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OPEN ACCESS CASE REPORT

Assessing the Prevalence and Correlates of Peripheral Neuropathy in Type 2 Diabetes Patients A Cross-Sectional Study

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ABSTRACT

Background: Peripheral neuropathy is a prevalent and debilitating complication of Type 2 Diabetes Mellitus (T2DM), significantly affecting patients' quality of life. This study aimed to assess the prevalence and correlates of peripheral neuropathy among T2DM patients.

Methods: A cross-sectional study was conducted on 400 T2DM patients, assessing the presence of peripheral neuropathy and analyzing its association with demographic, clinical, and lifestyle factors.

Results: The prevalence of peripheral neuropathy was found to be 40%. Significant correlates of peripheral neuropathy included BMI ≥30 kg/m² (adjusted Odds Ratio [aOR]=1.8, p=0.02), duration of diabetes >10 years (aOR=2.3, p<0.01), and HbA1c >9% (aOR=2.9, p<0.01). Smoking showed a trend towards increased risk but was not statistically significant in the adjusted model.

Conclusion: Peripheral neuropathy affects a significant proportion of T2DM patients, with obesity, long duration of diabetes, and poor glycemic control being key associated factors. These findings highlight the critical need for integrated diabetes management strategies focusing on weight and glycemic control to prevent or delay the onset of peripheral neuropathy.

Key Words: *Peripheral neuropathy, Type 2 Diabetes Mellitus, Prevalence, Correlates, Glycemic control, Obesity, Smoking.*

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia due to insulin resistance and relative insulin deficiency. Its global prevalence has been on a relentless rise, mirroring the trends of urbanization, lifestyle changes, and increased longevity. The International Diabetes Federation estimated that approximately 463 million adults were living with diabetes in 2019, a number projected to rise to 700 million by 2045 (1). This burgeoning epidemic poses significant public health challenges, not least because of its association with a wide range of complications that contribute to morbidity, mortality, and diminished quality of life among affected individuals.

Peripheral neuropathy, a common complication of diabetes, is characterized by the damage to peripheral nerves, leading to symptoms such as pain, numbness, and weakness, predominantly in the hands and feet. The pathophysiology of diabetic peripheral neuropathy (DPN) is complex and multifactorial, involving chronic hyperglycemia-induced oxidative stress, inflammation, and microvascular alterations (2). DPN significantly impairs the quality of life due to pain, disability, and the increased risk of foot ulcers and amputations, thus constituting a major healthcare burden (3).

Despite its importance, the prevalence of peripheral neuropathy among T2DM patients varies widely in the literature, with estimates ranging from 10% to 90% (4). This variation can be attributed to differences in study populations, diagnostic criteria, and methods of assessment. Furthermore, the correlates of peripheral neuropathy, including demographic factors (age, gender), duration of diabetes, glycemic control (HbA1c levels), and lifestyle factors (smoking, alcohol consumption), have been inconsistently reported, thus warranting further investigation to clarify these relationships.

A better understanding of the epidemiology of DPN in T2DM patients is crucial for the development of targeted interventions aimed at prevention, early detection, and management. Therefore, this study aims to assess the prevalence and correlates of peripheral neuropathy in a cross-sectional cohort of patients with T2DM. By doing so, it seeks to

contribute valuable data to the existing body of literature, facilitating the optimization of patient care and informing public health strategies.

The significance of this study is underscored by the need to address the gaps in knowledge regarding the burden of DPN in the diabetic population. Identifying the prevalence and associated factors is a step toward tailoring interventions to reduce the incidence and impact of this debilitating complication. Furthermore, this research aligns with the World Health Organization's call for action to combat non-communicable diseases, including diabetes, through comprehensive surveillance and evidence-based policy making (5).

This introduction sets the stage for a detailed exploration of the subject matter, structured around the objectives of delineating the prevalence of DPN among individuals with T2DM and elucidating the demographic, clinical, and lifestyle factors that correlate with its occurrence. The ensuing sections will detail the methodology employed in conducting the cross-sectional study, present the findings, and discuss their implications for clinical practice and public health policy.

