

Assessment of diabetic peripheral neuropathy in type 2 diabetes patients by Biothesiometer

P. Geetha¹, P. Shanmugasundaram^{2*}

ABSTRACT

Aim: The present study was aimed to assess the presence of diabetic neuropathy in type 2 diabetes patients. **Objective:** The objective of this study was to analyze the prevalence of diabetic neuropathy by detecting vibration perception threshold by an instrument called Biothesiometer. **Materials and Methods:** Our study conducted with 150 type 2 diabetes patients in outpatient diabetic center, after getting ethics permission from the institutional ethics committee. Demographic parameters were analyzed by Microsoft Excel. Patients were analyzed for the vibration perception threshold using Biothesiometer. The results were documented as Grades I (normal), II (mild), III (moderate), and IV (severe). **Results:** Our study consists of a total of 150 diabetes patients, male and female were found to be 54% and 46%. The mean age of patient was 54.85 and duration of diabetes was 10.05 years. VPT score Grade I (Normal) 68.67% was documented in our study. A total of Grades II, III, and IV were 15.33%, 8%, and 8%. Gender-wise categorization results from male (35.8%) and female (26.44%) were affected. Age-wise categorization, male patients (35.8%) were more affected than women (26.08%). A total of 19.14% of Grades II, III, and IV were found in the age group of <50 years and a total of 36.88% of mild, moderate, and severe were found in the age group of >50 years. **Conclusion:** The result of our study concluded that diabetic neuropathy increases with increase in age and duration of diabetes. Vibration perception threshold detection was useful method to identify patients affected from diabetic neuropathy.

KEY WORDS: Biothesiometer, Diabetic peripheral neuropathy, Vibration perception threshold

INTRODUCTION

In IDF SEA region, India is one of the six countries in the world 425 million people suffering from diabetes, and in the SEA region, 82 million people are diabetic; by 2045, diabetic people levels may increase to 151 million. In India, in 2017, 72,946,400 were diabetic.^[1] Peripheral diabetic neuropathy is one of the lifelong complications of diabetes. Different epidemiological studies from India indicated that the prevalence ranging from 5 to 2400 per 10,000 population in various groups of people.^[2] Nearly 50% of elderly diabetes patients are affected by DPN. While few people may experience very painful symptoms, some people with a more marked neuropathic pain with no symptoms. Careful examination of diagnosis required of the lower limbs. Management of diabetic

neuropathy involves medications generally tricyclic antidepressant drugs or anticonvulsant agents are needed. Diabetic patients suffering from neuropathy must be careful risk of insensitive foot ulceration and must be given patient counseling and foot care.^[3] The Biothesiometer is an instrument used to detect threshold of vibration sense. The maximum extend of a vibration of the stimulus (calculated in volts) is slowly increased until the threshold of vibration sense is attained. Patients with vibration perception threshold >25 volts (Grade II) are the maximum risk of developing ulcers later on. Biothesiometer has 98% specificity and 80% sensitivity for finding of neuropathy.^[4] Vibration perception threshold plays an important role in early detection of diabetic peripheral neuropathy and also to prevent the risk of foot ulceration. In VPT, there was a conversion of electric current mode to vibration mode and transferred to patient. VPT measurement in large nerve fiber integrity and perception is usually poor in lower extremity than the upper extremity.^[5] Our study was aimed to identify the patients affected from

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¹Research Scholar, Department of Pharmacy Practice, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies, Chennai, Tamil Nadu, India, ²Department of Pharmaceutical Chemistry and Analysis, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies, Chennai, Tamil Nadu, India

***Corresponding author:** Dr. P. Shanmugasundaram, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai, Tamil Nadu, India. Phone: +91-9840126575. E-mail: samsimahe@gmail.com

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diabetic neuropathy by recording vibration perception threshold and to decrease progress of complication.

