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Original Research Article

Diabetic peripheral neuropathy and its risk factors : A community based study

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Introduction: Diabetes mellitus is a chronic metabolic disorder which has the potential of leading to the development of microvascular complications such as retinopathy, nephropathy and neuropathy. Peripheral sensory neuropathy is common among persons with type 2 diabetes, and manifests as loss of sensory modalities such as touch, joint position and vibration sense. The vibrometer is an electronic device used in clinical diagnosis of peripheral neuropathy as well as in quantifying the extent or severity of the condition.
Aim: to determine the prevalence of peripheral neuropathy among individuals with type 2 diabetes, as well as outline its associated predisposing factors.
Methodology: One hundred (100) adults with type 2 diabetes participated in the study. Relevant history such as age, sex, and duration of diagnosis of diabetes was obtained from each participant. Anthropometric indices – height, weight and waist circumference—were also measured. A vibrometer was used to assess vibration perception threshold (VPT) in both feet of each participant. A VPT of greater than 15 volts in one or both feet was used as diagnosis of peripheral neuropathy. Serum lipids (triglycerides and cholesterol) were also assayed.
Results: Females comprised 68% of the study population. Mean age of study participants was 57.8±11.6 years and mean duration of diagnosis of diabetes was 10.1±6.6 years. Prevalence rate of peripheral neuropathy in study population was 75%. The independent predictors of peripheral neuropathy were age (OR = 4.00; 95% CI 1.46 – 10.77) and duration of diagnosis of diabetes ≥ 10 years (OR = 3.37 95% CI 1.23 – 9.25).
Conclusion: the risk of developing diabetic peripheral neuropathy increases with age and with the length of time an individual has been known to have diabetes mellitus. This information will be helpful in identifying high risk groups during screening programmes for diabetic peripheral neuropathy.

Key words: neuropathy, vibrometer, diabetes

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycaemia resulting from insufficient amounts of insulin, resistance to insulin action, or a combination of both (ADB,2006). The predominant form of the disease, type 2 diabetes, is very often diagnosed only when complications begin to occur. These include macrovascular complications such as cerebrovascular disease and coronary artery disease, as well as microvascular complications, such as retinopathy, nephropathy and neuropathy. These complications are responsible for the increased morbidity and mortality associated with diabetes mellitus (Bailes, 2002). Stroke and myocardial infarction occurring in the setting of diabetes mellitus are potentially life-threatening conditions, if not managed properly. Diabetic retinopathy, nephropathy and neuropathy are all associated with reduced quality of life, due to increased risk of blindness, End Stage Renal Disease and limb amputations (Dagogo-Jack, 2002). There

Figure 1 : Vibrometer (Diabetik Foot Care Pvt Limited India)

is also the economic burden associated with these conditions due to the relatively high cost of care involved in their management. This is particularly a challenge in countries like Nigeria where a lot of its residents do not have access to affordable health care services (Ogbera and Ekpebegh, 2014; Fasanmade and Dagogo-Jack, 2015).

Diabetic neuropathy commonly manifests as peripheral neuropathy affecting sensory and motor nerves, although other nerves such as cranial nerves and autonomic nerves may also be affected. Peripheral neuropathy involving sensory nerves may be asymptomatic, or may present with symptoms such as numbness, paraesthesia or burning pain in the hands and/or feet (Davies et al., 2006). When a foot is rendered insensate as a result of peripheral neuropathy, it is predisposed to the development of neuropathic ulcers which are a leading cause of limb amputation (Poncelet, 2003). A variety of bedside clinical techniques can be used to demonstrate signs of peripheral neuropathy. These include the use of the 10g monofilament to assess sensation on the sole of the feet, tendon hammer for assessment of Achilles jerk reflex, and the assessment of vibration sense using a tuning fork or a vibrometer. The combination of more than one of these techniques increases the diagnostic accuracy in detecting the presence of peripheral neuropathy (Armstrong et al., 1998). This combination approach is employed in certain scoring systems such as the Michigan Neuropathy Screening Instrument (Ugoya et al., 2006) and the Neuropathy Disability Score (Weintrob et al., 2007).

