Quest Journals
Journal of Medical and Dental Science Research
Volume 10~ Issue 4 (2023) pp: 62-67
ISSN(Online) : 2394-076X ISSN (Print):2394-0751
www.questjournals.org

Research Paper

Corelation of Neuropathy Disablity Score (NDS) With Nerve Conduction Study to Assess the Severity of Peripheral Neuropathy: A Cross-Sectional Study

Ashwathi A K[1], Mamatha B Patil*, Gottimukkala Divya[1]
Department of General Medicine, Rajarajeswari Medical College and Hospital
Corresponding author: Mamatha B Patil
[1]Junior resident, Department of General Medicine, Rajarajeswari Medical College and Hospital, Bengaluru
**Corresponding author: Professor, Department of General Medicine, Rajarajeswari Medical College and Hospital, Bengaluru*

ABSTRACT
BACKGROUND*: Peripheral neuropathy is a common neurological disorder with variable presentation and etiologies. The severity of peripheral neuropathy can be determined using revised NDS. It measures specific neurological deficits affecting the peripheral nervous system as seen in a polyneuropathy. It can be used for initial assessment and to monitor the patient over time to measure disease status. Nerve conduction studies, as a part of peripheral neurophysiological examination, are an extension of clinical history and examination. It is an excellent measure of the function of the peripheral nervous system and provide a reliable index of measurement in the diagnosis, treatment, and prognosis of the patient. They are less invasive and are sensitive to both myelin sheath and axonal changes.*
OBJECTIVES*: To study the clinical parameters in suspected cases of peripheral neuropathy using NDS and its correlation with nerve conduction study.*
METHODS*: 100 patients of both genders above the age of 18 years presenting with clinical features suggestive of peripheral neuropathy, known cases and newly diagnosed, were included as a part of the study to correlate clinical signs (using revised NDS) with nerve conduction study, to assess the severity of peripheral neuropathy.*
RESULTS*: Out of 100 subjects, 64 with NDS of 6 – 10 (moderate to severe) were having mixed sensory motor involvement on NCS, with both axonal and demyelinating lesions. Most of the patients with NDS 0 - 5 (mild) had sensory involvement with demyelinating injury on NCS.*
CONCLUSION*: Detailed clinical examination by using revised NDS strongly correlates with NCS parameters. As the NDS increases (6 – 10), patients had mixed sensory motor involvement on NCS with axonal and demyelinating changes. Mild NDS shows only sensory and demyelinating changes on NCS. Hence, clinical examination by using revised NDS will guide the clinician to assess the bedside severity of peripheral neuropathy and the extent of involvement of peripheral nerves. For further confirmation, submitting the patient for NCS is a safe and non-invasive method to identify specific pathological lesions of peripheral nerves.*
KEYWORDS*: clinical neurology, peripheral neuropathy, nerve conduction study, revised NDS, axonal, demyelinating*

R*eceived 10 Apr., 2023;* ***R****evised 22 Apr., 2023;* ***A****ccepted 24 Apr., 2023 © The author(s) 2023.*
P*ublished with open access at* ***www.questjournals.org***

I. INTRODUCTION

The peripheral nervous system is the main intermediary between the brain and peripheral tissues. The peripheral nervous system is more exposed to environmental toxins than the central nervous system and can easily undergo trauma. Peripheral neuropathy refers to any disorder of the peripheral nervous system. Dysfunction in the peripheral nervous system can result from ageing, injury, or disease, including infection and diabetes. Peripheral neuropathy affects 2% - 3% of the population and increases to 8% in the elderly population.

Neuropathy Disability Score (NDS) is a scale used to assess the severity of neuropathy in individuals with various neurological conditions.The NDS is a standardized scale that evaluates physical signs and symptoms of neuropathy, such as vibration sense, temperature sense, pin-prick and ankle jerk. It is a quantitative measure

of neurologic deficits, ranging from 0 to 10 (maximum disability). It can be used to detect changes in neuropathy due to treatment and can be helpful in predicting clinical outcomes.

