Vibration Perception Threshold as a Measure of Distal Symmetrical Neuropathy in Type 2 Diabetes

Jeewandeep Kaur[1], Arvinder Pal Singh Batra[2]

ABSTRACT

Introduction: The prevalence of diabetic is increasing worldwide due to its chronic progressive behaviour and its complications. Among the complications incurred by diabetic, nervous system is most commonly and frequently affected. Although all types of peripheral nerves can be involved, it is usually sensory dominant with eventual involvement of motor nerve fibers. VPT (Vibration Perception Threshold) as a stand-alone method for identifying distal symmetrical peripheral neuropathy relative to gold standard assessments involving neurology examinations and nerve conduction studies. Early detection of diabetic neuropathy in diabetic patients is essential to decrease morbidity

Material and Methods: In this study we determined VPT and nerve conduction along with signs and symptoms of peripheral neuropathy in 30 subjects with type 2 diabetes.

Results: In the study we found VPT as a reliable measure of DSPN (Distal Symmetrical Poly Neuropathy) and a sensitive and specific measure of definite clinical neuropathy with the highest sensitivity noted for definite clinical neuropathy (74.07%). The sensitivity of VPT to predict abnormal nerve conduction and confirmed clinical neuropathy was 50%.

Conclusion: From our study we conclude VPT as a sensitive indicator of definite clinical neuropathy but this analysis do not address the utility of VPT as a measure of disease severity or the ability of VPT to measure change in neuropathy status over time.

Keywords: Diabetes, Vibration Perception Threshold, Distal Symmetrical Poly Neuropathy.

INTRODUCTION

Quantitative determination of vibro-tactile thresholds has been proposed as a method to assess the somato-sensory pathways that transmit information induced by Cutaneous vibratory stimuli.[1] In comparison with testing of vibration with a tuning fork, the quantitative method for measuring vibration perception thresholds (VPT) has shown reliability, primarily because the equipment used minimizes the subjectivity of the examiner.[2] The prevalence of diabetic is increasing worldwide due to its chronic progressive behaviour and its complications. Among the complications incurred by diabetic, nervous system is most commonly and frequently affected.[3]

Although all types of peripheral nerves can be involved, it is usually sensory dominant with eventual involvement of motor nerve fibers.[4] Distal symmetrical polyneuropathy (DSP), which predisposes patients to variable pain, sensory disturbance, motor dysfunction, ulcers, and gangrene, is the most common type of diabetic neuropathy.[5-7] Quantitative sensory testing (QST) consists of several non-invasive, standardized tests aimed at examining different aspects of the entire somato sensory nervous system. QST has many advantages over the electromyography such as the ability to test the function of thin and unmyelinated nerve fibers as well as the subjective sensation of a somato sensory stimulus.[8] In the present study we evaluate the performance of VPT as a stand-alone method for identifying distal symmetrical peripheral neuropathy relative to gold standard assessments involving neurology examinations and nerve conduction studies.

MATERIAL AND METHODS

Vibration perception threshold (VPT) testing was determined in 30 adults with type 2 diabetes mellitus with > 10 years of diabetes.Before taking sample informed consent was taken from the subjects and ethical clearance was taken from the institutional ethical clearance committee. Subjects were taken in the study only by taking following inclusion and exclusion criteria:-

Inclusion criteria

i) Subjects having history of type 2 diabetes mellitus with more than 10 years of duration.
ii) Subjects above 35 years of age.

Exclusion criteria

i) Subjects having amputated limbs\gangrene.
ii) Subjects having neuropathy due to causes other than diabetes.

VPT was assessed using the Diabetic Neuropathy Analyzer (Bio star Health Care).

The device produces vibration amplitudes from 0.005–200 microns, expressed as vibration units (0.005microns =0.1 vibration unit; 200 microns=20.0 vibration units), with a higher vibration unit value indicating worse performance or greater sensory dysfunction. First probe was applied to patient's hand to explain the feet of vibration clearly. Then patient is asked to concentrate on feet & tell as soon as he starts feeling the vibration and value is noted. In the present study average of 6 specific points in both feet were taken for analysis and these points were:–

– Great toe
– 1st metatarsal
– 3rd metatarsal
– 5th metatarsal
– Instep
– Heel

Subjects were unaware of the device settings.

Every incorrect response increased the vibration intensity by

[1]Assistant Professor, Department of Physiology (C R L), [2]Professor and Head, Department of Anatomy, BPS GMC for Women, Sonepat, India

Corresponding author: Arvinder Pal Singh Batra, Professor and Head, Department of Anatomy, BPS GMC for Women, Sonepat, India

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10% and each correct response lead to dectrease in the intensity by 10%. Stimuli at vibration units of <1.0 were repeated before increasing or decreasing the vibration intensity. If there were 5 errors made by the subject over a minimum of 18 trials, the test was stopped. Vibration units corresponding to the subject's first five errors and the five lowest correctly identified vibration units were rank ordered; the highest and lowest of these 10 were discarded.

