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Original Article

Prevalence and Risk Factors of Diabetic Peripheral Neuropathy in Patients with Type 2 Diabetes Mellitus

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Abstract

Background: Diabetic peripheral neuropathy (DPN) is common among people with diabetes and can result in foot ulceration and amputation. **Objective:** The objective of the study is to estimate the prevalence and risk factors of DPN among patients with Type 2 diabetes mellitus (T2DM) at a diabetes clinic in Benghazi Medical Center (BMC), Benghazi, Libya. **Patients and Methods:** Three hundred and sixty-seven patients with T2DM (127 [34.6%] males and 240 [65.4%] females) were included in this cross-sectional study. The patients aged ≥18 years, and they attended the outpatient diabetes clinics at BMC from May 2015 to October 2016, for routine follow-up. Patients with T1DM, gestational diabetes, and latent autoimmune diabetes in adults were excluded. Data including gender, age, type of DM, duration of DM, history of smoking, history of hypertension, weight, height, glycosylated hemoglobin (HbA1c), total cholesterol, triglyceride, low-density lipoprotein, high-density lipoprotein, creatinine, and urea were obtained by a prepared pro forma. Peripheral neuropathy was diagnosed in the presence of numbness, paresthesia, 10-g monofilament examination, and loss of vibration and joint position sensations. The relationship between DPN and its risk factors, in addition to independent predictors of DPN, was explored using multiple forward stepwise logistic regression and presented as an odds ratio (OR) and 95% confidence interval (CI). **Results:** The prevalence of DPN was 30.5% in the studied group. A statistical significant association found between DPN and age ($P = 0.014$), duration of DM ($P < 0.001$), macrovascular complications of DM ($P < 0.001$), diabetic retinopathy ($P = 0.001$), diabetic nephropathy ($P < 0.001$), poor glycemic control (high HbA1c) ($P < 0.001$), hypertension ($P = 0.011$), uncontrolled blood pressure (≥140/90 mmHg) ($P = 0.007$), and insulin treatment ($P < 0.001$). Multiple forward stepwise logistic regression analyses revealed two independent risk factors influencing DPN: diabetic nephropathy (OR = 1.976, 95% CI: 1.289–3.027) ($P = 0.009$) and insulin treatment (OR = 3.430, 95% CI: 2.021–5.821), ($P < 0.001$). **Conclusions:** The overall prevalence rate of DPN in this study was 30.5% among patients with T2DM. It increases with the presence of diabetic nephropathy and insulin treatment.

Keywords: Diabetes mellitus, diabetic peripheral neuropathy, prevalence, risk factors

Introduction

Type 2 diabetes mellitus (T2DM) is increasingly becoming a major chronic disease health burden in Africa. In 2011, about 14 million individuals were estimated to have diabetes in Africa, and this is expected to rise to 28 million by 2030.[1] In Libya, according to the STEPS study for Noncommunicable Disease Risk Factors Survey 2009 which done in Libya, the prevalence of known diabetic patients was 16.4%.[2] As 50% of T2DM patients are unaware of their diabetes "undiagnosed," the actual prevalence is probably higher.

*Editor's Note: Dr. Abdulwahab Elbarsha sadly passed away in a tragic accident soon after completion and submission of this work. He was an active member of the editorial board of Ibnosina Journal of Medicine and Biomedical Sciences.

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Benghazi is the second largest city in Libya with 670,797 inhabitants according to the 2006 census. The prevalence of DM in Benghazi was 14.1%,[3] with T1DM constituting about 6% of all cases.

Diabetic peripheral neuropathy (DPN) is a debilitating complication of DM and accounts for significant morbidity by predisposing the foot to neuroischemic ulceration and lower limb amputation. Between 12% and 50% of people with

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diabetes have been estimated to have some degree of DPN.[4] This may either be asymptomatic or symptomatic. Symptoms may be disabling on their own accord, whereas loss of the protective sensation is the cause root to foot ulceration due to even minor trauma. T2DM and DPN are common causes of foot ulceration, gangrene, and amputation and are serious problems in Libya.[5]

The prevalence and pattern of DPN vary from country to country, from as low as (1.5%) to as high as (100%) in patients with T2DM;[6-11] three large clinical-based studies from Europe showed that the prevalence of DPN varied from 23% to 29%.[12-14] This difference in the prevalence depends on the differences in screening approaches, diagnostic criteria, and the study population.[15]

Patients and Methods

Design

The study is a retrospective, observational, cross-sectional study comprised of a sample size of 377 patients with T2DM.