In addition to clinical examination, nerve conduction study (NCS) is extremely helpful in determining the severity of nerve injury. Using the NCS, peripheral neuropathy is divided into those that primarily affect the myelin sheath and those that primarily affect the axon.[1] Indications for nerve conduction studies include evaluating the nature of the pathophysiology, quantifying the severity of involvement, detecting the level of a neurologic deficit, and determining prognosis. Nerve conduction studies are less invasive than many other measurements of health span and can be easily incorporated into longitudinal studies. NCS being sensitive to axonal and myelin sheath changes makes it an excellent measure of the peripheral nervous system function. Nerve conduction studies provide the most sensitive and accurate account of peripheral neuropathophysiology. Therefore, NCS is a good measurement of overall peripheral nerve health.

II. METHODOLOGY

Our study was a hospital-based cross-sectional observational study. After approval from the institutional ethics committee, written informed consent was obtained from 100 patients of both genders, above the age of 18 years, presenting to OPD/admitted under medicine department in Rajarajeswari medical college and Hospital, with symptoms suggestive of peripheral neuropathy. Critically ill patients and pregnant women were excluded from the study. Each patient was subjected to detailed medical history of symptoms like paraesthesia, tingling sensation, burning feet, hyperaesthesia, loss of sensation, numbness, foot ulcer, weakness, and gait abnormalities. General physical examination and vitals were recorded. All system examination were performed. Motor examination was performed to look for signs such as diminished power and ankle jerk. Sensory examination using monofilament 10g for loss of light touch, superficial pain, and vibration and joint position sensation were examined. Romberg's sign was also elicited. The signs were graded using the revised Neuropathy Disability Score (NDS). The NDS is one of the most widely used and accepted scoring systems for neuropathy. It includes the examination of vibration (using a 128-Hz tuning fork), pain (pin-prick) and temperature (cold tuning fork) sensation and ankle reflex (tendon hammer) (Table 1). The score of pin-prick, vibration, and temperature sensation each is '0' if present and normal, and '1' if absent, reduced, or uncertain, whereas the ankle reflex scores on either side were '0' if present and normal, '1' if present with reinforcement, and '2' if absent, with a maximum total score of '10'. Accordingly, the grades of severity of neuropathy are classified as mild (scores: 3–5), moderate (scores: 6–8), and severe (scores: 9–10). Nerve conduction study measurements were performed in a warm room with the participants in a supine position. Nerve conduction velocity data were recorded using a Nihon Kohden Neuropack MEB-9400. Other investigations included complete blood count (CBC), renal function test (RFT), liver function test (LFT), and thyroid function test (TFT). Special investigations, including vitamin D/ vitamin B_{12}/ ANA profile/ RA factor, were done as and when required. Data was analysed using descriptive and inferential statistics using software MS Excel and SPSS V23.

TABLE 1. REVISED NDS CRITERIA

NDS items	Description
Vibration sensation (128 Hz tuning fork)	0 = present, 1 = reduced/absent
Temperature sensation (cold tuning fork)	0 = present, 1 = reduced/absent
Pin-prick	0 = present, 1 = reduced/absent
Ankle reflex	0 = normal, 1 = present with reinforcement, 2 = absent per side

