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

Jeewandeep Kaur¹, Arvinder Pal Singh Batra²

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. Vibration perception threshold (VPT) testing was determined in 30 adults with type 2 diabetes mellitus with > 10 years of duration. 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:-

Subjects were unaware of the device settings.

Every incorrect response increased the vibration intensity by

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10% and each correct response lead to decrease 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 the 30 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 in 33.3% 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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Subject (n)</td>
<td>30</td>
</tr>
<tr>
<td>Definite Clinical Neuropathy (%) (23/30)</td>
<td>76.6</td>
</tr>
<tr>
<td>Abnormal Nerve Conduction (%) (10/30)</td>
<td>33.3</td>
</tr>
<tr>
<td>Confirmed Clinical Neuropathy (%) (10/30)</td>
<td>33.3</td>
</tr>
</tbody>
</table>

Table-1: Characteristics of Subject

<table>
<thead>
<tr>
<th>VPT</th>
<th>Chi square test of categorical variables with VPT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Definite Clinical Neuropathy</td>
</tr>
<tr>
<td></td>
<td>Abnormal Nerve Conduction</td>
</tr>
<tr>
<td></td>
<td>Confirmed Neuropathy</td>
</tr>
<tr>
<td></td>
<td>*p&lt; 0.05 is taken significant.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Total subjects (n=30)</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive predictive value</th>
<th>Negative predictive value</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite neuropathy (23)</td>
<td>74.07</td>
<td>100</td>
<td>30</td>
<td>0</td>
<td>.857</td>
</tr>
<tr>
<td>Abnormal nerve conduction (10)</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td>0</td>
<td>.200</td>
</tr>
<tr>
<td>Confirmed clinical neuropathy (10)</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td>0</td>
<td>.200</td>
</tr>
</tbody>
</table>

Table-3: Showing vibration perception threshold (VPT) a sensitive predictor of all three Distal Symmetrical Polyneuropathy (DSPN)
on reducing the inherent morbidity of DN.

**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.

**REFERENCES**


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