

ORIGINAL RESEARCH

A comparative analysis of the scoring system used for examining Diabetic Neuropathy and the measurement of Nerve Conduction Velocity in patients with Diabetic Neuropathy

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ABSTRACT

Aim: A comparative analysis of the scoring system used for examining Diabetic Neuropathy and the measurement of Nerve Conduction Velocity in patients with Diabetic Neuropathy. **Material and Methods:** The research included individuals with diabetes who were either receiving outpatient or inpatient care and had concerns related to diabetic neuropathy. The patients had a comprehensive evaluation, including a thorough medical history, a full physical examination, and electrophysiological testing. Fifty patients diagnosed with type 2 diabetes mellitus had a comprehensive assessment of their medical history and physical examination, followed by the determination of their DNE scores. The investigations conducted included CBC, ESR, MCV, FBS, PP, HbA1C, Urine, serum creatinine, and NCV Study. **Result:** The neurologic signs were observed and graded based on the DNE score. The scoring was divided into 0, 1, and 2. The score 0, represents the absence of the sign while 1 and 2 indicate the presence of neuropathy. The quadriceps signs showed that 35 participants did not present with the sign while 3 participant has a score of 2 and 12 participants had 1 score. The T-Anterior results showed that 25 participants scored 0, while 15 participants scored 1 and 10 participants scored 2. Based on the ankle reflex, 17 participants scored 0, while 10 of them scored 1 and 23 of them scored 2. The sign of pinprick big toe results showed that about 9 participants presented with 0, while 29 participants scored 1 and 12 participants scored 2. The pinprick index results showed that 12 participants scored 0, while 27 participants scored 1 and 11 participants scored 2. The grading of diabetes neuropathy was divided into three grades. According to the diabetic neuropathy examination, 26 respondents were in first grade, 19 were in second grade and 5 respondents were graded three. According to NCV grading, 25 participants have graded I, 21 participants were graded II and 4 participants were graded III. **Conclusion:** Diabetic Neuropathy is a prevalent complication that arises from having diabetes for a long time and is associated with the length of diabetes and inadequate management of blood sugar levels. Early diagnosis may be attained via conducting a comprehensive clinical examination, which is cost-effective and straightforward.

Keywords: Scoring system, Diabetic Neuropathy, Nerve Conduction Velocity,

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INTRODUCTION

Diabetes mellitus is a disorder of metabolism. Persistent metabolic dysfunction in both type 1 and type 2 diabetes mellitus leads to alterations in several organ systems and gives rise to problems such as neuropathy, nephropathy, and retinopathy, among others. Neuropathy may present itself in the forms of Polyneuropathy, Mononeuropathy, and/or Autonomic Neuropathy. The prevailing kind of neuropathy is

Diabetic Sensorimotor. Polyneuropathy refers to a condition characterised by damage or dysfunction of multiple peripheral nerves. DSPN refers to a condition characterised by a lack of sensation, tingling, and a prickling feeling that specifically affects the toe and foot. Paraesthesia progresses from the lower extremities to the upper extremities in a distribution like a stocking and gloves. Later on, there is a development of gait disruption and weakness in the

distal parts of the body. Experiencing pain or insensitivity in the extremities increases the likelihood of developing foot ulcers. Autonomic symptoms include impotence, nocturnal diarrhoea, trouble in voiding, excessive sweating, and orthostatic hypotension. The clinical examination demonstrates peripheral sensory impairment in the distal regions, affecting the perception of pain, warmth, touch, and vibration. The ankle reflexes consistently show a decrease or absence. The presence of motor weakness, if seen, is of a modest nature and specifically affects the muscles responsible for flexing and extending the toes[1,2].

The Diabetic Neuropathy Examination Score (DNE SCORE) is a modified version of Dyck's Neuropathy Disability Score. It involves conducting a comprehensive neurological examination and assigning DNE scores [3,4]. Nerve conduction velocity testing (NCV) is an electrophysiological technique that has become a crucial tool in evaluating individuals with diabetic neuropathy[5]. Electrodiagnostic tests are much preferable than clinical exams since the latter do not provide a thorough quantitative analysis. Furthermore, these procedures are characterised by their low invasiveness. The popularity of these investigations arises from the fact that the level of variability in these tests is much lower compared to other non-invasive nerve testing[6]. Patients who do not show any symptoms may nonetheless have an anomaly in nerve conduction, regardless of whether their clinical evaluation is normal or abnormal[3]. Progressive degeneration and loss of nerve fibres result in a substantial reduction in sensory and motor amplitudes seen in nerve conduction investigations. The impairment of sensory nerve conduction is greater in comparison to motor nerve conduction[7]. The American Diabetic Association discovered that diabetic neuropathy leads to a decrease in both nerve conduction and amplitude, indicating demyelination and axonal degeneration[8]. Electrophysiological investigations have shown a robust association between nerve conduction studies, disability ratings, and quantitative autonomic testing. The consensus is that the optimal diagnosis of DPN is achieved by a combination of clinical observations that align with the condition and the corresponding electrophysiological alterations.

