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Original Article

Role of Electrodiagnostic Nerve Conduction Studies in the Early Diagnosis of Diabetic Neuropathy: A Case-Control Study

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Abstract

Background: The complications of diabetic neuropathy lead to diabetic foot, ulceration, amputation, and loss of ambulation. It is better to prevent the complications by the early diagnosis of onset of diabetic neuropathy and start treatment. The present study was undertaken to find out the right parameter in early intervention of diabetic neuropathy.

Materials and Methods: Nerve conduction studies were performed on median, ulnar, tibial, common peroneal and sural nerves bilaterally in 60 subjects (30 diabetic and 30 non-diabetic). Motor nerve conduction velocity, motor amplitude, sensory conduction velocity and sensory amplitudes were measured and recorded. The data were processed in student t test and analysis of variance.

Results: Significant difference was observed between the diabetic and non-diabetic groups for all the nerves. Lower limb nerves are affected more than the upper limb nerves, and the sensory nerves are severely affected than the motor nerves. A negative correlation was observed between the duration of diabetes and nerve conduction studies.

Conclusion: Nerve conduction studies can be employed in the routine examination of diabetes mellitus for the early intervention of diabetic neuropathy. Lower limb sensory nerves were the good choice in early diagnosis as the lower limb nerves are affected severely compared to upper limb nerves and the sensory are affected more than motor nerves.

Key words: Diabetes mellitus, Diabetic neuropathy, Nerve conduction velocity

INTRODUCTION

Diabetes mellitus is the most common endocrine disorder which is characterized by metabolic abnormalities and in the long run with micro and macrovascular complications that cause significant morbidity and mortality.[1,2] India has the second highest diabetes prevalence in the world as India is one of the rapidly developing country and the rapid urbanization has brought along with it a sedentary lifestyle, which is an important contributor for diabetes.[3] Diabetic neuropathy is a common complication of diabetes mellitus with severe morbidity, compromising the quality of life. An intensive treatment of neuropathy at the subclinical level decreases the risk of neuropathy.[4] The American Academy of Neurology recommends at least one of the five criteria for screening and diagnosing diabetic neuropathy: Symptoms, signs, electro diagnostic tests, quantitative sensory\tests and autonomic testing.[5]

Screening and diagnostic testing of diabetic neuropathy are very much essential to prevent the complications associated with it such as diabetic ulceration followed by amputation. The present study was undertaken to find out the use of nerve conduction studies in the diagnosis of diabetic neuropathy. In this study, we would like to compare nerve conduction of the upper limb nerves with the lower limb nerves and also would like to know which nerve is severely affected.

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MATERIALS AND METHODS

The present study was a case-control study carried out in the department of physiology, Government Medical

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College, Nizamabad in collaboration with Krishna institute of medical sciences, Hyderabad. The room temperature was set to 24°C. The study was conducted on 60 Participants in the following groups: 30 subjects with diabetic neuropathy (15 men and 15 women) and 30 nondiabetic subjects (15 men and 15 women). All the research participants were between the age group of 40 to 60 years. The mean duration of diabetes mellitus was 21.02 ± 17.65 years. All the subjects were recruited after informed consent was taken. Institutional ethical clearance was obtained to carry out the study. The diabetic subjects without any other associated medical conditions were included in the study. The diabetic subjects with other concomitant diseases which may affect nerve conduction were excluded from the study. The present study was a non-invasive method of estimation of nerve conduction using electromyography/evoked potential system (Nicolet/systems - USA make). The surface electrodes are surface stimulates with an automatic computerized monitor with printer attached. For assessing the degree of neuropathy and comparing with normale following parameters were recorded. The motor conduction velocity, motor amplitude, sensory conduction velocity and sensory amplitude were measured and recorded. All the measurements were recorded in median, ulnar, tibial, common peroneal and sural nerves bilaterally in cases and controls.

Statistical Analysis

Data are presented as mean ± SD. Results of the nerve conduction studies were evaluated by unpaired *t*-test, and regression analysis along with analysis of variance (ANOVA) with duration of diabetes as independent variable and other parameters as dependent variables. A level of $P < 0.05$ was accepted as statistically significant.

RESULTS

The mean values of all the parameters of diabetic group were very low in all the four nerves when compared with control or non-diabetic group. The values are depicted in Tables 1-4.

Motor nerve conduction velocities and motor amplitudes in median, ulnar, common peroneal and tibial nerves were significantly lower in the diabetic group than in nondiabetic healthy group ($P < 0.05$; Figures 1 and 2). The lower limb nerves were affected significantly higher than the upper limb nerves. A significant difference was observed between the nerves of the upper limb and lower limb.

Sensory velocities and sensory amplitudes in median, ulnar and sural nerves were significantly lower in the diabetic group than in non-diabetic healthy group ($P < 0.05$; Figures 3 and 4). The sensory velocities and sensory amplitudes of lower limb nerves (sural nerve) were significantly lower than the upper limb nerves.