The aim of this study was to determine the prevalence of peripheral neuropathy among individuals with type 2 diabetes mellitus using the vibrometer, as well as to outline its associated risk factors.

MATERIALS AND METHODS

This study involved one hundred (100) adults diagnosed with type 2 diabetes mellitus. They were all members of the Diabetes Association of Nigeria (DAN), Plateau state chapter, who were invited to take part in this research as part of events marking the World Diabetes Day celebration for the year 2016. All study participants assembled on the day of the research at the premises of the State Specialist hospital after observing an overnight fast (to enable the research team perform assays for serum lipids). Details of the research procedure was explained to every participant and informed consent obtained.

Socio-demographic data (age, gender, occupation, highest level of educational, residence) were obtained from each participant, as well as duration of diagnosis of diabetes mellitus (in years). Anthropometric indices (weight, height, waist circumference) were measured for each participant.

A vibrometer Figure 1 (manufactured by Diabetik Foot Care Pvt Limited, India) was used to determine the Vibration Perception Threshold (VPT) in both feet for each study participant. The study participant was required to lie on a couch and remove all foot wear. The vibrating tip of the vibrometer probe was then placed on five designated points (one at a time) on the sole of the foot. For each point, the frequency of vibration was steadily increased and the participant asked to indicate at what point he/she perceived the vibration. This was taken as the VPT reading for that point. The average VPT for those five points was then calculated separately for the left and right foot. Average VPT readings greater than 15 Volts indicated the presence of peripheral neuropathy in the affected foot.

Blood samples were also taken to assay for serum triglyceride and cholesterol levels.

Statistical analysis

Data was entered into Microsoft Excel sheet and analyzed using the EPI INFO statistical software (version 7.0). Quantitative variables were expressed as mean± standard deviation. Logistic regression analysis was used to determine the independent predictors of peripheral

Table 1. characteristics of study population

Categorical variable	Prevalence
Age ≥ 50 years	79%
Duration of diagnosis of diabetes ≥ 10 years	38%
Central obesity	73%
Dyslipidaemia	49%

Table 2. Predictors of peripheral neuropathy in study population

Predictor	Odds Ratio	95% confidence Interval	P value
Age ≥ 50 years	4.00	1.46 – 10.77	0.004*
Duration of DM ≥10 years	3.37	1.23 – 9.25	0.015*
Central obesity	0.42	0.15 – 1.17	0.090
Dyslipidaemia	0.89	0.34 – 2.10	0.792
Height ≥ 1.6m	2.35	0.98 – 5.63	0.051

*statistically significant; DM = Diabetes Mellitus

Table 3. correlates of left foot and right foot VPT readings

Variables	Correlation Coefficient (r)	P value
Age vs VPT (left foot)	0.40	0.0003
Age vs VPT (right foot)	0.39	0.0001
DDM vs VPT (left foot)	0.41	0.0003
DDM vs VPT (right foot)	0.40	0.0002
WC vs VPT (left foot)	0.03	0.0250
WC vs VPT (right foot)	-0.11	0.0330
TG vs VPT (left foot)	0.07	0.0190
TG vs VPT (right foot)	0.04	0.0610

DDM = Duration of diagnosis of diabetes; VPT = Vibration Perception Threshold; WC = Waist Circumference; TG = Triglycerides

neuropathy while Pearson's correlation was used to determine the relationship between the various quantitative variables and VPT readings. In all cases, p value less than 0.05 was considered statistically significant.

Definition of terms

Dyslipidaemia: serum triglyceride > 1.7mmol/L or HDL-Cholesterol < 1.03mmol/L (male), <1.29mmol/L (female) (Parikh and Mohan, 2012).

Central obesity: waist circumference > 94cm (male), >80cm (female) (Parikh and Mohan, 2012).

RESULTS

The study population comprised 32% males and 68% females. The mean age of study participants was 57.8±11.6 years. 30% of participants had tertiary education as their highest level of education, while 86% of them resided in urban settlements. The mean duration of diagnosis of diabetes mellitus was 10.1±6.6 years.

Peripheral neuropathy was present in 70% of the study population. Males had a higher prevalence of the condition than females (81.3% and 64.7% respectively).

