# ORIGINAL RESEARCH PAPER

**Medicine**

## A STUDY TO COMPARE DETECTION OF PERIPHERAL NEUROPATHY IN TYPE 2 DIABETES USING NERVE CONDUCTYION VELOCITY AND BIOTHESIOMETRY

**KEY WORDS:** Diabetes, neuropathy

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**ABSTRACT**

**Introduction**: Diabetes is one of the leading non communicable diseases throughout the world. Due to its chronic nature it causes a number of complications. Diabetic peripheral neuropathy is one of the most dreaded complications of diabetes as it is associated with significant morbidity. Diagnosis of neuropathy is commonly done by ncv which is a gold standard test for it. Other simpler methods to detect early loss of protective vibration sensation and thus to find out feet at risk of future complications is the need of the hour.

**Aims & objective**: To study the symptoms of peripheral neuropathy in type 2 diabetic patients, to correlate these with ncv and biothesiometry and to compare results of ncv with  biothesiometry.

**Material & method**: This was a cross sectional study carried out in 40 patients with symptoms of peripheral neuropathy. All patients were subjected to detailed clinical history, examination of their feet and neuropathy testing by ncv using the rms ncv/emg machine and vpt using a hand held biothesiometer of dhansai lab, mumbai.

**Results**: Out of the total of 40 patients, 30 were male and 10 were female. The most frequently encountered symptom of neuropathy in our study was burning feet. Vpt using biothesiometry was highly sensitive and accurate for early detection of neuropathy when compared to gold standard ncv.

**Conclusion**: Vpt using biothesiometer is very sensitive for early detection of diabetic peripheral neuropathy and due to rapidity and ease of performing this test it can be used as a useful out patient test to rapidly screen patients and thus can prevent or retard development of end stage complications.

## Introduction

Diabetes mellitus (dm) has been defined in a way that it is a metabolic disorder with hyperglycemia as an essential and common feature and has number of abnormalities in metabolic parameters namely the carbohydrate, protein and fat metabolism which is further explained by either a defect in insulin secretion, insulin action or both.1  globally, prevalence of diabetes has risen from 108 million in 1980 to 422 million in 20142. The numbers are expected to rise to 552 million by year 2030.[3]

Neuropathies are the most common complication of dm affecting up to 50% of patients with type 1 and type 2 dm 4. In contrast to type 1 dm where distal polyneuropathy typically becomes symptomatic after many years of chronic prolonged hypreglycemia, patients with type 2 dm may present with distal polyneuropathy after many years of poor glycemic control; sometimes neuropathy may be present at the time of diagnosis.

Ncv being a gold standard for detection of diabetic peripheral neuropathy has a steep learning curve and is cumbersome to perform in an opd based patient. There have been various studies suggesting that vibration sense is the earliest to be affected in diabetic peripheral neuropathy5. Vibration perception can be checked by a simple hand held biothesiometer and it requires only minutes to perform this test.

So the objective of this study is to focus on clinical profile of diabetic distal sensory neuropathy and compare the results of ncv with vibration perception threshold for detection of neuropathy

## Aim and objective

1. To correlate clinical features of neuropathy with nerve conduction study and vibration perception threshold.
2. To compare ncv results with biothesiometry

## Material and method

Study design: prospective cross sectional study
Sample size: 40 patients
Duration of enrollment: 1.5 years

Study was started after clearance from institutional ethics committee.

## Method
### Inclusion criteria:
1. Patients willing to give informed and written consent to participate in the study.

2. Type 2 diabetic patients with symptoms indicative of peripheral neuropathy like tingling, burning, numbness, hyperesthesia etc.

### Exclusion criteria:
1. patients not willing to give consent
2. extremes of ages <18 and >80 years
3. persons with known neurological disease
4. known alcoholics
5. on sedatives/hypnotics
6. anemic (hb<=11gm%, mcv>92 fl)

A detailed history about their diabetes (i.e duration, drugs, complications), age, gender, symptoms of peripheral neuropathy (i.e tingling, numbness, hyperesthesia, burning sensation in limbs) and foot ulceration were taken. All were investigated for cbc, fpg, pppg, hba1c, urine routine microscopy, blood urea, serum creatinine and evaluation of fundus for retinopathy. A systemic examination was also done to find any associated comorbid conditions like hypertension, obesity etc. Patient's feet were examined for surrogate markers of diabetic peripheral neuropathy like callus, fissures, trophic changes, dryness, shiny skin etc. And also any past or present ulceration history was sought. Light touch sensation was checked with a cotton cusp applied to both limbs alternatively and asking the patient for the perception of touch. Superficial and deep pain was tested using a head end of a pin and sharp end of the pin respectively. Temperature sense was checked using hot and cold water filled test tubes. Joint position was checked using patient's recognition of his toe position either in planter or dorsiflexed position when eyes were closed. All enrolled patients were subjected to neuropathy testing by nerve conduction velocity (ncv) and vibration perception threshold (vpt) testing by a hand held biothesiometer to check for loss of protective vibration sense (lops).

