

Reliability of the neurological scores for assessment of sensorimotor neuropathy in type 2 diabetics

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Abstract

Objective: To check the reliability of the commonly used neurological scoring systems taking the nerve conduction studies as the reference.

Methods: Diagnosed diabetics (n=60) were selected by purposive sampling. Detection and grading of neuropathy were done according to Diabetic Neuropathy Symptom Score (DNS), modified Neuropathy Symptom Score (NSS), Diabetic Neuropathy Examination (DNE) and modified Neuropathy Disability Score (NDS). For the nerve conduction studies, amplitudes, velocities and latencies of minimum two (Sural, Peroneal) and maximum six i.e. three sensory (Sural, Ulnar, Median) and three motor (Peroneal, Ulnar, Tibial) nerves were checked. If the patient had 2 or more than two abnormal findings in any of the nerve he was labeled to have peripheral sensorimotor neuropathy. Later the sensitivity, specificity and diagnostic efficacy of each neurological score was checked taking nerve conduction studies as the gold standard.

Results: Taking the NCS as gold standard DNS, DNE, NSS and NDS had 64.1%, 17.95%, 82.05%, 92.31% sensitivity and 80.95%, 100%, 66.67%, 47.62% specificity, respectively. Diagnostic efficacy of DNS was 70%, DNE was 47%, NSS was 77% and NDS was 77%.

Conclusions: Combining different scores gives better sensitivity and specificity. NDS is the most reliable neurological test for detecting and grading DPN (JPMA 60:166; 2010).

Introduction

Normal glucose levels are important not only for energy but for many other functions including adequate nerve conduction.¹ The disease process of diabetes causes alterations in the normal nerve functions which can be reflected either when performing neurological examination or during electrophysiological testing of the patient. The neurological scores and the electrophysiological studies both are used for the diagnosis of the sensorimotor neuropathy. The relations between physiology and pathophysiology emphasize the close interdependence between electrophysiological studies and clinical findings.²

The neuropathies are among the most common of the long-term complications of diabetes, affecting up to 50% of patients in the world.³ The prevalence of neuropathy in type 2 diabetics is about 40% in some areas of Pakistan and it is likely to increase more than twice between years 2000-2030.^{4,5} Pakistan is among the countries where ratio of previously undiagnosed to known diabetes is 2:1.⁶

The electrodiagnostic evaluation of diabetic polyneuropathy has been done in our set up but still there is a need to formulate a standard protocol for diagnosing the disease at early stage. In recent years different protocols have been developed to establish minimum criteria for the detection

of diabetic neuropathy and criteria for its staging.⁷ The nerve conduction studies can be used to evaluate the different neurological scores being used for diagnosing diabetic polyneuropathy. The screening of patients can be done to assess the sensitivity and specificity of the selected neurological scores.^{8,9} Recent criteria regarding nerve conduction studies for clinical research of distal symmetric polyneuropathy can be followed.¹⁰

We chose to select the four neurological scoring systems which are common, easy to perform and we checked them against NCS which also has similar advantages. The aim was to devise scores which are practical to diagnose and grade neuropathy.

Earlier detection will help the physician in learning the pattern of pathophysiology of disease progression at different stages and will facilitate the patient in improving towards a better life style.

Methods

This comparative cross-sectional study was performed at Islamic International Medical College (IIMC) in collaboration with Combined Military Hospital (CMH) and Armed Forces Institute of Rehabilitative Medicine (AFIRM), both in Rawalpindi. The study was started in January 2006 and was completed in one year. All the diabetic patients were collected from the outpatient department of CMH, Rawalpindi. On arrival of the patient the details of study was explained and written informed consent was obtained.

Total 70 diagnosed type 2 diabetic patients, who fulfilled the selection criteria given below, were included in the study. Non-probability purposive sampling was used to select the patients. To include the patients they had to be diagnosed type 2 diabetics, between 25- 61 years (male or female) with duration of known diabetes greater than one year and had intact sites to be tested. All those patients were excluded from the study that had any other type of neuropathy diagnosed or suspected, acute or chronic musculoskeletal disorder, poor compliance or pregnancy. The patients on drugs that may improve, mask or aggravate the normal course of neuropathy were also excluded or were recalled with instructions to stop the drug for two weeks if possible. Ten patients dropped out later leaving 60 patients with complete data.