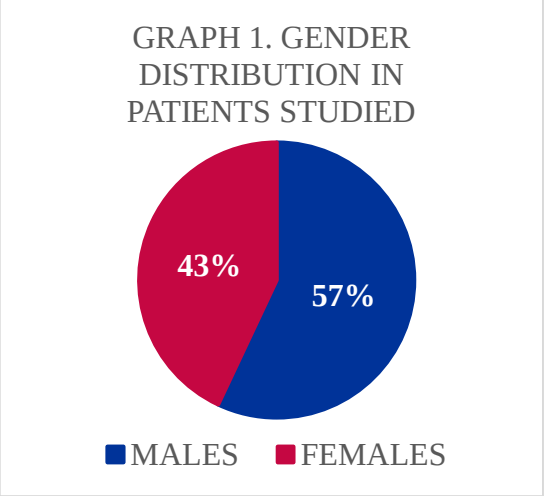
III. RESULTS

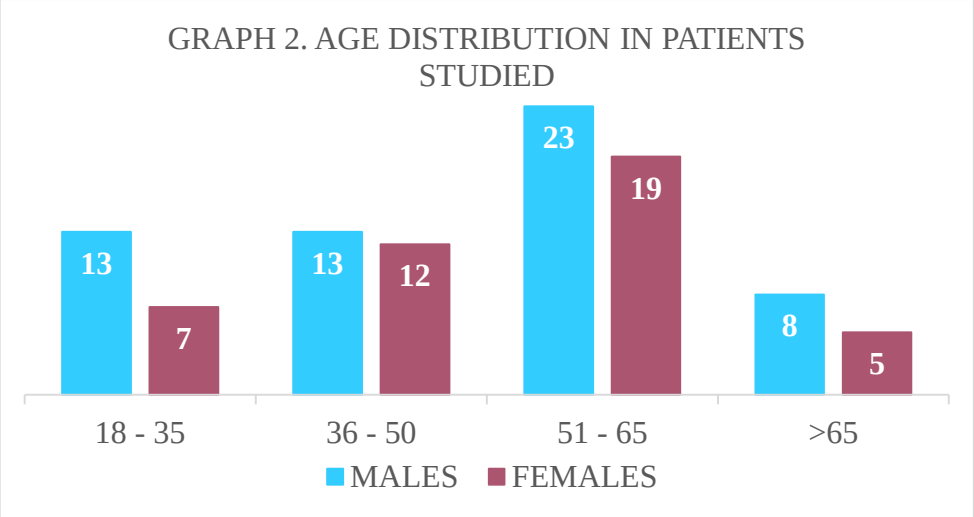
100 subjects of both genders, with their informed consent, who met the inclusion and exclusion criteria were studied. Following were the observations and results. 57 were male, and 43 were females. Mean age was 51.6±13.71. 67 subjects were in the age group of 35 - 65 years. (Graph 1, 2)

Most common clinical presentation of peripheral neuropathy in our study was burning/ tingling/ pricking sensation in the limbs (59%). 21% patients presented with loss of sensation/ numbness of limbs and 20% had both. Out of 59 cases presenting with burning/ tingling sensation, 43 had mixed sensory motor involvement on NCS with 34 having pure demyelinating injury. (Graph 3, Table 3))

64 out of 100 patients had NDS of 6 – 10 (moderate to severe) and 36 patients had NDS of 0 – 5 (mild). Majority of patients with NDS of 6 – 10 presented with burning/ tingling sensation (Table 2). Out of 100 patients studied, 91 NCS were abnormal. Abnormal NCS included sensory, motor, axonal and demyelinating lesions in various combinations. Out of 64 cases with NDS 6 -10, 59 had mixed sensory motor lesions on the NCS with 26

patients having mixed axonal and demyelinating nerve injury, and 23 having pure demyelinating injury. Out of 36 cases having NDS 0 – 5, most patients had mixed sensory motor involvement with pure demyelinating injury (Table 4). Significant P value (<0.05) shows correlation between NDS and NCS, with specificity in mixed sensory motor and mixed axonal demyelinating lesions. (Graph 4)