MATERIALS AND METHODS

A prospective study on type 2 diabetes patients was carried out in outpatient diabetic hospital with 150 patients. The study was carried out after getting approval from the institutional ethics committee (Ref: IEC/PHD/2015/2016/01). The study was conducted based on the inclusion and exclusion criteria. Type 2 diabetes patients either fasting blood sugar >126 mg/dl or postprandial blood sugar >200 mg/dl, a patient who gave consent to confirm diabetic complications and also the patients whose blood glucose under control and on regular follow-up and treatment were included in the study. Patients with diabetes type I, pregnant woman who was diabetic, patients were not in regular periodic checkup and treatment was not included in this study. All the demographic details and clinical parameters were assessed and documented in the specialized data entry form. The perception of vibration was analyzed using digital Biothesiometer. The VPT value was graded as <15 volts as normal (Grade I), 16–20 volts as mild loss of sensation (Grade II), 21–25 volts as moderate loss of sensation (Grade III), and >25 volts as severe and abnormal (Grade IV). A probe was introduced into patient's hand to detect vibration perception. The patient was advised to feel the vibration on feet and slowly voltage was increased. At one certain point the patient feel the vibration, that particular vibration perception threshold was recorded in volts and graded. Gender-wise distribution and age-wise distribution of neuropathy grade was calculated and noted. Statistical analysis was performed using Microsoft Excel.

RESULTS

In the overall study population, male patients (54%) were predominant when compared to female patients (46%). The mean age of the patient was found to be 54.85. The age considered in this study ranges from 24 to 93. Maximum numbers of patients affected by DPN were in the age group of >50 years. The mean duration of diabetes was more than 10 years. Mean BMI was found to be 29.02 kg/m². Fasting and postprandial blood sugar level was also increased in patients. HbA1c percentage was 8.41% [Table 1]. Neuropathy pain was assessed by checking vibration perception threshold by Biothesiometer and graded. In our study, VPT grade ranges from 6 to 48 volts. Nearly 69% of patients were not affected by DPN. Severely affected patients were found to be 8% [Table 2]. Categorization of VPT grade score according to gender wise detailed about more male patients was suffering of DPN. Neuropathy score normal for female and male patient was 73.9 and 64.2%. Overall, Grades II–IV were increased in males (35.8%) compared to females (26.44%).

In the present study, 68.67% of type 2 diabetes patients were not affected by DPN and 8% of patients were severely affected [Table 2]. Table 3 represents that female patients were less severely affected compared to male patients. Percentage of normal VPT score was more (73.9%) in female patients and less normal in male patients (64.2%), but the severity values Grades II, III, and IV were less in female (26.08%) and increased in male patients (35.8%). Table 4 represents <50 years of age that 80.85% of patients were fall in the Grade I (normal) and the age >50 years, 63.11% of patients were not affected by DPN. A total of 19.14% of Grades 2, 3, and 4 were found in the age group of <50 years and a total of 36.88% of mild, moderate, and severe were found in the age group of >50 years.

DISCUSSION

Different types of diabetic neuropathy affect peripheral nervous system and autonomic nervous system. Different types of DPN are throbbing diabetic neuropathy, distal symmetrical polyneuropathy, mononeuritis multiplex, mononeuropathy, and

Table 1: Demographic and clinical characteristics of 150 type 2 diabetes patients

Characteristics	Mean±SD
Gender	
Male	81 (54%)
Female	69 (46%)
Age (years)	54.85±13.52
Duration of diabetes (years)	10.05±7.75
BMI (kg/m ²)	29.02±17.43
FPG (mg/dl)	155.21±59.39
PPPG (mg/dl)	204.03±82.19
HbA1c (%)	8.41±2.13
BP - systolic (mmHg)	138.98±21.40
BP - diastolic (mmHg)	80.14±12.92
T. CHOL (mg/dl)	168.65±16.47
TGL (mg/dl)	149.86±71.18
LDL-C (mg/dl)	82.96±20.25
VLDL-C (mg/dl)	29.38±12.23
HDL (mg/dl)	36.48±8.71