Neurological Examination Scores: We selected four scores on the basis of ease of performance and common use. The scores were Diabetic Neuropathy Symptom (DNS), Diabetic Neuropathy Examination (DNE), modified Neuropathy Symptom Score (NSS) and modified Neuropathy Disability Score (NDS).^{10,11} All the patients were graded on the basis of the each of the above scores. DNS had maximum 4 points and DNE had maximum 16 points. In the other two scores NSS had maximum 9 points and NDS had maximum 10 points. The patients were labeled to have neuropathy if

DNS, NSS and NDS were ≥ 1 and if DNE was >3 .

Nerve Conduction Studies: The nerve conduction studies were used to identify normal or deranged. The patients were labeled to have polyneuropathy if value of two or more than two parameters were abnormal in one nerve or one parameter was abnormal in any two nerves.

The studies were done at room temperature of 23 ± 2 °C. For all studies, the machine used was Keypoint Work Station (Medtronic, France). The simplified nerve conduction studies (NCS) protocol was followed to record the nerve conduction studies of the patients.¹²

All data was recorded on a pre-designed questionnaire proforma. For each neurological score patients were divided into four groups a, b, c and d. If neuropathy was present by both clinical examination and NCS the patient was placed in group a (true positive), in group b (false positive) it was present on clinical examination but was absent on NCS, in group c (false negative) it was present on NCS but was absent on clinical examination and in group d (true negative) it was absent on both testing methods. Sensitivity and specificity of each score was calculated taking nerve conduction studies as the gold standard. The data were entered in a 2x2 table (Table-1). Cells

Table-1: 2 X 2 Tables for Comparison of Neurological Scores with Nerve Conduction Studies as gold standard.

	Neuropathy on NCS		
	Present	Absent	
Neuropathy on DNS			
Present	25 (a)	4 (b)	29 a + b
Absent	14 (c)	17 (d)	31 c + d
	39 a + c	21 b + d	60 a + b + c + d
Neuropathy on NSS			
Present	32 (a)	7 (b)	39 a + b
Absent	7 (c)	14 (d)	21 c + d
	39 a + c	21 b + d	60 a + b + c + d
Neuropathy on NDS			
Present	36 (a)	11 (b)	47 a + b
Absent	3 (c)	10 (d)	13 c + d
	39 a + c	21 b + d	60 a + b + c + d
Neuropathy on DNE			
Present	7 (a)	0 (b)	7 a + b
Absent	32 (c)	21 (d)	53 c + d
	39 a + c	21 b + d	60 a + b + c + d

DNS: Diabetic Neuropathy Symptom Score. DNE: Diabetic Neuropathy Examination Score. NSS: Neuropathy Symptom Score. NDS: Neuropathy Disability Score.

Table-2: Test Performance Characteristics of the Neurological Scores as compared with Nerve Conduction Studies as gold standard.

Characteristic	Calculation	DNS	DNE	NSS	NDS
Sensitivity (%)	$a / (a + c) \times 100$	64.1	17.95	82.05	92.31
Specificity (%)	$d / (b + d) \times 100$	80.95	100	66.67	47.62
False Positive (%)	$b / (b + d) \times 100$	19.05	0	33.33	52.38
False Negative (%)	$c / (a + c) \times 100$	35.9	82.05	17.95	7.69
Positive Predictive Value (%)	$a / (a + b) \times 100$	86.21	100	82.05	76.6
Negative Predictive Value (%)	$d / (c + d) \times 100$	54.84	39.62	66.67	76.92
Diagnostic Efficacy (%)	$(a + d) / (a + b + c + d) \times 100$	70	46.67	76.67	76.67

DNS: Diabetic Neuropathy Symptom Score. DNE: Diabetic Neuropathy Examination Score. NSS: Neuropathy Symptom Score. NDS: Neuropathy Disability Score.

of the table were used to calculate test performance characteristics by the formula shown in Table-2 (column-2). Diagnostic Efficacy (Last row of Table 2) of each test was derived from the same data.