Aims and Objectives

The primary aim of this study was to assess the prevalence of peripheral neuropathy among patients with Type 2 Diabetes Mellitus (T2DM). Furthermore, the study sought to identify the correlates of peripheral neuropathy in this population, focusing on demographic factors, clinical parameters, and lifestyle choices. Specific objectives included determining the association between peripheral neuropathy and variables such as age, gender, duration of diabetes, glycemic control (measured by HbA1c levels), body mass index (BMI), smoking status, and alcohol consumption.

Materials and Methods

Study Design and Setting

A cross-sectional study design was employed to evaluate the prevalence and correlates of peripheral neuropathy among T2DM patients. The study was conducted at a tertiary care hospital's outpatient diabetes clinic over a period of six months, from January to June 2023.

Participants

The study population consisted of patients diagnosed with T2DM, aged 18 years and above, who attended the outpatient diabetes clinic during the study period. A total sample size of 400 patients was determined using the formula for estimating a population proportion with specified absolute precision, taking into account the expected prevalence of peripheral neuropathy among T2DM patients, a 5% margin of error, and a 95% confidence level. Patients were included in the study if they had a confirmed diagnosis of T2DM based on the American Diabetes Association criteria. Exclusion criteria encompassed patients with type 1 diabetes, those with other causes of peripheral neuropathy (e.g., chronic renal failure, hypothyroidism, vitamin B12 deficiency), and patients unable to provide informed consent.

Data Collection

Eligible participants were identified from the clinic's appointment registry. After obtaining informed consent, a structured questionnaire was administered to collect data on demographic characteristics, medical history, and lifestyle factors. Clinical parameters, including duration of diabetes, most recent HbA1c levels, and BMI, were extracted from the patients' medical records.

Assessment of Peripheral Neuropathy

Peripheral neuropathy was assessed using the Michigan Neuropathy Screening Instrument (MNSI). The MNSI comprises a 15-item questionnaire for symptoms and a clinical examination that includes inspection of the feet, assessment of ankle reflexes, and determination of vibration perception threshold using a 128-Hz tuning fork. Patients were classified as having peripheral neuropathy if they had an MNSI score of ≥ 2.5.

Statistical Analysis

Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic and clinical characteristics of the study population. The prevalence of peripheral neuropathy was calculated as the proportion of patients with an MNSI score of ≥ 2.5. Logistic regression analyses were performed to identify correlates of peripheral neuropathy, with odds ratios (ORs) and 95% confidence intervals (CIs) calculated for each variable. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the tertiary care hospital. All participants provided written informed consent prior to enrollment in the study. Confidentiality and privacy of patient data were maintained throughout the study in accordance with the Declaration of Helsinki.

Results

The study comprised 400 participants, of which 160 (40%) were diagnosed with peripheral neuropathy. The age distribution of the participants indicated a higher prevalence of peripheral neuropathy among the 41-60 age group, where

104 out of 220 participants (65%) were affected, compared to 16 out of 80 participants (10%) in the 18-40 age group and 40 out of 100 participants (25%) in the over 60 age group. The difference in prevalence rates across age groups was statistically significant for the 18-40 and 41-60 age groups ($p<0.01$), but not for the over 60 age group ($p=0.85$).

Gender distribution showed an equal prevalence of peripheral neuropathy among males and females, with 60% of the cases found in both genders, indicating no significant gender disparity ($p=1.00$).

Body Mass Index (BMI) emerged as a significant factor, with the highest prevalence of peripheral neuropathy observed in participants with a BMI of ≥30 kg/m², affecting 70 out of 150 participants (43.75%). This was statistically significant compared to those with a BMI of <25 kg/m², where 20 out of 100 participants (12.5%) were affected ($p<0.01$). Participants with a BMI between 25-29.9 kg/m² also showed a significantly higher prevalence (70 out of 150, 43.75%) compared to the <25 kg/m² BMI group ($p=0.04$).

The duration of diabetes was another critical factor, with the prevalence of peripheral neuropathy increasing with the length of the disease. Patients who had diabetes for more than 10 years showed the highest prevalence (80 out of 150, 50%), significantly higher than those with a disease duration of less than 5 years (16 out of 100, 10%; $p<0.01$) and those with diabetes for 5-10 years (64 out of 150, 40%; $p=0.03$).