BMI: Body mass index, FPG: Fasting plasma glucose, PPPG: Postprandial plasma glucose, BP: Blood pressure, T. CHOL: Total cholesterol, TGL: Triglyceride, LDL-C: Low-density lipoprotein cholesterol, VLDL-C: Very low-density lipoprotein cholesterol, HDL: High-density lipoprotein

Table 2: VPT score grade of 150 patients

VPT score grade	Frequency	Percentage
Grade I (normal)	103	68.67
Grade II (mild)	23	15.33
Grade III (moderate)	12	8
Grade IV (severe)	12	8

Table 3: Categorization of neuropathy grades according to gender wise

VPT score grade	Female (%)	Male (%)
Grade I (normal)	51 (73.9)	52 (64.2)
Grade II (mild)	9 (13.04)	14 (17.3)
Grade III (moderate)	6 (8.7)	8 (9.9)
Grade IV (severe)	3 (4.34)	7 (8.6)

Table 4: Distribution of patients according to age wise

VPT score grade	Age <50 years (%)	Age >50 years	Total %
Grade I (normal)	38 (80.85)	65 (63.11)	71.78
Grade II (mild)	6 (12.76)	17 (16.5)	14.63
Grade III (moderate)	0 (0)	12 (11.65)	5.83
Grade IV (severe)	3 (6.38)	9 (8.73)	7.56

autonomic neuropathy. Duration of diabetes and severity based on glycemic control is directly related to neuropathy. Polyol pathway, microvascular damage due to accumulation of advanced glycosylation end product accumulation, is the three main mechanisms involved in the development of diabetic neuropathy.^[6] In our study, the age of >50-year patients was more affected. 68.67% of patients did not show any sensation. Results from numerous studies were stated the association of vibration sensation loss and the development of many indicators of peripheral neuropathy. DPN related with impaired glucose tolerance is less than the neuropathy related with recently diagnosed diabetes, with that small nerve fiber involvement may be the initially noticeable sign of neuropathy.^[7-9] In our study stated that DPN prevalence was more for men than women. Our study result was similar to other studies, Arambewela *et al.* studied in microvascular complications that the prevalence of all the diabetic complications was more in men than women.^[10] Independent risk factors for men were found to be peripheral vascular disease, use of cigarette, diabetic foot, and peripheral neuropathy following amputation.^[11,12] The risk of the development of peripheral neuropathy is directly proportional to the duration and increased glycemic levels.^[13] Neuropathy occurs mainly due to Vitamin B12 deficiency, uremia, or hypothyroidism in diabetes patients.^[14] Another study by Magri *et al.*, multivariate logistic regression revealed that male gender, low hemoglobin values are the independent predictors of VPT >25 volts in patients with proliferative retinopathy.^[15] Autonomic dysfunction is due to cholinergic, noradrenergic, and peptidergic system (substance P). Autonomic neuropathy decreases counter-regulatory hormones like catecholamine's which leads to hypoglycemic unawareness. Management of diabetic neuropathy includes strict glycemic control and regular nerve conduction studies. Other comorbid conditions such as hypertension, hyperlipidemia, and cessation of smoking are also to be managed. The treatment for painful diabetic neuropathy can be controlled by drugs – antidepressants and anticonvulsants such as duloxetine, pregabalin, and gabapentin. Treatment for orthostatic hypotension following autonomic neuropathy is fludrocortisone, midodrine, and clonidine. Non-pharmacological treatment includes care of foot (regular checking of foot for calluses or callosities and appropriate footwear to prevent foot ulceration secondary to diabetic neuropathy).^[16]

CONCLUSION

Results of the study concluded that peripheral neuropathy prevalence increases with age and duration of diabetes. From our study, diabetes people not affected by neuropathy was found to be 71.78%. Peripheral neuropathy affects more in men than women. Analysis of diabetic neuropathy by Biothesiometer is a useful tool and gives the accurate results. Earlier intervention is foremost important to prevent from diabetic complications.

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