MATERIAL AND METHODS

This research is a prospective observational study. The research included individuals with diabetes who were either receiving outpatient or inpatient care and had concerns related to diabetic neuropathy. The patients had a comprehensive evaluation, including a thorough medical history, a full physical examination, and electrophysiological testing. Fifty patients diagnosed with type 2 diabetes mellitus had a comprehensive assessment of their medical history and physical examination, followed by the

determination of their DNE scores. The investigations conducted included CBC, ESR, MCV, FBS, PP, HbA1C, Urine, serum creatinine, and NCV Study.

This research comprised diabetic individuals who had a clinical diagnosis of diabetic sensory-motor polyneuropathy.

The research excluded patients with sensorimotor neuropathy caused by factors other than those under investigation.

DNE scoring: it consists of testing of two muscle strengths, one a tendon reflex and five sensations. The maximum score is 16. A score of >3 points is considered abnormal. Those with a score of more than 3 are considered to be suffering from diabetic neuropathy.

Only the right leg and foot are tested. If the right leg is amputated, then the left leg is tested.

Scoring from 0 to 2 {0 = Normal, 1 = Mild/moderate deficit, Muscle strength: MRC scale 3-4

Reflex: Decreased but present, Sensation: Decreased but present, 2 = Severely disturbed/absent, Muscle strength: MRC scale 0-2, Reflex: Absent, Sensation: Absent}

Those with a score of more than 3 are considered to be suffering from diabetic neuropathy.

Scoring to DNE {4 to 8 = Mild Grade I, 9 to 12 = Moderate Grade II 13 to 16 = Severe Grade III}.

NCV TESTING: It is a diagnostic test performed to evaluate the ability of electrical conduction, of the motor and sensory nerves. The stimulation is like a low-intensity electric shock which is not painful. Sensory testing is done on the sural nerve behind the lateral malleolus. Action potentials were recorded at a standard distance of 14 cm. Motor testing produced assessments of MNCV and distal latency for tibial and peroneal nerves. All the neurophysiological tests were according to a standardized setup with distance specified. The impulses produced by this electrical current are viewed on a computer screen and data were recorded. Patients being hemodynamically stable with normal body temperature and room being maintained at 32°C.

Distal Latency Grading {Normal distal latency is considered to be upto 6ms.}

Grading is done according to increase from normal 5% greater than normal is considered as a result of an error. Distal Latency Score { Upto 25% of normal – 0, 26% - 50% - 1, >50 % - 2

Grading of SNCV and MNCV.

Normal SNCV (sural) and MNCV (tibial and peroneal) are considered upto 41m/sec.

Grading is done according to decrease in NCV from normal. {SNCV/MNCV Score, 85%-95% of normal – 0, 75% - 85% - 1, <75% - 2}

Upto 5% decrease to be considered as part of the error. Scoring of SNAP (Sural Sensory Nerve Action Potential) Normal SNAP is considered to be upto 6µV .

Grading of SNAP according to decrease from normal value. SNAP Score {>75% of normal – 0, 50% to 75%

- 1, < 50% - 2, Those with normal NCV/ SNAP/ distal latency are to be given a score = 0. {Scoring in EP{ Grade I 0 - 4 Mild, Grade II 5 - 8 Moderate, Grade III 9 - 12 Severe}

RESULT

The research observed a predominance of males, accounting for 70% of the cases. The age group with the highest number of cases was between 50 and 60 years, representing 44% of the total. The average age of the participants was 65.85±3.85 years. Half of the group had diabetes for a duration of 6-10 years, with the average age at which symptoms of neuropathy appeared being 8.21±1.85 years (as shown in Table 1 and 2). Tingling is experienced by the highest number of patients 33(66%) of the total patients, followed by numbness in 26patients (52%), hyperesthesia in 19 cases (38%), foot ulcer in 7 cases (14%), and weakness in 17 cases (34%) (Table 3).

The neurologic signs were observed and graded based on the DNE score. The scoring was divided into 0, 1, and 2. The score 0, represents the absence of the sign while 1 and 2 indicate the presence of neuropathy. The quadriceps signs showed that 35 participants did not present with the sign while 3participant has a score of 2 and 12 participants had 1 score.

The T-Anterior results showed that 25 participants scored 0, while 15 participants scored 1 and 10 participants scored 2. Based on the ankle reflex, 17 participants scored 0, while 10 of them scored 1 and 23 of them scored 2. The sign of pinprick big toe results showed that about 9 participants presented with 0, while 29 participants scored 1 and 12 participants scored 2. The pinprick index results showed that 12 participants scored 0, while 27 participants scored 1 and 11 participants scored 2(Table 4.)

For the signs of touch, vibration, and joint position, 8, 11, and 25 participants present with 0 respectively, and 28, 26 and 15 scored 1 and 14, 13and 10 participants scored 2 respectively.