Results

The reliability of the neurological scores (DNS, DNE, NSS and NDS) was assessed by measuring their sensitivity and specificity taking the nerve conduction studies as gold standard. Other diagnostic parameters of the tests were assessed including diagnostic efficacy of each test. These results are shown in Table-1 and Table-2.

NDS was found to be the most sensitive test and DME had the highest specificity. NDS and NSS had a better diagnostic efficacy.

Discussion

Diagnosis of diabetic neuropathy is done through many methods including neurological examination and electrophysiology to detect and evaluate the disease at its earliest stage. However, the role of traditional methods and parameters for diagnosis, as a prognostic factor of diabetic neuropathy is a matter of on-going debate.^{11,12} Early detection or diagnosis of neuropathy enables the clinician to give appropriate drugs to control it or at least decreasing its progress. It is also important to educate the patient to take care of his illness vigilantly. Neuropathy is a debilitating and crippling problem if not controlled at an early stage.

American Academy of Neurology has issued a report in which it has compared major studies evaluating the methods of diagnosing DPN. We have considered its report to compare our results of sensitivity and specificity with the others.¹²

We assessed the sensitivity and specificity of four major scores i.e. DNS, DNE, NSS and NDS taking NCS as gold standard (Table 1 and 2). Taking the two closest studies regarding the protocol taken from the above mentioned report, the results of our study were compared with them. Recently Jurado et al. and an Indian study by Bansla et al. also suggested the use of NCS to assess the validity of other diagnostic tests for diagnosing DPN.^{13,14}

NDS:

NDS was found to be reliable regarding sensitivity. We have found that NDS is 92% sensitive and 48% specific. According to Dyck et al. NDS is 65% sensitive and 91% specific which is quite different from our results.¹⁵ This difference may be due to different geographic area and different races being examined in both the studies. However in another study by Gentile et al. the clinical examination was found to be 94% and 92% sensitive and specific respectively taking NCS as reference.¹⁶ This result is not however regarding NDS only so it cannot be compared directly with our results. We have found the positive and negative predictive value of NDS as 77% each with about the same diagnostic efficacy.

NSS:

NSS has 82% sensitivity and 67% specificity with positive predictive value of 82% and negative predictive value of 67%. Recently Jia et al. studied the validity of NSS with some other scores including NDS and rated it as moderate to detect DPN when compared with NCS. They rated vibration perception better than NSS which is different from results in our area. In that study, some other scores were included which have not been assessed in our study and this aspect can be further explored in our area.¹⁷ Gentile et al. found the symptoms as 87% sensitive and 60% specific again taking NCS as reference.²¹ These symptoms again were not confined only to NSS questionnaire yet the results resemble ours which is interesting.

DNS:

DNS has 64% sensitivity and 81% specificity with positive predictive value of 86% and negative predictive value of 55%. Meijer et al. also assessed the validity of this score against NSS. They did not use NCS. Their results regarding sensitivity and specificity were different from ours. They found high correlation between the two testing methods.¹⁸

DNE:

DNE has 18% sensitivity and 100% specificity with positive predictive value of 100% and negative predictive value of 40%. Meijer et al. introduced this score and assessed its sensitivity against NDS. We have, however, assessed it

against NCS which showed quite different results.¹⁹

Meijer also assessed the value of the last two scores as significant but he did not compare them with other tests like NCS. He assessed the scores in control and patients having foot ulcers. These scores have a definite significance in this case but neuropathy in those patients was obviously quite advanced. Such patients are easy to detect on almost all examination protocols. It is noticeable that the validity of the last two tests has been assessed by their originator only. We can say that clinical diagnosis of diabetic polyneuropathy with DNS and DNE is not very promising in case of early neuropathy.

