dataset of 100 patients, facilitating a comprehensive understanding of orthostatic hypotension prevalence and its associated factors in diabetic individuals.

Inclusion Criteria:

1. Newly detected type 2 diabetic patients of a tertiary care hospital defined as any one of the following.
   - FBS>=126 mg/dl
   - 2h glucose level after oral glucose tolerance test >=200 mg/dl
   - HbA1c >= 6.5%
   - Random blood sugar >= 200 with sign and symptoms of diabetes.
2. Known case of type 2 diabetes mellitus.
3. Age >= 18yrs
4. Patient willing for admission and willing to participate in study.
5. All patient giving informed written consent for study

Exclusion Criteria (Any of the following):

- Dehydration
- Hypovolemia
- Sepsis
- Anemia
- Arrhythmia
- Patients taking antiarrhythmic drugs and drugs causing arrhythmia or QTc prolongation
- CKD pt. on HD
- Patients intoxicated with alcohol, opioid etc.
- Cirrhosis
- Any other pathology other than diabetes causing orthostatic hypotension
- Pt. not willing for hospital admission and not willing to participate in study.

RESULTS

In a study of 100 patients diagnosed with type 2 Diabetes Mellitus

(DM), the investigation aimed to determine the prevalence of Cardiac Autonomic Neuropathy (CAN) through the assessment of Orthostatic Hypotension (OH) in asymptomatic DM individuals, while also exploring correlations with various factors linked to DM. The majority of participants (59%) were aged between 40 and 59 years, with a mean age of 57.21 years and a standard deviation of 10.62 years. Gender distribution was relatively balanced, with 46% male and 54% female participants. The duration of DM varied, with 39% having a duration of less than 5 years and 25% having a duration of 11-15 years, resulting in a mean duration of 7.15 years with a standard deviation of 4.18 years. HbA1c levels were predominantly elevated, with 66% having levels above 8.2 and a mean HbA1c of 8.52 with a standard deviation of 0.99. Body Mass Index (BMI) ranged widely, with 10% having a BMI less than 20, 44% having a BMI between 20 and 25, and 46% having a BMI greater than 25, yielding a mean BMI of 25.11 with a standard deviation of 4.78. Treatment modalities included 33 patients on insulin and 67 on oral hypoglycemic agents (OHAs). Fasting blood sugar (FBS) levels were predominantly elevated, with 51% having less than or equal to 200 mg/dl and 49% having more than 200 mg/dl, resulting in a mean FBS of 221.05 mg/dl with a standard deviation of 91.07. During the study, 36% of the patients had postprandial blood sugar (PP2BS) levels equal to or less than 250 mg/dl, while 64% had levels exceeding 250 mg/dl, resulting in a mean PP2BS of 328.78 mg/dl with a standard deviation of 113.89. Orthostatic Hypotension (OH) was significant in 33% of the patients and insignificant in 67%. Notably, among the 100 patients, 21 with a drug history showed significant OH, while 12 exhibited insignificant OH. Conversely, among patients without a drug history, 12 had significant OH, whereas 54 had insignificant OH. The calculated p-value from the Chi-Square Test was <0.001, indicating statistical significance. In the subgroup analysis based on HbA1c levels, among patients with HbA1c less than 8.2, 3 had significant OH and 33 had insignificant OH. Among those with HbA1c more than 8.2, 30 had significant OH, while 34 had insignificant OH. The observed p-value from the Chi-Square Test was <0.001, highlighting statistical significance. Additionally, among patients with HbA1c less than or equal to 8.2 and a drug history, 2 had significant OH, while 1 without a drug history exhibited significant OH. For patients with HbA1c more than 8.2 and a drug history, 19 showed significant OH, whereas 11 with the same HbA1c but without a drug history had insignificant OH. The calculated p-value from the Chi-Square Test was 0.9, indicating statistical nonsignificance. Similarly, the Independent T test revealed a p-value of <0.001, indicating a statistically significant correlation between HbA1c level and significant OH. Conversely, for patients with HbA1c less than or equal to 8.2, the Independent T test yielded a p-value of >0.99, indicating no statistically significant correlation between HbA1c level and significant OH, with or without drug history. Regarding fasting blood sugar (FBS), among patients with FBS equal to or less than 200 mg/dl, 11 had significant OH, while 40 had insignificant OH. For those with FBS more than 200 mg/dl, 22 exhibited significant OH, while 27 had insignificant OH. The Chi-Square Test produced a p-value of <0.01, indicating a statistically significant correlation between FBS and OH. Among patients with PP2BS levels