The first, definite clinical neuropathy, indicate the presence of symptoms and signs consistent with DSPN based on history and physical examination by a board-certified neurologist. The second, abnormal nerve conduction represents one or more abnormal nerve conduction results (amplitude, conduction velocity, or F response latency) in two different peripheral nerves among the median (sensory or motor), peroneal motor, or sural sensory studies. Finally, confirmed clinical neuropathy was defined as the presence of both definite clinical neuropathy and abnormal nerve conduction.[9-11]

STATISTICAL ANALYSIS

Qualitative data was represented in groups and were compared using chi square tests for categorical variables. The Cohen k measured agreement between two methods.

RESULTS

Characteristics of the30 subjects with both DSPN and VPT Assessment (data as n %) are shown in Table-1.

DSPN prevalence among all subjects was highest when defined by Definite clinical neuropathy (76.6%). Abnormal nerve conduction was present in 33.3% of subjects and confirmed clinical neuropathy in33.3% of subjects. There was significant relationship between abnormal nerve conduction test and VPT ($p<0.005$). Also there was significant relationship between confirmed neuropathy and VPT ($p<0.05$). However, there was no significant relationship between definite clinical neuropathy and VPT, as shown in table-2

Characteristic	Total Cohort
Number of Subject (n)	30
Definite Clinical Neuropathy (%) (23/30)	76.6
Abnormal Nerve Conduction (%)(10/30)	33.3
Confirmed Clinical Neuropathy (%)(10/30)	33.3

Table-1: Characteristics of Subject

	Chi square test of categorical variables with VPT
Definite Clinical Neuropathy	Non-significant
Abnormal Nerve Conduction	Significant
Confirmed Neuropathy	Significant
*p< 0.05 is taken significant.	

Table-2: Relationship between vibration preception threshold (VPT) with all the three distal symmetrical polyneuropathy (DSPN)

VPT was a sensitive predictor of all three DSPN outcome measures (Table-3), with the highest sensitivity noted for definite clinical neuropathy (74.07%). The sensitivity of VPT to predict abnormal nerve conduction and confirmed clinical neuropathy was 50%.Specificity of VPT for abnormal nerve conduction, definite and confirmed clinical neuropathy was 100% (Table-3).

The PPV of VPT was higher for abnormal nerve conduction (50%) and confirmed clinical neuropathy (50%) (Table-3). k values indicated good agreement between VPT and definite clinical neuropathy, k values indicated at least fair agreement between abnormal nerve conduction, confirmed clinical neuropathy and VPT.

DISCUSSION

We determined VPT and nerve conduction studies along with signs and symptoms of peripheral neuropathy in 30 subjects with type 2 diabetes. We found that VPT was a reliable measure of DSPN and a sensitive and specific measure of definite clinical neuropathy.VPT tests at foot were performed concurrently with detailed neurological assessments and electrophysiological studies. VPT testing was performed on the same day as the subject's neurological assessment and electrophysiological studies to minimize temporal variability when results were compared. Sensitivity of VPT with definite clinical neuropathy was highest. With k as another measure of agreement, VPT had good agreement with definite clinical neuropathy but at least fair agreement with abnormal nerve conduction and confirmed clinical neuropathy. Abnormal nerve conduction was more prevalent than definite clinical neuropathy therefore; the PPV of VPT was highest as a measure of abnormal nerve conduction. In previous studies it was found that VPT may provide important, clinically meaningful information about large nerve fiber dysfunction in diabetes.[12]

In another study common criticism of VPT testing are that it is not sufficiently specific to large fiber or even to peripheral nerve dysfunction, that the results are influenced by subject attentiveness, motivation, and fatigue. VPT testing are simple, quick, painless, and generally well tolerated and are unaffected the presence of foot callus or by limb temperature.[13-16] In another study it was shown that VPT at the great toe is a sensitive predictor of both definite clinical neuropathy and confirmed clinical neuropathy. Because sensory examination of large nerve fibers (e.g., vibration and position sense) is a component of the neurologists 'evaluation, this finding is not unexpected. VPT was a less sensitive indicator of abnormal nerve conduction.[17] Overall, the sensitivities obtained in our study compare favorably to those of others who have reported sensitivities between 58 and 84% for VPT[18-21] measured by a variety of test devices and test methods. Early detection of DN is essential for the initiation of potential preventative measures, patient education, and evaluation of therapeutic options. Patient education concerning foot care may make a substantial impact

Total subjects (n=30)	Sensitivity	specificity	Positive predictive value	Negative predictive value	K
Definite clinical neuropathy (23)	74.07	100	30	0	.857
Abnormal nerve conduction(10)	50	100	50	0	.200
Confirmed clinical neuropathy (10)	50	100	50	0	.200

Table-3: Showing vibration perception threshold (VPT) a sensitive predictor of all three Distal symmetrical Polyneuropathy (DSPN)

on reducing the inherent morbidity of DN.[22]

CONCLUSION

From our study we conclude VPT as a sensitive indicator of definite clinical neuropathy but this does not mean that VPT can be used as a measure of disease severity or the ability of VPT to measure change in neuropathy status over time. Future researchers may choose to select VPT cut of points for defining abnormalities based on the population studied and clinical outcome of interest.

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