According to Krarup sensitivity and specificity of a physiological profile is increasingly important because in cases of diabetic polyneuropathy as early intervention, can many a time, improve or at least prevent further aggravation of neuropathy.⁴ Assessing sensitivity and specificity also helps the remotely located clinician to have a better idea of his clinical examination value who does not have access to sophisticated measures especially in a country like Pakistan.

According to the consensus report by American Academy of Neurology, NCS is the most informative part of electrodiagnostic evaluation.¹² In addition they recommend that the combination of clinical symptoms and signs with the electrodiagnostic findings provide the most accurate diagnosis of distal symmetric polyneuropathy.

According to American Daibetic Association, most common among the neuropathies are chronic sensorimotor DPN and autonomic neuropathy. Electrophysiological testing is rarely ever needed for establishing diagnosis of clinical cases, except in situations where the clinical features are atypical. Our results are also similar in clinical cases but this report again is not considering the value of NCS in the subclinical cases. According to them usually NCS is not required routinely once the diagnosis of DPN is established. Although DPN is a diagnosis of exclusion and complex investigations to exclude other conditions are rarely needed. According to ADA, combinations of more than one test have about 87% sensitivity in detecting DPN. A minimum of one clinical test should be carried out annually, and the use of two tests will increase diagnostic ability.²⁰

Such a range of variations from one study to another is probably due to different study designs, population variation; inter group variation or different sampling techniques and sizes.

The management suggestions by the American Diabetes Association propose different strategies for control of hyperglycaemia.²¹ The diagnosis can also be improved by doing nerve conduction studies more directed to specific nerves for early diagnosis.²² Early detection or diagnosis of neuropathy enables the clinician to give appropriate drugs to control it or at least decreasing its progress. It is also important

to educate the patient to take care of his illness vigilantly. Neuropathy is a debilitating and crippling problem if not controlled at an early stage.

Forouzandeh et al also evaluated the diagnostic value of different screening methods for diabetic neuropathy. According to him, obvious differences were observed between the results of different methods in the study. However, there was not much correlation between sign and symptom score methods. He advised further studies to compare different methods with a gold standard test and reveal the specificity and sensitivity of these tests for determining the most reliable screening test.²³ A very important aspect of exploring DPN is that symptoms assessment methods do not seem very promising and should be revised. It was our observation during the study that if symptoms of patients were carefully picked they may help in earlier detection of neuropathy. H reflex and F wave were performed in many patients but were not included in data as it could not be done in all due to non compliance of the patients. The subjectivity of symptoms could not be translated into objectivity.

Need for new score: Old scoring in different cases are not only difficult to perform but also sometimes impractical for use in day to day out patient department.²⁴ A new protocol may be suggested which combines different examination scores for better detection of diabetic polyneuropathy on neurological examination with special emphasis on symptoms. Following protocol is suggested for centers where only clinical examination is possible and NCS is not available. It can be combined with NCS also if both the facilities are available. The examination protocol is shown in Table-3. Its applicability should be assessed against NCS and correlation should be checked as well in further studies.

Table-3: New scoring method for detecting and staging diabetic sensorimotor polyneuropathy.

Test	Right	Left
ASK		
Pain (sharp, lancinating, Shooting, Dull, allodynia etc.)		
Burning		
Tingling		
Parasthesia		
Numbness		
CHECK (dorsal surface of great toe where applicable)		
Touch sensation		
Pinprick		
Thermal sensation		
Vibration sensation		
Joint sensation		
Ankle jerk		
Triceps jerk		
Motor power at feet and hands		

For each normal finding score is zero, for each past abnormal finding it is 0.5, for each present abnormal finding it is 1 and for each absent response it is 2 with the total maximum score 52. Maximum sensory score is 40 and maximum motor score is 12. (Score>1= detectable neuropathy).

Conclusion

In all the scores NDS is most sensitive and DNE is most specific. NDS and NSS have better diagnostic efficacy.

Combination of different examination scores gives better sensitivity and specificity regarding diabetic polyneuropathy to detect and grade diabetic polyneuropathy.

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