A correlation coefficient of DNE Score V/s NCV Score is 0.59 that indicates that a strong linear relationship exists between DNE and NCV scores with P-value = <0.001.

The grading of diabetes neuropathy was divided into three grades. According to the diabetic neuropathy examination, 26 respondents were in first grade, 19 were in second grade and 5 respondents were graded three. According to NCV grading, 25 participants have graded I, 21 participants were graded II and 4 participants were graded III. The Chi-square value to DNE and NCV is p>0.05(Table 5) .

Table 1- Gender and age of patients

Patient data	Number of patients (N=50)	Percentage (%)	P value
Gender			0.12
Male	35	70.00	
Female	15	30.00	
Age group (in years)			0.25
Below 30	5	10.00	
30-40 years	11	22.00	
40-50 years	7	14.00	
50-60 years	22	44.00	
Above 60 years	5	10.00	

Table 2- History of diabetes

Number of years	Number of patients	Percentage (%)
Since 1 year	2	4.00
Since 1-5 years	11	22.00
Since 6-10 years	25	50.00
More than 10 years	12	24.00

Table 3- Symptoms of Diabetic neuropathy in study patients

Symptoms	Number	Percentage
Tingling	33	66.00
Hyperesthesia	19	38.00
Foot ulcer	7	14.00
Gait	1	2.00
Numbness	26	52.00
Weakness	17	34.00

Table 4- Neurologic Signs in Study patients with Diabetic Neuropathy (DNE Scoring)

Neurologic signs	Number of patients with DNE score 0	Number of patients with DNE score 1	Number of patients with DNE score 2
Quadriceps	35	12	3
Tibialis anterior	25	15	10
Ankle reflex	17	10	23
Pin prick Big toe	9	29	12
Pin prick Index	12	27	11
Touch	8	28	14
Vibration	11	26	13
Joint position	25	15	10

Table 5- Grading in relevance to DNE and NCV

Grading	Number of patients	Percentage
DNE Grade I	26	52.00
DNE Grade II	19	38.00
DNE Grade III	5	10.00
NVC Grade I	25	50.00
NVC Grade II	21	42.00
NVC Grade III	4	8.00

DISCUSSION

Diabetic neuropathy refers to the dysfunction of nerves resulting from uncontrolled or chronic diabetes mellitus. Unmanaged diabetes often causes damage to the nerves, resulting in impaired functionality. Primarily, it affects the nerves located in the hands and feet.

The examination of the obtained data revealed a correlation between those with elevated blood sugar levels and a longer duration of diabetes, and the occurrence of diabetic neuropathy. It is well recognised that the sensitivity of nerves to different bodily sensations rises during the first phase of diabetic neuropathy, especially in patients who rely on insulin[7-9]. Individuals between the ages of 50 and 60 have the most severe symptoms of diabetic neuropathy. Prior research has shown that maintaining blood sugar levels within the normal range may reduce the likelihood of diabetes people getting nerve damage. The present investigation was carried out on a sample of 50 individuals who were diagnosed with diabetic sensory-motor polyneuropathy and then evaluated using DNE grading. The age range of 50-60 years has the biggest number of participants, accounting for 44.00% of the total. Among the participants, there are 35 males and 15 females. The average age of the study population was 65.85±3.85 years. Tingling was the most common presenting symptom present in 66.00% of the total participants. This is followed by numbness which is experienced by 52.00% of the participants. About 38.00%, 14.00%, and 34.00% of the participants experienced hyperesthesia, foot ulcer, and weakness respectively. DNE scoring showed that ankle reflex was deranged in the maximum of 23 respondents followed by pinprick sensation over the toes. NCV findings showed that the sural nerve was most frequently involved followed by tibial and peroneal respectively.

A correlation coefficient of DNE Score V/s NCV Score is 0.59 that indicates that a strong linear relationship exists between DNE and NCV scores. The P-value is <0.001. Misra UK et al. state that the result of the study to compare nerve conduction studies and clinical scores to detect sensorimotor polyneuropathy revealed that there is a significant association between nerve conduction studies (NCS) and the clinical scores[8]. NCS and clinical scores both are beneficial in detecting DPN. The EP parameter can be correlated with the severity of nerve neuropathy. NCS has proved to be highly beneficial in the study over clinical scores. Feki and Lefaucheur also conducted a similar study to observe the correlation between the nerve conduction studies and clinical scores. It was found that a correlation existed between neuropathy disability score and index of polyneuropathy[9]. Pfeifer et al. state that the EP study has found that there is a strong correlation between nerve conduction studies, disability scores, and quantitative autonomic testing[10].

CONCLUSION

Diabetic Neuropathy is a prevalent complication that arises from having diabetes for a long time and is associated with the length of diabetes and inadequate management of blood sugar levels. Early diagnosis may be attained via conducting a comprehensive clinical examination, which is cost-effective and straightforward. Electrophysiological investigations aid in the initiation and maintenance of improved control, therefore slowing the course of neuropathy and enhancing quality of life.

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