RESEARCH ARTICLE

Assessing the effectiveness of Toronto clinical neuropathy score in diagnosing diabetic peripheral neuropathy – A descriptive comparative study

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ABSTRACT

Background: There has been an increasing prevalence of diabetes worldwide. Diabetic peripheral neuropathy is the most common complication of type I and II diabetes. Peripheral neuropathy is a damage occurring in the nerves due to prolonged higher levels of blood sugar and diabetes. There are various screening tests such as vibration perception threshold (VPT), neuropathy symptom profile, michigan neuropathy screening instrument, neuropathy disability score, and Michigan diabetic neuropathy score. VPT accounts for an easy and accurate identification of diabetic patients, who are at risk, including patients, with early neuropathic deficits. Toronto clinical neuropathy score (TCNS) has been validated as a score for monitoring and diagnosing diabetic peripheral neuropathy. Aims and Objectives: This study was done to estimate the sensitivity, evaluate specificity, and determine the positive predictive value and negative predictive value of TCNS scoring in diabetic peripheral neuropathy patients considering VPT as the gold standard. Materials and Methods: In this study, VPT and TCNS were determined in 100 type 2 diabetic subjects with signs and symptoms of peripheral neuropathy. Results: In this study, it was estimated that TCNS is a reliable measure of distal poly neuropathy with a sensitivity of 95.83%, 100% specificity, positive predictive value of 100%, and negative predictive value of 50%. Conclusion: From our study, it was found that TCNS is a sensitive indicator of definite clinical neuropathy.

KEY WORDS: Diabetes; Vibration Perception Threshold; Toronto Clinical Neuropathy Score

INTRODUCTION

One of the most common complications of diabetes mellitus is distal symmetrical polyneuropathy (DSPN). Peripheral neuropathy is damage occurring in the nerves due to prolonged higher levels of blood sugar and diabetes. It causes feeling of numbness, and loss of pain sensation in feet, legs, or hands. Around 60–70% of diabetes, patients will develop peripheral neuropathy over a period of time. The incidence of neuropathy increases with the duration of diabetes and >50% of patients suffered from DSPN with a duration of more than 25 years of diabetes.

Early diagnosis of diabetic peripheral neuropathy may decrease patient morbidity through various therapeutic interventions. However, there is not a single diagnostic test to detect DSPN.

The diagnostic criteria for DSPN were first introduced by Dyck in 1985. DSPN is insidious in progression. Initially, lower limbs are affected distally followed by progression to the proximal parts of the body. Thin myelinated nerves
will be damaged, causing aching pain “asleep numbness” or sensation of prickling in the heels, foot, calves, hands, dorsum of foot, toes, and feet. The diagnosis of DSPN can be done on the basis of detailed clinical history, general physical examination, and nerve conduction studies (NCS). Early detection of DSPN is crucial in minimizing the risks by providing proper education to the patients, awareness about foot care, and pharmacologic treatment. Many information are suggestive of suboptimal screening for DSPN, with the unfamiliarity of non-invasive screening tests.

There are various screening tests such as vibration perception threshold (VPT), Michigan diabetic neuropathy score, neuropathy disability score, neuropathy symptom profile, and Michigan neuropathy screening instrument. Literature evidences suggest, VPT accounts for an easy and accurate identification of diabetic patients, who are at risk, including patients, with early neuropathic deficits. Toronto clinical neuropathy score (TCNS) has been validated as a score for monitoring and diagnosing DSPN. TCNS scoring has relatively high sensitivity and specificity. TCNS is an amalgam of neuropathy symptoms, physical health examination, sensory evaluation, and symptoms (TCNS and modified TCNS in DSPN).

This study was done for assessing the effectiveness of TCNS in diagnosing diabetic neuropathy. VPT provides clinically important information about dysfunction involving large nerve fibers in diabetes.

Abnormality in VPT values predicts long-term complication of ulceration and amputation. Abnormality in VPT values may be related to ulcers in the foot, gangrene, amputation, bypass in lower extremities, and angioplasty in diabetes. VPT is the lowermost vibrational intensity that is possible to perceive the stimulus. VPT will be impaired at a much early stage with various neuropathies. DSPN is a non-inflammatory disease associated with sensory and motor abnormalities in the peripheral nervous system. It has an effect on various organ systems such as eyes, kidneys, nerves, blood vessels, and heart. One of the most dreadful complications of diabetes is the complications occurring in the foot. It may start with an ulcer to the extent of amputation. In 40–50% of population, there was the development of neuropathy within 10 years of diabetic onset. Among diabetic patients who were hospitalized, the generality of diabetic peripheral neuropathy was 30%, among the community, it was 20%. Type 2 DM patients have a higher prevalence of diabetic neuropathy than Type 1. VPT plays an key role in the early detection of DSPN and ultimately reduces the complication. VPT measures the integrity of large nerve fibers. The grading of VPT values – mild (15–20 V), moderate (20–25 V), and severe (>25 V). It is an accurate indicator for assessing the risk of foot ulceration in DSPN, so it can be used as a tool for early identification and treatment. The objectives of the present study were to estimate the sensitivity, specificity, positive predictive value, and negative predictive value of TCNS scoring of patients with diabetic peripheral neuropathy considering VPT as gold standard.

**MATERIALS AND METHODS**

**Sampling Procedure**

The study is a descriptive study in which 100 patients with diabetes mellitus between the age of 40–60 years were recruited from Annapoorana Medical College and hospitals by history, questionnaire, and by clinical examination. Informed written consent was obtained from all subjects participating in the study.

**Ethical Clearance**

Ethical clearance was got from Annapoorana Medical College Institutional Ethical Committee for the conduction of the study.

**Design of Study**

This was a descriptive and comparative study.