equal to or less than 250 mg/dl, 4 had significant OH, while 32 had insignificant OH, indicating a statistically significant correlation between PP2BS level and significant OH, supported by an Independent T test with a p-value of <0.01. Similarly, for patients with PP2BS levels exceeding 250 mg/dl, 29 exhibited significant OH, while 35 displayed insignificant OH, with a Chi-Square Test yielding a p-value of <0.01, further highlighting the correlation. Considering the duration of diabetes mellitus (DM), among those with a duration of less than 5 years, 9 had significant OH, while 30 had insignificant OH. Similarly, in the 5-10 years duration group, 7 had significant OH, while 29 had insignificant OH. Furthermore, among patients with a DM duration of 11-15 years, 17 were identified with significant OH, while 8 had insignificant OH, indicating a statistically significant correlation between DM duration and OH, supported by a p-value of <0.01. In terms of age groups, among patients aged 30-50, 8 had significant OH, while 20 had insignificant OH. In the 51-70 age group, 22 exhibited significant OH, compared to 38 with insignificant OH. Additionally, a correlation was observed between the history of drugs causing postural hypotension and age, with a p-value of 0.03, suggesting an influence on the correlation of significant OH with age. Among patients over 70 years old, 3 had OH, while 9 had insignificant OH. Regarding Body Mass Index (BMI), among those with less than 20 BMI, 2 exhibited significant OH, compared to 8 with insignificant OH. In the 20-25 BMI range, 10 had significant OH, while 34 had insignificant OH. Finally, among patients with a BMI over 25, 21 had significant OH, and 25 had insignificant OH. A statistically significant correlation was observed between BMI and OH, with a p-value of 0.04, indicating potential associations between age, BMI, and significant OH occurrence, warranting further investigation. The history of drugs causing postural hypotension was found to affect the correlation of significant OH with BMI, as evidenced by a p-value of 0.03. However, both independent T tests yielded statistically significant results, with p-values of less than 0.01, indicating a significant correlation between significant OH and BMI. Regarding gender distribution, out of 54 females, 20 were found with significant OH, while 34 had insignificant OH. Among 46 males, 13 had significant OH, and 33 had insignificant OH. However, the correlation of OH with gender was found to be insignificant, with a p-value of 0.3 from the Chi-Square Test. Importantly, the history of drugs causing postural hypotension did not affect the correlation of significant OH with gender, as indicated by a p-value of 0.3. Additionally, among patients with cardiac autonomic neuropathy other than OH identified by Ewing's test, 17 exhibited significant OH, while 6 had insignificant OH. Conversely, among those with cardiac autonomic neuropathy, 16 had significant OH, and 61 had insignificant OH. A statistically significant correlation was noted between other cardiac autonomic neuropathy and OH, with a p-value of less than 0.01 from the Chi-Square Test. These findings underscore potential associations between cardiac autonomic neuropathy and significant OH, emphasizing the need for further investigation into their relationship. Among the 100 patients studied, 33 were identified with significant Orthostatic Hypotension (OH), while 67 had insignificant OH. Notably, out of the 33 patients with significant OH, 21 were on medications known to cause postural hypotension, while 12 experienced significant OH without such medication history. The correlation between other autonomic neuropathy (excluding cardiac) and OH was statistically significant, with a p-value of 0.03 from the Chi-Square Test. Interestingly, the presence of drugs causing postural hypotension did not influence the correlation between autonomic neuropathy and significant OH. Furthermore, a statistically significant correlation was observed between symptoms of orthostatic intolerance and OH, although this correlation was affected by the history of drugs causing postural hypotension. Similarly, a significant correlation was noted between symptoms of peripheral neuropathy and OH, with no influence observed from drugs causing postural hypotension. Additionally, there was a statistically significant correlation between QTc prolongation and OH, highlighting a potential physiological link between these factors and OH. These findings underscore the complex nature of OH and emphasize the importance of considering various comorbidities and medication histories in its assessment and management.