In all subjects, peripheral sensory ncs (nerve conduction study) was performed bilaterally with surface electrodes on the lower limbs on dorsal sural nerve and vibration perception threshold using hand held biothesiometer. Results of both of these tests were compared with each other and sensitivity of vpt as a simple screening test in diagnosis of peripheral neuropathy was checked keeping ncv as a gold standard.

## Nerve conduction study
Nerve conduction study was performed using nicolet viking quest edx machine by natus neurology.

**Biothesiometry**
using a hand held "biothesiometer" (sensitometer, dhansai lab, mumbai)

## Results
### Table 1: distribution of patients

| | | Frequency | Percentage |
|---|---|---|---|
| Age (years) | 41-50 | 12 | 30% |
| | 51-60 | 15 | 37.5% |
| | 61-70 | 10 | 25% |
| | 71-80 | 3 | 7.5% |
| Sex | Male | 30 | 75% |
| | Female | 10 | 25% |
| Duration of diabetes (years) | <5 | 3 | 7.5% |
| | 5-10 | 23 | 57.5% |
| | >10 | 14 | 35% |
| Smoking | Present | 27 | 67.5% |
| | Absent | 13 | 32.5% |
| Urine albumin (mg/dl) | Present | 23 | 57.5% |
| | Absent | 17 | 42.5% |
| Retinopathy | Present | 15 | 37.5% |
| | Absent | 25 | 62.5% |
| Hba1c (gm%) | <7.5 | 6 | 15% |
| | 7.5-10 | 25 | 62.5% |
| | 10-12 | 5 | 12.5% |
| | >12 | 4 | 10% |
| Symptoms of neuropathy | Burning feet | 33 | 82.5% |
| | Hyperesthesia | 11 | 27.5% |
| | Tingling | 26 | 65% |
| | Pain/tepmerature loss | 6 | 15% |
| | Foot ulcer | 2 | 5% |
| | Weakness | 1 | 2% |
| | Gait abnormality | 1 | 2% |
| Foot examination | Normal | 20 | 50% |
| | Abnormal | 20 | 50% |
| Signs of neuropathy | Loss of light touch | 7 | 17.5% |
| | Loss of superficial pain | 4 | 10% |
| | Loss of deep pain | 0 | 0% |
| | Loss of temperature | 8 | 20% |
| | Loss of joint position | 4 | 10% |

Out of total of 40 patients, 12 were in age group 41-50 years (30%), 15 were in 51-60 year group (37.5%), 10 in 61-70 year group (7.5%) and 3 in 71-80 year age group (7.5%) with maximum patients between 51-60 years. (table 1, graph 1)

### Graph 1:"distribution of patients according to age"
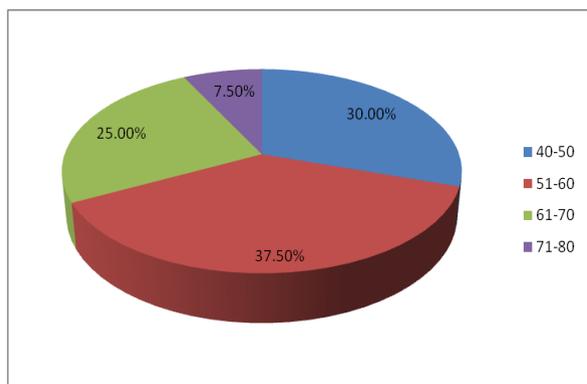


Out of total of 40 patients, 30 (75%) were male and 10 (25%) were female.

Out of total of 40 patients, 3 had disease of less than 5 year duration, 23 patients had diabetes since 5 to 10 years duration and 14 patients had diabetes of more than 10 year duration. In my study maximum patients (57.5%) had their diabetes since 5 to 10 years.

20 patients out of 40 (50%) had normal foot examination while others had abnormalities in foot examination (e.g callus, fissures, trophic changes, charcot foot, ulcers, shiny skin etc.) (table 1)

Abnormality in perception of light touch sense was present in 7 patients (17.5%), superficial pain sense in 4 (10%), deep pain sense in 0 patients, temperature sense in 8 patients (20%) and joint position sense abnormality was present in 4 patients (10%).