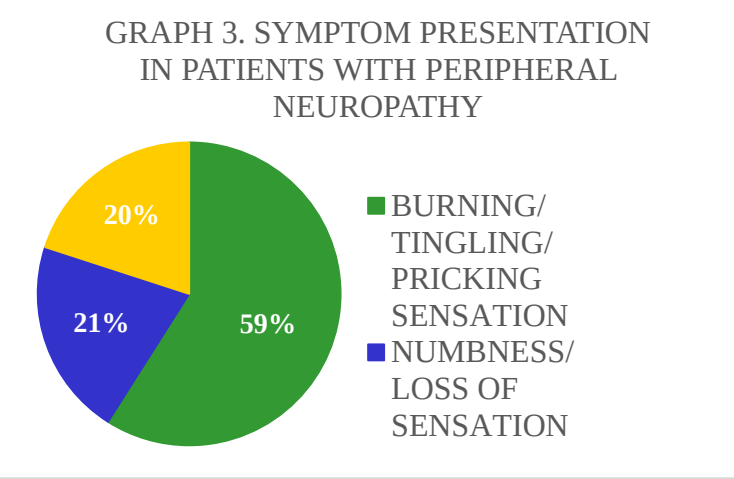


TABLE 2. SYMPTOM PRESENTATION WITH RELATION TO NDS

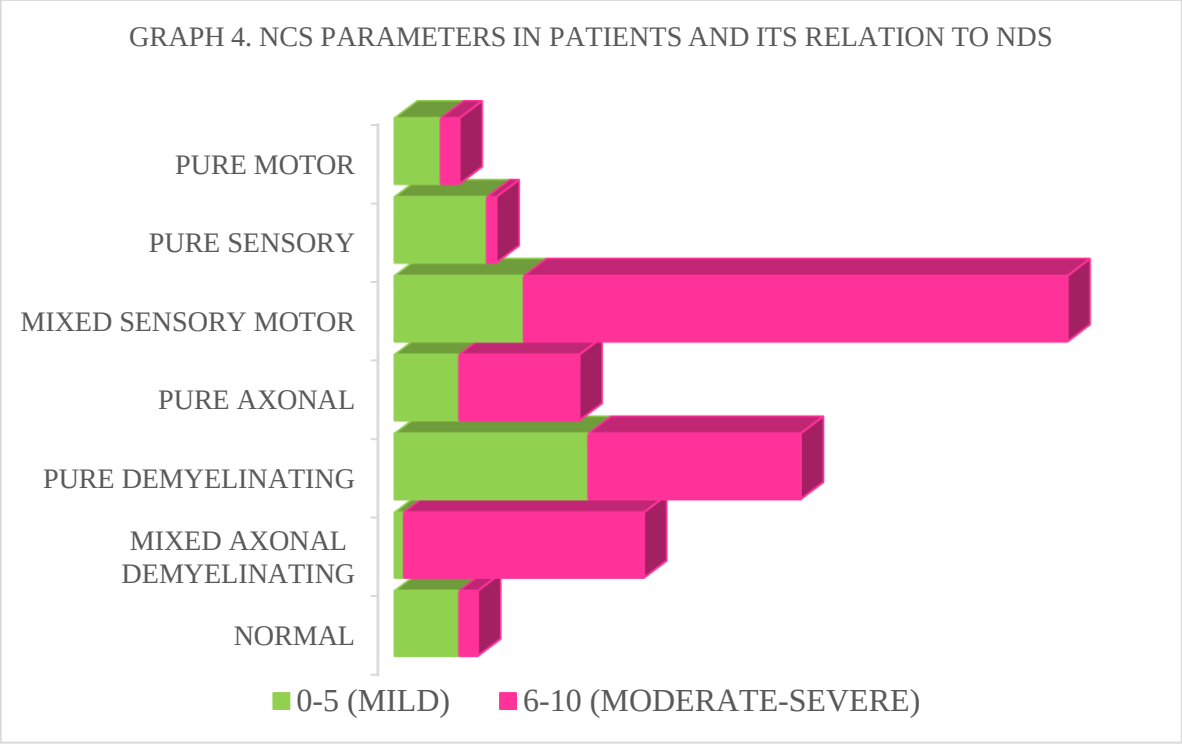
NDS	BURNING	NUMBNESS	BOTH
0 – 5 (MILD) (36)	26	9	1
6 – 10 (MODERATE-SEVERE) (64)	33	12	19

TABLE 3. NCS PARAMETERS WITH RELATION TO SYMPTOM PRESENTATION

NCS PARAMETERS	BURNING	NUMBNESS	BOTH
PURE MOTOR	0	4	3
PURE SENSORY	10	1	0
MIXED SENSORY MOTOR	43	13	17
PURE AXONAL	10	6	4
PURE DEMYELINATING	34	9	1
MIXED AXONAL DEMYELINATING	9	3	15
NORMAL	6	3	0

TABLE 4. NCS PARAMETERS IN PATIENTS STUDIED WITH RELATION TO NDS

NCS PARAMETERS	NDS	0 – 5	6 – 10	P VALUE
PURE MOTOR		5	2	0.0089
PURE SENSORY		10	1	0.0089
MIXED SENSORY MOTOR		14	59	<0.0001
PURE AXONAL		7	13	0.0421
PURE DEMYELINATING		21	23	0.0421
MIXED AXONAL DEMYELINATING		1	26	<0.0001
NORMAL		7	2	<0.0001