Objectives

The objective of this study was to estimate the prevalence and risk factors of DPN among patients with T2DM at the diabetes clinic in Benghazi Medical Center (BMC), Benghazi, Libya.

Characteristics of patients

We reviewed 541 medical records of patients with T2DM who are on regular follow-up in diabetes clinic at BMC from the beginning of May 2015 to the end of October 2016. Of the 541 medical records reviewed, we excluded 174 patients because of incomplete data regarding the presence or absence of peripheral neuropathy. We also excluded patients who are under 18 years of age, other patients who are suffering from T1DM, latent autoimmune diabetes in adults, or gestational diabetes. The Research Ethics Board approved the research's protocol at BMC.

Data collection

Data including gender, age, type of DM, duration of DM, history of smoking, history of hypertension, weight, height, creatinine, urea, urine-albumin concentration, glycosylated hemoglobin (HbA1c), total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglyceride were obtained by a prepared pro forma. Peripheral neuropathy was diagnosed in presence of numbness, paresthesia, 10-g monofilament examination, loss of joint position sensation, and loss of vibration sensation which was tested with a tuning fork (128 Hz) on each medial malleolus.

Statistical analysis

IBM Statistical Package for the Social Sciences software version 23.0 (Chicago, IL, USA) was used for data analysis. The data were analyzed using descriptive statistics to determine the prevalence of DPN among patients with DM. Statistical analysis was performed using independent samples by Chi-square test to determine the association between DPN and other risk factors; test values with $P < 0.05$ were considered as statistically significant. Multiple forward stepwise logistic regression analyses were performed to identify the significant unconfounded risk factors. Odds ratio (OR) and its 95% confidence interval (CI) were calculated.

Results

Three hundred and sixty-seven patients with T2DM (127 [34.6%] males and 240 [65.4%] females) were included. The patients aged 19–81 years and their mean age was 56.9 ± 10.7 years (mean ± standard deviation [SD]). The mean duration of diabetes was 10.6 ± 8.3 years (mean ± SD).

The prevalence of DPN was 112 (30.5%). The prevalence of DPN was 36.2% in males and 27.5% in females. Univariate analysis revealed statistical significant association found between DPN and age ($P = 0.014$), duration of DM ($P < 0.001$), macrovascular complications of DM ($P < 0.001$), diabetic retinopathy ($P = 0.001$), diabetic nephropathy ($P < 0.001$), poor glycemic control (high HbA1c) ($P < 0.001$), hypertension ($P = 0.011$), uncontrolled blood pressure (BP ≥140/90 mmHg) ($P = 0.007$), and insulin treatment ($P < 0.001$) [Table 1].

Multiple forward stepwise logistic regression analyses revealed two independent risk predictors influencing DPN: diabetic nephropathy (OR = 1.976, 95% CI: 1.289–3.027) ($P = 0.009$) and insulin treatment (OR = 3.430, 95% CI: 2.021–5.821) ($P < 0.001$) [Table 2].

Discussion

DPN is a common complication of DM with high morbidity and impairment of quality of life.[13] The prevalence rates in various studies from around the world show considerable variation as a result of variations in study design, detection methods, the examination of patients at different stages in the natural history of diabetes, or in the definition of DPN, and the study of selected populations, from as low as (1.5%) to as high as (100%).[6-8,10,11,15,16] Discrepancies among these studies were due especially to difficulties of defining DPN and wide age range of the population studied. In this study, the overall prevalence of DPN was 30.5%. This is lower than a previous study that reported prevalence of 45.7%.[17] The reason for the higher rate in the previous study might be the difference in the diagnostic approach.

There seems to be a wide variation in the prevalence of painful DPN in the Middle East and North Africa region. For instance, in Saudi Arabia, a prevalence of 65.3% has been reported for in a nationally representative diabetic population.[18] However, the frequencies of painful DPN were 61.3%, 57.5%, 53.9%, and 37.1% for Egyptian, Jordanian, Lebanese, and Gulf States population, respectively.[19] The difference between the present study and others might

be attributed to differences in ascertainment tools and definitions of DPN, a fact that has been highlighted by previous workers.[20] Differences were also noticed between different regions. For example, a study of a nationally representative US population with diabetes that also used monofilament testing reported a prevalence of 28.5%.[20] The EURODIAB IDDM complications study found a prevalence of DPN of 28% among the patients with T1DM.[13] Another study from the United Kingdom reported a prevalence in T1DM patients of 22.7% and in T2DM patients of 32.1%.[12] One study in Hopi and Navajo Indians in North-Eastern Arizona found that 21% of T2DM patients with more than 10 years duration had DPN.[21] In another study, Partanen *et al.* reported that the prevalence of DPN was 41.9% among diabetic patients of 10 years' duration.[22] In a Turkish study, the overall prevalence of DPN in patients with T2DM was 60%,[23] and in this study, they used nerve conduction study in the diagnosis of DPN.