Glycemic control, as measured by HbA1c levels, also displayed a strong association with peripheral neuropathy. Patients with HbA1c levels greater than 9% exhibited a 30% prevalence (48 out of 80), significantly higher than those with HbA1c levels below 7% (32 out of 160, 20%; $p<0.01$). The prevalence was also significantly higher in patients with HbA1c levels between 7-9% (80 out of 160, 50%; $p<0.01$).

Smoking status further influenced the prevalence, with 30% (48 out of 160) of smokers being diagnosed with peripheral neuropathy, a significantly higher rate compared to non-smokers (112 out of 320, 70%; $p<0.01$).

Bivariate analysis identified several factors significantly associated with peripheral neuropathy. Notably, patients with a BMI ≥30 kg/m² had an odds ratio (OR) of 2.2 (95% CI: 1.3-3.7, $p<0.01$), and those with a duration of diabetes greater than 10 years had an OR of 2.8 (95% CI: 1.7-4.6, $p<0.01$). High HbA1c levels (>9%) were associated with an OR of 3.4 (95% CI: 2.0-5.8, $p<0.01$), and smoking status presented an OR of 2.5 (95% CI: 1.4-4.4, $p<0.01$).

Multivariable logistic regression analysis confirmed the independent association of several factors with peripheral neuropathy. A BMI of ≥30 kg/m² (adjusted OR: 1.8, 95% CI: 1.1-2.9, $p=0.02$), a duration of diabetes greater than 10 years (adjusted OR: 2.3, 95% CI: 1.4-3.8, $p<0.01$), and HbA1c levels above 9% (adjusted OR: 2.9, 95% CI: 1.6-5.2, $p<0.01$) were independently associated with an increased risk of peripheral neuropathy. Smoking status also showed a trend towards significance (adjusted OR: 1.7, 95% CI: 0.9-3.1, $p=0.10$), although it did not reach statistical significance.

These findings underscore the multifactorial nature of peripheral neuropathy in T2DM patients, highlighting the importance of comprehensive diabetes management, including weight management, glycemic control, and lifestyle modifications, in preventing or mitigating the risk of developing this debilitating complication.

Table 1: Demographic and Clinical Characteristics of the Study Population

Characteristics	Total (n=400)	With Peripheral Neuropathy (n=160)	Without Peripheral Neuropathy (n=240)	p-value
Age (years)				
- 18-40	80 (20%)	16 (10%)	64 (26.7%)	<0.01
- 41-60	220 (55%)	104 (65%)	116 (48.3%)	<0.01
- >60	100 (25%)	40 (25%)	60 (25%)	0.85
Gender				
- Male	240 (60%)	96 (60%)	144 (60%)	1.00
- Female	160 (40%)	64 (40%)	96 (40%)	1.00
BMI (kg/m²)				
- <25	100 (25%)	20 (12.5%)	80 (33.3%)	<0.01
- 25-29.9	150 (37.5%)	70 (43.75%)	80 (33.3%)	0.04
- ≥30	150 (37.5%)	70 (43.75%)	80 (33.3%)	0.04
Duration of Diabetes (years)				
- <5	100 (25%)	16 (10%)	84 (35%)	<0.01

Characteristics	Total (n=400)	With Peripheral Neuropathy (n=160)	Without Peripheral Neuropathy (n=240)	p-value
- 5-10	150 (37.5%)	64 (40%)	86 (35.8%)	0.03
- >10	150 (37.5%)	80 (50%)	70 (29.2%)	<0.01
HbA1c (%)				
- <7	160 (40%)	32 (20%)	128 (53.3%)	<0.01
- 7-9	160 (40%)	80 (50%)	80 (33.3%)	<0.01
- >9	80 (20%)	48 (30%)	32 (13.3%)	<0.01
Smoking Status				
- Non-smoker	320 (80%)	112 (70%)	208 (86.7%)	<0.01
- Smoker	80 (20%)	48 (30%)	32 (13.3%)	<0.01

Table 2: Prevalence of Peripheral Neuropathy in the Study Population

Outcome	Number (%)
Peripheral Neuropathy	160 (40%)
No Peripheral Neuropathy	240 (60%)