TABLE: 1

Age (years)	No of cases	%
20-39	4	4
40-59	59	59
60-70	25	25
>70	12	12
GENDER	NO OF CASES	%
Male	46	46
Female	54	54
DURATION OF DM(years)	NO OF CASES	%
<5	39	39
5-10	36	36
11-15	25	25
Level of HBA1c	No. of Cases	%
< 8.2	34	34
≥ 8.2	66	66
BMI	No of DM cases	%
<20	10	10
20-25	44	44
>25	46	46
RX	No of Cases	%
Insulin	33	33
OHA	67	67
FBS(mg/dl)	NO of Cases	%
≤200	51	51
>200	49	49
PP2BS(mg/dl)	No of cases	%
≤250	36	36
>250	64	64

TABLE: 2

Drugs History	Significant OH	Percentage of significant OH	Insignificant OH	Percentage of Insignificant OH
YES	21	63.64	12	18.18
NO	12	36.36	54	81.82
HbA1c	Significant OH	Percentage of significant OH	Insignificant OH	Percentage of Insignificant OH
≤8.2	3	9.09	33	49.25
>8.2	30	90.91	34	50.75
HbA1c	Significant OH With Drug History	Percentage of significant OH With Drug history	Significant OH Without Drug History	Percentage of Significant OH Without Drug History
≤8.2	2	9.52	1	8.33
>8.2	19	90.48	11	91.67
FBS (mg/dl)	Significant OH	Percentage of Significant OH	Insignificant OH	Percentage of Insignificant OH
≤200	11	33.33	40	59.70
>200	22	66.67	27	40.30
FBS	Significant OH With Drug History	Percentage of significant OH With Drug history	Significant OH Without Drug History	Percentage of Significant OH Without Drug History
≤200	7	47.62	4	33.33
>200	14	52.38	8	66.67
PP2BS (mg/dl)	Significant OH With Drug History	Percentage of significant OH With Drug History	Significant OH Without Drug History	Percentage of Insignificant OH Without Drug History
≤250	3	14.29	1	8.33
>250	18	85.71	11	91.67
Duration Of DM (years)	Significant OH	Percentage of Significant OH	Insignificant OH	Percentage of Insignificant OH
<5	9	42.42	30	28.36
5-10	7	39.39	29	49.25
11-15	17	18.18	8	22.39
Duration Of DM (years)	Significant OH With Drug History	Percentage of Significant OH With Drug History	Significant OH Without Drug History	Percentage of Significant OH Without Drug History
<5	6	28.57	3	25
5-10	2	23.81	5	41.67
11-15	13	61.90	4	33.33
Age (years)	Significant OH	Percentage of Significant OH	Insignificant OH	Percentage of insignificant OH
30-50	8	24.24	20	29.85
51-70	22	66.67	38	56.72
>70	3	9.09	9	13.43
Age (years)	Significant OH With Drug History	Percentage of Significant OH With Drug History	Significant OH Without Drug History	Percentage of Significant OH Without Drug History
30-50	2	9.52	6	50
51-70	17	80.95	5	41.67
>70	2	9.52	1	8.33

BMI	Significant OH With Drug History	Percentage of significant OH	Significant OH Without Drug History	Percentage of Significant OH Without Drug History
<20	2	9.52	0	0
20-25	9	42.86	1	8.33
>25	10	47.62	11	91.67