Other characteristics of the study population are described in Table 1

The results of logistic regression analysis revealed that age ≥ 50 years and duration of diagnosis of diabetes ≥ 10 years were independent predictors of peripheral neuropathy in the study population. This is depicted in Table 2.

These two variables – age and duration of diagnosis of diabetes – correlated positively with both the left foot and right foot VPT values of the study participants. This is summarized in Table 3 above.

DISCUSSION

The moment prevalence of peripheral neuropathy among the participants in this study was 75%. This figure is close to what was obtained by (Ugoya et al., 2006) who studied one hundred and twenty diabetics at the Jos University Teaching Hospital, Plateau State, Nigeria. They found a prevalence of 75%. In that study, peripheral neuropathy

was detected using the Michigan Neuropathy Screening Instrument which involved the use of tuning fork, Semmes Weinstein monofilament as well as the Achilles tendon reflex. (Uloko et al., 2012) obtained a lower figure of 59.2% in a multicentre study involving seven Nigerian tertiary health institutions. However, in that research, the study population encompassed participants with both type1 and type 2 diabetes mellitus.

Research from different parts of the world have revealed much lower prevalence for peripheral neuropathy among persons with diabetes mellitus. In a study in the United Kingdom, the vibrometer was used to diagnose peripheral sensory neuropathy among diabetic study participants, and 28.5% of them had peripheral neuropathy (Young et al., 1993). The study population in that research was much larger than in this study (6487 participants), and included both type 1 and type 2 diabetics (the participants in this study were strictly persons with type 2 diabetes). (Morkrid et al., 2010) conducted a screening exercise among individuals with strictly type 2 diabetes in Bangladesh using the Neuropathy Disability Score (which combines the use of the tuning fork, Achilles tendon reflex assessment, sensation to pin prick and temperature). They found out that 19.7% of them had peripheral neuropathy. The mean age of study participants in that research (50.8±10.6 years) showed that they were relatively younger than those in this study, and so probably less likely to have developed peripheral neuropathy. A large study in India involving 1044 participants with diabetes mellitus revealed that 34.9% of the population had peripheral neuropathy (Jayaprakash et al., 2011). In that study, the vibrometer was used to detect the presence of peripheral neuropathy. However, a vibration perception threshold of greater than 25 volts was used as definition for peripheral neuropathy. This probably explains why the prevalence in that research was much lower than what was obtained in this study (here, the cut-off for diagnosis of peripheral neuropathy was set at a much lower value of 15 volts). In the study among type 2 diabetic participants by (Davies et al., 2006) the prevalence for peripheral neuropathy was 26.4%. The research team in that work defined peripheral neuropathy as the presence of pain in the extremities, and not the absence or reduction of sensation on physical examination.

The results of this study showed that the development of peripheral neuropathy had a significant association with age and duration of diabetes mellitus. Peripheral neuropathy is a chronic complication of diabetes, and takes time to develop. And so it is expected that the older a person with diabetes becomes, and the longer the period during which he has had the condition, the more likely the possibility of developing peripheral neuropathy. The results of research from other parts of the world supports this association between age, duration of diabetes, and peripheral neuropathy (Adler et al., 1997; Tefsaye et al., 2005).

This study did not find any association between central obesity, dyslipidaemia, tall stature and peripheral neuropathy. This is at variance with the findings of other studies on the subject matter. Straub et al. (1994) found a significantly higher prevalence of peripheral neuropathy among type 2 diabetics who were obese than among normal weight subjects with type 2 diabetes. However, the participants in that study were relatively older (60.4±1.0 years) and had been diagnosed with diabetes for longer (mean duration = 13.6±1.0 years) than the participants in this study. Also, obesity was defined using body mass index, and not waist circumference, as was used in this study. Isomaa et al. (2001) demonstrated an association between central obesity, dyslipidaemia and the risk of developing peripheral neuropathy in a study among persons with type 2 diabetes. Vibrometry was not used in the definition of peripheral neuropathy in that work. Other researchers have demonstrated an association between increasing height and the risk of developing peripheral neuropathy (Gadia et al., 1987; Cheng et al., 2006) Such an association was not observed in this study.

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Conflict of interest

None to declare

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