IV. DISCUSSION

Peripheral neuropathy occurs as a result of several common and rare diseases. It can be heterogenous in etiology, diverse in pathology, and varied in severity. In our study, out of 100 patients with peripheral neuropathy, 57 were males and 43 were females (Graph 1). 42 cases presenting with peripheral neuropathy were in the age group of 51 to 65 years, which included 23 males and 19 females. Mean age was 51.6±13.71. There were 67 subjects in the age group of 35 to 65 years. (Graph 2)

A study carried out in two regions of Italy[2] estimated the frequency of chronic symmetric symptomatic polyneuropathy in people over the age of 55 years. Around 8% of people met these diagnostic criteria for polyneuropathy and the most common condition associated with polyneuropathy was diabetes.

Another study by A Chawla et al.[3] validated that neurological examination like NDS is simple, acceptable and reproducible and can be an important bed side tool in the clinics for early diagnosis of DPN with a sensitivity of 71.1% & specificity of 90%.

In a study by Kamel et al.,[4] diabetic sensorimotor polyneuropathy was diagnosed clinically and electrophysiologically in 17 patients (56.7%). However, there were nine cases (30%) of subclinical neuropathy. Neurological examination scores were significantly correlated with each other and with individual variables of NCS and the nerve conduction sum score. Taking the NCS as gold standard, DNS, modified NSS, DNE, and modified NDS had 65.4, 61.5, 30.8, and 61.5% sensitivity and 100, 75, 100, and 100% specificity, respectively. Their diagnostic efficacies were 70%, 63.3%, 40%, and 66.7%, respectively.

A study by Asad et al.,[5] taking the NCS as gold standard, various clinical scores were studied and NDS had 92.31% sensitivity and 47.62% specificity. Diagnostic efficacy of NDS was 77%. They concluded that combining different scores gives better sensitivity and specificity, although NDS is the most reliable neurological test for detecting and grading DPN.

The NDS compiled by Dyck et al.[6] is a composite scoring system that assesses signs of neuropathy. A simplified NDS has been utilized widely to identify the signs and severity of DPN[7] using a 0–10 scoring system[8] with a score of ≥6 to define established neuropathy[9] and can also be used to stratify patients into mild (3–4), moderate (5–6) or severe neuropathy (7–10) or those at high risk of foot ulceration as it is weighted for large fibre testing[10].

Wang et al.,[11] conducted a meta-analysis including a total of 19 comparative trials that met the inclusion criteria. Eight trials using nerve conduction studies as the reference standard were selected for the meta-analysis. The pooled sensitivity and specificity of monofilament tests for detecting diabetic peripheral neuropathy were 0.53 (95% confidence interval (CI) 0.32 to 0.74) and 0.88 (95% CI 0.78 to 0.94), respectively. Their review indicated that monofilament tests had limited sensitivity for screening diabetic peripheral neuropathy.

A study similar to ours, by Shariff et al.,[12] evaluated the peripheral neuropathy in type 2 diabetes mellitus by clinical examination and NCS, to correlate them with risk factors. They concluded that DPN is a highly dependent neuropathy, with lower extremity nerves more involved. Diabetic neuropathy is proportional to duration of diabetes. Severity of diabetic neuropathy was positively relating with higher blood glucose level. Paresthesia's and burning feet were most common found symptoms. Abnormal tendon reflexes and deep sensory loss were most common found signs and distal symmetrical type of polyneuropathy was the most common.

V. CONCLUSION

Peripheral neuropathy is a common neurological disorder with variable presentation and numerous causes. NDS is a useful tool to measure the severity of the neuropathy and to track the response to treatment. NDS can provide valuable information to healthcare providers and allow them to adjust treatment strategies accordingly at bedside. Although NCS is a reliable index in determining the nature, diagnosis, treatment and prognosis of peripheral neuropathy, there are constraints regarding its access and affordability. In such circumstances, clinical examination using revised NDS can guide the clinician to assess the severity of peripheral neuropathy and better management of the patients. Significant P value (<0.05) shows correlation between NDS and NCS, with specificity in mixed sensory motor and mixed axonal demyelinating lesions.