DISCUSSION

In our study, we aimed to examine the influence of various factors, including HbA1c, age, duration of diabetes, BMI, fasting blood sugar (FBS), postprandial blood sugar (PP2BS), and gender, on Orthostatic Hypotension (OH) among elderly individuals with diabetes. Our findings showed a mean HbA1c of 8.52 (SD = 0.99), mean age of 57.21 years (SD = 10.62), and mean duration of diabetes of 7.15 years (SD = 4.18). The mean BMI was 25.11 (SD = 4.78), while the mean FBS and PP2BS were 221.05 mg/dl (SD = 91.07) and 328.78 mg/dl (SD = 113.89), respectively. Conducted over a 15-month period in a tertiary care center, our cross-sectional study involved 100 elderly patients with diabetes, among whom 54% were female. This gender distribution is consistent with national health research data from RISKESDAS (National Basic Health Research) in 2013, which reported a higher prevalence of diabetes in females compared to males (7.7% vs. 5.6%). The higher proportion of female patients among the elderly population may be attributed to various factors, including demographic trends and longer life expectancy in females compared to males. These findings shed light on gender disparities in diabetes prevalence and emphasize the importance of considering demographic factors in diabetes research and healthcare provision for the elderly population. Studies by Catarina Budyono (10) and Soewondo demonstrated a significant correlation between HbA1c levels and Orthostatic Hypotension (OH). Budyono's research revealed that 27.4% of patients with HbA1c levels above 7 experienced significant OH, while 72.6% of those with HbA1c levels below 7 did not. Similarly, Soewondo's investigation in Indonesia discovered a mean HbA1c level of 8.3% among diabetic elderly subjects with OH, indicating a trend of higher HbA1c levels in those with OH compared to those without. This trend found support in studies conducted in Japan and China, where HbA1c levels were notably higher in diabetic individuals with OH compared to those without. The correlation between HbA1c and OH may be attributed to poor glycemic control, leading to impaired vascular elasticity and reduced extravascular volume due to osmotic diuresis, ultimately resulting in OH. Tsutsu et al.'s research in Japan identified a median HbA1c level of 9.7% and established an independent association between HbA1c levels and OH after adjusting for confounding variables ($p<0.025$). In our study, a striking contrast emerged: 90.91% of patients with HbA1c levels exceeding 8.2 experienced significant OH, while only 49.25% of those with HbA1c levels below 8.2 had insignificant OH. These findings underscore the critical role of glycemic control in managing OH among diabetic patients, with higher HbA1c levels strongly associated with an increased risk of significant OH. In our study, a significant association between HbA1c levels and Orthostatic Hypotension (OH) was identified, with 33 out of 100 patients exhibiting significant OH, accompanied by a mean HbA1c of 9.2 (SD = 0.94). Conversely, among the 67 patients without significant OH, the mean HbA1c was recorded at 8.2 (SD = 0.84). The calculated p-value of less than 0.001 indicated the robustness of this association. When comparing fasting blood sugar (FBS) levels with OH, our study yielded notable findings. Among our participants, those with significant OH exhibited a mean FBS of 257.85 mg/dl (SD = 105.95), while those without significant OH had a notably lower mean FBS of 201.91 mg/dl (SD = 78.12). The statistical analysis revealed a p-value of less than 0.01, emphasizing the significance of the association between FBS levels and OH in our study. These numerical values underscore the importance of both HbA1c and FBS levels in understanding and managing orthostatic hypotension among individuals with diabetes. When examining the relationship between postprandial blood sugar (PP2BS) levels and Orthostatic Hypotension (OH), findings from various studies provide insights. Meghanad Meher's study reported that among 176 patients, 73 with significant OH had a mean PP2BS of 299.45 mg/dl (SD = 48.73). Similarly, Jayanta Kumar Panda's (11) study revealed that among 176 patients, 73 with significant OH had a mean PP2BS of 292.40 mg/dl (SD = 48.68). Both studies demonstrated a statistically significant association between PP2BS levels and OH, with p-values less than 0.05. In our study with 120 participants, 33 were identified with significant OH. Among these individuals, the mean PP2BS was notably higher at 382.76 mg/dl (SD = 111.80). Conversely, among the