### Table 2: neuropathy by nerve conduction velocity

| Nc right | Frequency | Percent | Nc left | Frequency | Percent |
|---|---|---|---|---|---|
| Sensory neuropathy (amp </=10mv, velocity </=40ms) | 19 | 47.5 | | 21 | 52.5% |
| No neuropathy | 21 | 52.5 | | 19 | 47.5% |

Out of the total of 40 patients tested for neuropathy by ncv, 19 (47.5%) had presence of neuropathy and 21 (52.5%) did not have neuropathy of right foot while 21 out of 40 patients (52.5%) had neuropathy of left foot by ncv. (table 2)

### Table 3: neuropathy by vpt

| Vpt right | Frequency | Percent | Vpt left | Frequency | Percent |
|---|---|---|---|---|---|
| Present (>25 mv) | 26 | 65.0 | | 25 | 62.5% |
| Absent | 14 | 35.0 | | 15 | 37.5% |

### Table 4: comparison of neuropathy by ncv and vpt

| Nc_l | Vpt_l | | Total |
|---|---|---|---|
| | Present | Absent | |
| Sensory neuropathy | 19 | 2 | 21 |
| No neuropathy | 6 | 13 | 19 |
| Total | 25 | 15 | 40 |
| Nc_r | Vpt_r | | Total |
| | Present | Absent | |
| Sensory neuropathy | 19 | 0 | 19 |
| No neuropathy | 7 | 14 | 21 |
| Total | 26 | 14 | 40 |

Out of 19 patients who had sensory neuropathy by ncv of the right foot, all were also found to have neuropathy by vpt with a sensitivity of 100% and positive predictive value of 73.1%. While out of 21 patients who did not have neuropathy by ncv, 7 patients were found to have lops by vpt with a specificity of 66.7% and negative predictive value of 100% and accuracy of 82.5% (p-0.016). (table 4,graph 2)

### Graph 2: comparison of neuropathy by ncv and vpt: right foot
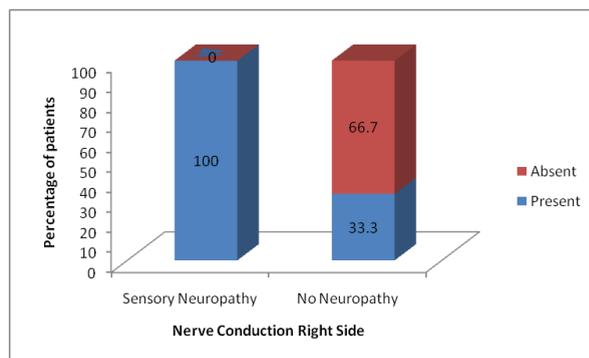


Out of 21 patients who had sensory neuropathy by ncv of the left foot, 19 were found to have abnormality of vpt with a sensitivity of 90.5% and a positive predictive value of 76%. While 6 patients out of 21 who did not have neuropathy by ncv were found to have abnormal vpt with a specificity of 68.4% and negative predictive value of 86.7% and accuracy of 80% for detecting lops. (p-0.289). (table 4)

## Discussion

Final aim of the study was to compare results of gold statndard ncv with a less cumbersome and time consuming method like vpt using a hand held biothesiometer which is very easy to perform and can be checked in no time. The study showed that vpt of the right foot was highly sensitive and moderately specific with a very high negative predictive value and accuracy when compared with the standard test for neuropathy detection ncv. (p- 0.016). In addition vpt of the left foot was also associated with a moderately high sensitivity, negative predictive value and accuracy but it failed to reach a statistical significance in our study (0.289) when compared with ncv of left foot most probably because of difference in staging of neuropathy of both feet and different type of neuropathy.

Vibration perception threshold is a very sensitive tool for early detection of lops and thus can identify feet at high risk for future complications 7,8,9,10,11,12,13. There are very few studies which have compared its applicability in day to day opd practice and did a head to head comparison with ncv study. There are very few studies which have evaluated the diagnostic usefulness of vpt testing and its applicability as a simple screening test to determine feet at risk 10,12. The present study used a hand held biothesiometer for the detection of vpt of 5 areas of feet and took an average of these areas. The average of >25 milivolts 11 was considered as high risk foot and at high chances of development of complications. The study also showed usefulness of this simple method when compared to ncv which has a steep learning curve and results of which are difficult to interpret. These results support the aim of the study and effectively compared the two methods namely ncv and vpt.

## Conclusion:

vpt is as efficient a study for detecting peripheral neuropathy in patients of diabetes as ncv. Due to ease of performing it may be used in opd easily and may be considered for routine use for early detection of diabetic neuropathy.

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