BIBLIOGRAPHY

[1]. Waxman SG. Determinants of conduction velocity in myelinated nerve fibers. Muscle Nerve. 1980; 3:141–150. 10.1002/mus.880030207.

[2]. Beghi E, Monticelli ML, Amoruso L, et al. Chronic symmetrical polyneuropathy in the elderly-a field screening investigation in 2 Italian regions 1. Prevalence and general characteristics of the sample. Neurology 1995; 45:1832-6.

[3]. Chawla, A., Bhasin, G.K., & Chawla, R. (2013). Validation of neuropathy symptoms score (NSS) and neuropathy disability score (NDS) in the clinical diagnosis of peripheral neuropathy in middle aged people with diabetes. *The Internet Journal of Family Practice, 12*.

[4]. Kamel, S.R., Hamdy, M., Abo Omar, H.A.S. et al. Clinical diagnosis of distal diabetic polyneuropathy using neurological examination scores: correlation with nerve conduction studies. Egypt Rheumatol Rehabil 42, 128–136 (2015). https://doi.org/10.4103/1110-161X.163945

[5]. Asad A, Hameed MA, Khan UA, Ahmed N, Butt MU. Reliability of the neurological scores for assessment of sensorimotor neuropathy in type 2 diabetics. J Pak Med Assoc. 2010 Mar;60(3):166-70. PMID: 20225769.

[6]. Dyck, P.J.; Sherman, W.R.; Hallcher, L.M.; Service, F.J.; O'Brien, P.C.; Grina, L.A.; Palumbo, P.J.; Swanson, C.J. Human diabetic endoneurial sorbitol, fructose, and myo-inositol related to sural nerve morphometry. Ann. Neurol. 1980, 8, 590–596.

[7]. Meijer, J.W.; Bosma, E.; Lefrandt, J.D.; Links, T.P.; Smit, A.J.; Stewart, R.E.; Van Der Hoeven, J.H.; Hoogenberg, K. Clinical diagnosis of diabetic polyneuropathy with the diabetic neuropathy symptom and diabetic neuropathy examination scores. Diabetes Care 2003, 26, 697–701.

[8]. Dyck, P.J.; Litchy, W.J.; Lehman, K.A.; Hokanson, J.L.; Low, P.A.; O'Brien, P.C. Variables influencing neuropathic endpoints: The Rochester Diabetic Neuropathy Study of Healthy Subjects. Neurology 1995, 45, 1115–1121.

[9]. Weintrob N, Amitay I, Lilos P, Shalitin S, Lazar L, Josefsberg Z. Bedside neuropathy disability score compared to quantitative sensory testing for measurement of diabetic neuropathy in children, adolescents, and young adults with type 1 diabetes. Journal of Diabetes and Its Complications 2007;21(1):13- 9. [PubMed] [Google Scholar]

[10]. Burgess J, Frank B, Marshall A, Khalil RS, Ponirakis G, Petropoulos IN, et al. Early Detection of Diabetic Peripheral Neuropathy: A Focus on Small Nerve Fibres. Diagnostics [Internet] 2021;11(2):165. Available from: http://dx.doi.org/10.3390/diagnostics11020165

[11]. Wang F, Zhang J, Yu J, Liu S, Zhang R, Ma X, Yang Y, Wang P. Diagnostic Accuracy of Monofilament Tests for Detecting Diabetic Peripheral Neuropathy: A Systematic Review and Meta-Analysis. J Diabetes Res. 2017; 2017:8787261. doi: 10.1155/2017/8787261. Epub 2017 Oct 8. PMID: 29119118; PMCID: PMC5651135.

[12]. Shariff et al. Clinical and Electrophysiological Correlation of Peripheral Neuropathy in Patients of Type 2 Diabetes Mellitus. Saudi J Med 2020: 198-204. DOI: 10.36348/sjm.2020.v05i04.008.