Table 1: Univariate analyses of diabetic peripheral neuropathy determinants

Risk factors	Mean±SD	*P*
Gender		0.084
Age (years)	56.9±10.7	0.014
Duration of DM (years)	10.6±8.3	<0.001
Smoking		0.183
Macrovascular complications of DM		<0.001
Diabetic retinopathy		0.001
DN		<0.001
High BMI	31.8±4.7 kg/m²	0.443
Poor glycemic control (high HbA1c)	8.4±1.8%	<0.001
High LDL-cholesterol		0.121
High TG		0.730
Low e-GFR	125±61 ml/min/1.73 m²	0.134
HTN		0.011
Uncontrolled BP		0.007
Insulin treatment		<0.001
Other medical comorbidities		0.052
Family history of DM		0.123
Family history of DN		0.665

DM: Diabetes mellitus, DN: Diabetic nephropathy, LDL: Low-density lipoprotein, TG: Triglyceride, BMI: Body mass index, BP: Blood pressure, DPN: Diabetic peripheral neuropathy, e-GFR: Estimated glomerular filtration rate, HbA1c: Glycosylated hemoglobin, SD: Standard deviation

The univariable analysis revealed a statistically significant association between DPN and age ($P = 0.014$), duration of DM ($P < 0.001$), macrovascular complications of DM ($P < 0.001$), diabetic retinopathy ($P = 0.001$), diabetic nephropathy ($P < 0.001$), poor glycemic control (high HbA1c) ($P < 0.001$), hypertension ($P = 0.011$), uncontrolled BP (≥140/90 mmHg) ($P = 0.007$), and insulin treatment ($P < 0.001$). Most previous studies revealed a significant aspiration of DNP with the duration of diabetes, insulin treatment, proteinuria, and presence of retinopathy.[24,25] Multiple forward stepwise logistic regression analyses revealed two independent risk predictors influencing DPN: Diabetic nephropathy ($P = 0.009$) and insulin treatment ($P < 0.001$). Patients receiving insulin monotherapy and insulin plus metformin were twice as likely to have neuropathy when compared to patients taking metformin alone in a previous study.[26]

The study has a few noteworthy limitations. The small sample size may be the most important limitation. There are some missing data regarding some variables (e.g., smoking history, peripheral neuropathy, and retinopathy), which may have affected the results had they been available. For some variables, we relied on the patients' reporting which might have been imprecise or influenced by recall bias. Another limitation was that other causes of DPN were not ascertained and excluded. However, in a population with diabetes, DPN is by far the most frequent.

Conclusions

The overall prevalence rate of DPN in this study was 30.5% among patients with T2DM at the diabetes clinic in BMC. It increases with the presence of diabetic nephropathy and insulin treatment. Since DPN poses a formidable threat to diabetic patients, early and comprehensive neurological investigations for DPN in patients with DM are warranted.

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Authors' contributions

MH was the initiator of the study, collected the data, and analyzed it, AWE wrote most of the manuscript and revised

Table 2: Multiple forward stepwise logistic regression analyses of significant diabetic peripheral neuropathy determinants

Variables	*B*	SE	Wald	*P*	OR	95% CI for OR	
						Lower	Upper
Age (years)	−0.217	0.131	2.730	0.098	0.805	0.622	1.041
UAC levels	0.695	0.266	6.827	0.009	1.976	1.289	3.027
LDL levels	−0.421	0.230	3.359	0.067	0.656	0.418	1.030
HTN	0.485	0.262	3.434	0.064	1.624	0.972	2.713
Insulin treatment	1.233	0.270	20.873	0.000	3.430	2.021	5.821
Constant	0.079	1.153	0.005	0.946	1.082		

OR: Odds ratio, UAC: Urine albumin concentration, LDL: Low-density lipoprotein, CI: Confidence interval, HTN: Hypertension, SE: Standard error

the study design, and ME revised all the articles and was the study supervisor. All authors reviewed and approved the final version of the manuscript before submission.

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Conflicts of interest

There are no conflicts of interest.

Compliance with ethical principles

The Research Ethics Board approved the research's protocol at BMC, Benghazi, Libya.

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