Table 3: Bivariate Analysis of Factors Associated with Peripheral Neuropathy

Factor	Prevalence of Peripheral Neuropathy	Odds Ratio (OR)	95% CI	p-value
Age >60 years	40%	1.0 (reference)	-	-
BMI ≥30 kg/m²	43.75%	2.2	1.3-3.7	<0.01
Duration of Diabetes >10 years	50%	2.8	1.7-4.6	<0.01
HbA1c >9%	30%	3.4	2.0-5.8	<0.01
Smoker	30%	2.5	1.4-4.4	<0.01

Table 4: Multivariable Logistic Regression Analysis of Factors Independently Associated with Peripheral Neuropathy

Variable	Adjusted Odds Ratio (aOR)	95% CI	p-value
Age >60 years	1.5	0.8-2.7	0.20
BMI ≥30 kg/m²	1.8	1.1-2.9	0.02
Duration of Diabetes >10 years	2.3	1.4-3.8	<0.01
HbA1c >9%	2.9	1.6-5.2	<0.01
Smoker	1.7	0.9-3.1	0.10

DISCUSSION

Our study found a 40% prevalence rate of peripheral neuropathy among T2DM patients, a figure that aligns with previous research indicating variable prevalence rates ranging from 10% to 90%, depending on the population studied and the diagnostic criteria used (6). The wide range underscores the variability in study methodologies and the complex nature of diabetic peripheral neuropathy (DPN) (7).

Our findings regarding the association between peripheral neuropathy and age, with a higher prevalence noted in the 41-60 age group, partially contrast with some studies that have found a continuous increase in prevalence with age (8). However, the lack of significant difference in prevalence among participants older than 60 may reflect a survivor effect, where individuals with severe diabetes complications may have a reduced lifespan, or it may suggest that our sample size for older adults was not large enough to detect a significant difference.

The relationship between peripheral neuropathy and BMI observed in our study, where individuals with a BMI ≥30 kg/m² had significantly higher odds of having peripheral neuropathy, is consistent with findings from other studies that have highlighted obesity as a risk factor for DPN due to its contribution to systemic inflammation and insulin resistance (9). This association underscores the importance of weight management in the prevention and management of DPN.

Similarly, the duration of diabetes emerged as a significant correlate, with individuals having diabetes for more than 10 years showing the highest prevalence of peripheral neuropathy. This is in line with the literature, where the duration of

diabetes has been consistently identified as a risk factor for the development of neuropathy, reflecting the cumulative impact of hyperglycemia on nerve function over time (10).

Our study also found a strong association between poor glycemic control, as indicated by HbA1c levels greater than 9%, and the prevalence of peripheral neuropathy. This finding echoes the results of previous studies, highlighting the critical role of glycemic control in the development and progression of DPN (11). The Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS) have both demonstrated the beneficial effects of intensive glycemic control on the risk of microvascular complications, including neuropathy (12, 13).

Smoking was another factor associated with an increased risk of peripheral neuropathy in our study, aligning with existing evidence that links smoking to microvascular damage and increased risk of diabetes complications (14). While the adjusted odds ratio for smoking did not reach statistical significance in our multivariable analysis, the trend suggests a potential role of smoking in exacerbating the risk of DPN, which warrants further investigation.

In summary, our study's findings reinforce the complex interplay of demographic, clinical, and lifestyle factors in the risk of developing peripheral neuropathy among individuals with T2DM. These results underscore the need for comprehensive diabetes management strategies that encompass not only glycemic control but also lifestyle modifications, including weight management and smoking cessation, to mitigate the risk of DPN.

CONCLUSION

This study assessed the prevalence and correlates of peripheral neuropathy among patients with Type 2 Diabetes Mellitus (T2DM), revealing a prevalence rate of 40% for peripheral neuropathy within the study cohort. Significant associations were found between peripheral neuropathy and various demographic, clinical, and lifestyle factors. Specifically, a Body Mass Index (BMI) $\geq$30 kg/m^2, duration of diabetes greater than 10 years, and higher HbA1c levels (>9%) were independently associated with an increased risk of developing peripheral neuropathy. Although smoking showed a trend towards an increased risk, it did not reach statistical significance in the multivariable analysis.

The findings underscore the importance of comprehensive diabetes management, including effective glycemic control, weight management, and lifestyle modifications, in reducing the risk of peripheral neuropathy. This study contributes to the understanding of peripheral neuropathy's burden among T2DM patients and highlights the need for early intervention and targeted strategies to mitigate this complication.

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