67 patients without significant OH, the mean PP2BS was lower, measuring 302.19 mg/dl (SD = 105.94). The calculated p-value of less than 0.01 indicated a significant association between PP2BS levels and OH in our study. These findings underscore the relevance of monitoring postprandial blood sugar levels in individuals with OH, highlighting its potential role as a predictive factor or marker for OH in diabetic patients. The duration of diabetes mellitus (DM) has emerged as a significant factor in the occurrence of Orthostatic Hypotension (OH), as highlighted by various research studies. In Ashok K. Bhuyan's study (12), 11 out of 100 patients were identified with significant OH, with a mean duration of diabetes among these individuals recorded at 13.14 years (SD = 6.49). The calculated p-value of less than 0.001 underscored the statistical significance of this association. Further supporting evidence comes from Tsutsu et al., who noted the highest prevalence of orthostatic hypotension among individuals with a DM duration exceeding 10 years.

This observation aligns with previous research demonstrating a correlation between the duration of hyperglycemia and the development of DM neuropathy. Prolonged hyperglycemia has been implicated in reducing the levels of nerve growth factor, leading to damage to the myelin sheath and nerve fibers. This cascade of events contributes to the manifestation of orthostatic hypotension, particularly among patients with a longer duration of DM. These insights underscore the importance of considering the duration of diabetes as a critical factor in assessing the risk and management of orthostatic hypotension in diabetic individuals. In our study, the duration of diabetes mellitus (DM) emerged as a significant factor associated with Orthostatic Hypotension (OH). We found that 42.42% of patients with a duration of DM less than five years, 39.39% with a duration of 5-10 years, and 18.18% with a duration of 11-15 years were identified with significant OH. Specifically, among 100 participants, 33 were diagnosed with significant OH, with a mean duration of DM of 8.94 years (SD = 4.74). In contrast, among the 67 patients without significant OH, the mean duration of DM was 6.31 years (SD = 3.71). The calculated p-value of less than 0.01 underscored the statistical significance of this association. In comparison, Ashok K. Bhuyan's study (12) reported 11 out of 100 patients with significant OH, with a mean age of 53.3 years (SD = 10.37). The study revealed a significant correlation between age and OH, with a p-value of less than 0.005. Conversely, studies by Wu et al. did not find a correlation between age and orthostatic hypotension in diabetic patients, while Rahayu et al. noted a prevalence of OH among elderly patients over 60 years at 15.5%, although their study did not specifically focus on diabetic patients. These findings collectively highlight the multifactorial nature of OH, with variables such as duration of DM and age playing significant roles in its manifestation among diabetic individuals. In a study conducted in the Netherlands, it was discovered that among elderly patients aged over 70 years, the prevalence of orthostatic hypotension stood at 28%. This prevalence rate may be influenced by various factors, encompassing socio-demographic status, characteristics of the study population, age distribution of subjects, diagnostic criteria utilized, duration of diabetes mellitus (DM), and the adequacy of blood glucose control among patients. Additionally, the exclusion of certain individuals who may exhibit orthostatic hypotension could potentially impact the final prevalence rate, leading to an underestimation of the true proportion of affected individuals. In our study, 24.24% of the patients fell within the age group of 30-50 years, while 66.67% were in the age range of 51-70 years. Furthermore, 9.09% of patients belonged to the age group exceeding 70 years and were identified as having significant orthostatic hypotension. Among our 100 participants, 33 individuals were diagnosed with significant orthostatic hypotension, with a mean age of 55.82 years (SD = 9.21). Conversely, among the 67 patients without significant orthostatic hypotension, the mean age was 57.90 years (SD = 11.25). The calculated p-value of 0.3 suggested no statistically significant association between age and orthostatic hypotension in our study. In a study by Meghanad Meher and Jayanta Kumar Panda, out of 176 patients, 73 had significant orthostatic hypotension, with a mean BMI of 29.79 (SD = 2.85). The calculated p-value was less than 0.05, indicating a significant association between BMI and orthostatic hypotension. In our study, significant orthostatic hypotension was observed in 6.06% of patients with a BMI less than 20, 30.30% with a BMI between 