**Inclusion Criteria for Cases**

The following criteria were included in the study:
- Age group 40–60 years of both sexes
- Fasting blood sugar > 126 mg/dL
- Diabetic neuropathy symptom score of 1–4.

**Exclusion Criteria**

The following criteria were excluded from the study:
- Patients with symptoms associated with other neuropathies.
- History of chronic renal failure
- History of previous spinal injury
- History of discopathies
- Alcohol abuse
- Smoking history
- History of folic acid and vitamin deficiency.

**Diabetic Neuropathy Symptom Score**

The patients were questioned about the existence of symptoms, whether present or not, which suggests the presence of neuropathy. If a symptom had come about several times in a week over the past 2 weeks, the patient will answer with a “yes” (positive: one point). If it did not occur, the patient will answer with a “no” (negative: no point).

The following are the symptoms that were questioned by the subjects:
1. Feeling of unsteadiness while walking
2. Shooting pain in the legs or feet
3. Tingling sensations in legs and feet
4. Numbness over the legs and feet.

Maximum points: 4; 0 – no polyneuropathy (PNP); 1–4 – PNP present.[19]

### Investigations and Interventions

VPT and TCNS scores were recorded over all subjects.

#### Toronto Clinical Scoring System

The TCNS has a scoring system from 0 to 19 points. Six points were procured from the symptom scores, eight points from reflexes (lower limb), and five points from sensory examination at the toes.

#### Symptom Scores

Pain in the foot, lack of sensation, prickling sensation, weakness, ataxia, and symptoms involving the upper limb.

#### Reflexes

Knee and ankle reflex.

#### Sensory Test Scores

- Pinprick, temperature, light touch, vibration, and position
- Sensory testing was performed on the first toe
- Symptom scores: present = 1, absent = 0
- Reflex scores: absent = 2, reduced = 1, normal = 0
- Sensory test score: abnormal = 1, normal = 0
- Scores extending from 0–19 (maximum).

#### Scoring

- No neuropathy – 0–5 points
- Mild neuropathy – 6–8 points
- Moderate neuropathy – 9–11 points
- Severe neuropathy – 12 + points.

#### VPT

Sensitometer designed by Dhansai Laboratory, Mumbai was used to record VPT. The patient was made to lie in a supine posture. The diagnostic probe was applied over eight fixed points (greater toe, 1st, 3rd, and 5th metatarsal, middle arch, posterior tibial arch, heel, and dorsalis pedis) over both the foot after explaining the procedure. The subject was asked to inform when they start perceiving the vibration. The voltage was increased gradually from the minimum to the point where the subject perceives the vibrations. This value was considered as the score for the VPT. The average value was calculated from the values obtained from the eight fixed points. When the average value exceeds 25V, it was considered to be diabetic neuropathy.

This study involved screening procedures (VPT, TCNS) undertaken by all the type 2 DM patients. There was no financial liability on the subjects for any of the investigations and procedures performed.

### Statistical Analysis

Statistical analysis was performed using Med Calc version 15.8 (Med Cal Software bvba, Ostend, Belgium).

### RESULTS

Descriptive statistics of the participants are summarized in Tables 1 and 2. Diagnostic accuracy of TCNS considering VPT as the gold standard is mentioned in Tables 3 and 4. There were 100 type 2 diabetics, consisting of 57 males and 43 females. The study population’s mean age was found to be 50.89 years (±5.28). The mean diabetic duration was 12 years. The mean height was 164.63 ± 8.62 cm, weight was 63.56 ± 10.21 kg. The average value of BMI was found to be 23.49 ± 3.67 kg/m², mean FBS was 159.18 ± 8.39 mg/dL. We evaluated the diagnostic value of TCNS keeping VPT as the gold standard. Out of the total 100 diabetic patients, VPT (>25 V) was abnormal in 96 patients and normal in four patients and TCNS (>6) was abnormal in 92 patients and normal in eight patients [Table 3]. The sensitivity of the test (TCNS) was found to be 95.83%, specificity was 100% with a positive predictive value of 100 % and a negative predictive value of 50% [Table 4].

### DISCUSSION

We determined VPT and TCNS in 100 diabetic patients. It was established that TCNS is a definitive, sensitive, and specific estimate of diabetic peripheral neuropathy.

In the previous studies, which compared VPT and NCS in peripheral neuropathy patients, it was said that VPT was a definitive measure of peripheral neuropathy with a sensitivity of 74.07% for explicit clinical neuropathy. There exists a significant relationship between abnormal nerve conduction test and VPT with \( P < 0.005 \). There also existed a significant correlation between established neuropathy and VPT with \( P < 0.05 \). The VPT sensitivity for prediction of nerve conduction abnormality and established peripheral neuropathy was found to be 50%. [20] In another study, which was done to check VPT as a marker of diabetic neuropathy, it was said that for all patients irrespective of assessed by VPT testing, VPT helps in the identification of the risk group of diabetic peripheral neuropathy and helps in preventing further diabetic complications. It was found that Grade 1
In a study done on the accuracy and rationality of the modified TCNS in detecting DPN, there was a good authenticity for mTCNS with a correlation coefficient of 0.87, which was similar to TCNS (0.83). This showed that mTCNS has higher face validity and good reliability in clinical research compared to TCNS.[24]

The strengths of the study are – TCNS is a simple, cost-effective technique that does not require trained technicians. It can be done even in non-hospitalized setups. The limitations of the study are – it could have been done in a large sample size to generalize the findings. Since it is an hospital-based study, there is a possibility of selection bias.

CONCLUSION

In this study, it was found that TCNS is a valuable sensitive indicator of definite clinical neuropathy when compared to VPT. Since it is a simple and cheaper technique, perhaps it could be used as an assessment tool for preventing diabetic neuropathy.

REFERENCES

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