20 and 25, and 63.64% with a BMI greater than 25. Among our 100 participants, 33 were diagnosed with significant orthostatic hypotension, with a mean BMI of 27.67 (SD = 5.12). Conversely, among the 67 patients without significant orthostatic hypotension, the mean BMI was 23.86 (SD = 4.09). The calculated p-value was less than 0.01, indicating a significant correlation between higher BMI and the likelihood of significant orthostatic hypotension. Therefore, our findings suggest that as BMI increases, the probability of significant orthostatic hypotension also increases. In a study by Andrea S. Méndez et al., the overall prevalence of orthostatic hypotension (OH) in the sample population was 19.3%, with no significant difference between genders. However, when stratified by age and sex groups, the prevalence of OH was similar for women and men under 75 years of age, but significantly higher in men compared to women aged 75 years and above. In our study, out of the 33 cases of significant OH, 13 were male and 20 were female. Among the total population, consisting of 46 males and 54 females, the calculated p-value was 0.3, indicating no significant difference in OH prevalence between genders. Regarding the association between OH and cardiac autonomic neuropathy (tested by the Ewing test), Vincenza Spallone's study reported a significant association with a p-value of less than 0.001. In our study, out of the 33 cases of significant OH, 17 patients tested positive for cardiac autonomic neuropathy using the Ewing test. The calculated p-value was less than 0.001, further supporting a significant association between OH and cardiac autonomic neuropathy. In our study, out of the 33 cases of significant orthostatic hypotension (OH), 6 patients were identified with autonomic neuropathy (other than cardiac), yielding a p-value of 0.01, which did not reach statistical significance. In our investigation, we uncovered a significant correlation between peripheral neuropathy and orthostatic hypotension (OH). Among the 33 cases of significant OH, 6 patients were diagnosed with peripheral neuropathy, resulting in a p-value of 0.03. The influence of drug history, particularly medications causing postural hypotension, was striking in our findings. Out of the 33 cases of significant OH, 21 patients had a history of taking medications known to induce postural hypotension. This association was statistically significant, with a p-value of less than 0.001. Overall, our study unveiled a prevalence of OH in diabetic patients at 12%, with 12% of these cases concurrently taking antihypertensive drugs known to cause OH. Furthermore, our study demonstrated a noteworthy association between significant orthostatic hypotension (OH) and QTc prolongation. This finding aligns with previous research conducted by Gonin J.M. (13) and Bellavere F (14)., where both studies reported significant associations between OH and QTc prolongation, with p-values of less than 0.01 and 0.005, respectively. Among the 33 cases of significant OH in our study, 18 patients exhibited QTc prolongation, with a statistically significant p-value of less than 0.001. Various confounding variables, including age, insulin treatment, duration of diabetes, hypertension, stroke, and chronic kidney disease, may influence the relationship between HbA1c levels and orthostatic hypotension. Some studies have suggested that the onset of initial OH may be linked to autonomic nervous dysfunction, attributed to the mismatch between vascular resistance and cardiac output, compounded by active leg muscle contraction. Heart rate variability (HRV) measurement, reflecting sympathetic and parasympathetic nervous system activity, can indicate autonomic nervous system function. The presence of OH in diabetic patients suggests underlying autonomic neuropathy.

CONCLUSION

Diabetes mellitus presents a complex interplay of genetic and environmental factors, leading to hyperglycemia and subsequent complications. Orthostatic hypotension, a key indicator of cardiac autonomic neuropathy, is influenced by various factors including age, diabetes duration, and glycemic control. This study, involving 100 diabetic patients, found a 12% prevalence of orthostatic hypotension, with significant correlations observed with parameters such as HbA1c, BMI, FBS, and PP2BS. Notably, some cases of orthostatic hypotension were unrelated to drug-induced factors, suggesting underlying neuropathies. Overall, orthostatic hypotension was associated with various neuropathic conditions, highlighting its significance in diabetic patient management.

Financial Support And Sponsorship
Nil.

Conflicts Of Interest
There are no conflicts of interest.

Ethical Clearance
Obtained from the ethical committee of the institution.

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