Table 1: The mean, standard deviation, *t* and *P* values of median nerve

Parameter	Diabetic	Non-diabetic	*t*-value	*P*-value
Motor velocity	49.4±10.1	59.9±4.03	6.11	0.0001
Motor amplitude	7.80±2.94	9.96±1.74	4.01	0.0001
Sensory velocity	41.9±22.1	57.3±5.57	4.29	0.0001
Sensory amplitude	18.6±16.5	47.3±21.5	6.70	0.0001

Table 2: The mean, standard deviation, *t* and *P* values of ulnar nerve

Parameters	Diabetic	Non-diabetic	*t*-value	*P*-value
Motor velocity	49.5±12.8	59.8±4.42	4.84	0.0001
Motor amplitude	7.65±3.17	11.3±2.28	5.95	0.0001
Sensory velocity	36.0±19.2	56.4±4.96	6.49	0.0001
Sensory amplitude	17.2±14.4	46.0±18.6	7.75	0.0001

Table 3: The mean, standard deviation *t* and *P* values of common peroneal nerve

Parameters	Diabetic	Non-diabetic	*t*-value	*P*-value
Motor velocity	36.9±16.6	50.8±3.13	5.22	0.0001
Motor amplitude	3.35±3.31	6.00±1.80	4.45	0.0001

Table 4: The mean, standard deviation, *t* and *P* values of tibial nerve

Parameters	Diabetic	Non-diabetic	*t*-value	*P*-value
Motor velocity	38.5±14.3	31.3±18.8	1.90	0.061
Motor amplitude	6.89±5.18	8.30±5.73	1.13	0.26

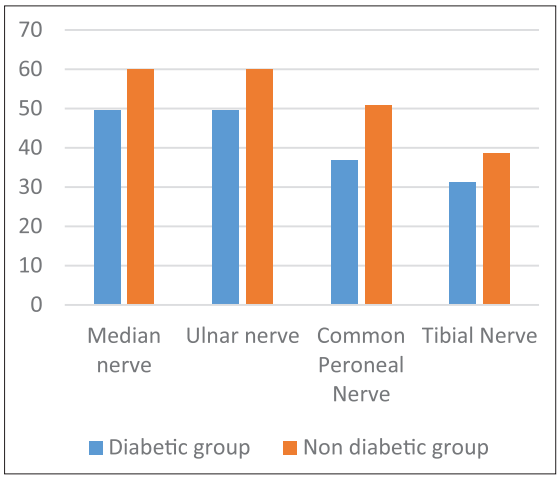

Figure 1: Bar diagram showing the motor nerve conduction velocities in diabetic and non-diabetic groups

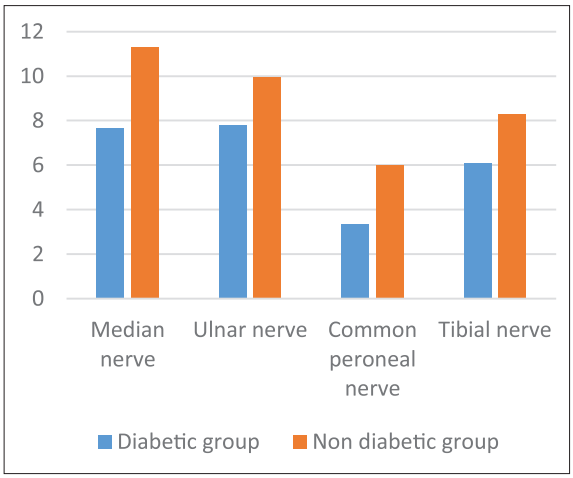

Figure 2: Bar diagram showing the motor amplitudes in diabetic and non-diabetic groups

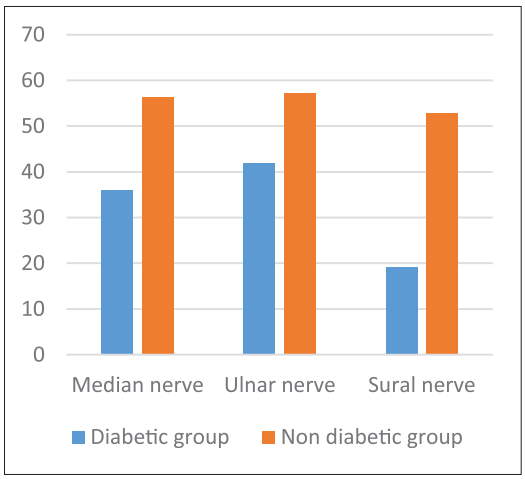

Figure 3: Bar diagram showing the sensory nerve conduction velocities in diabetic and non-diabetic groups

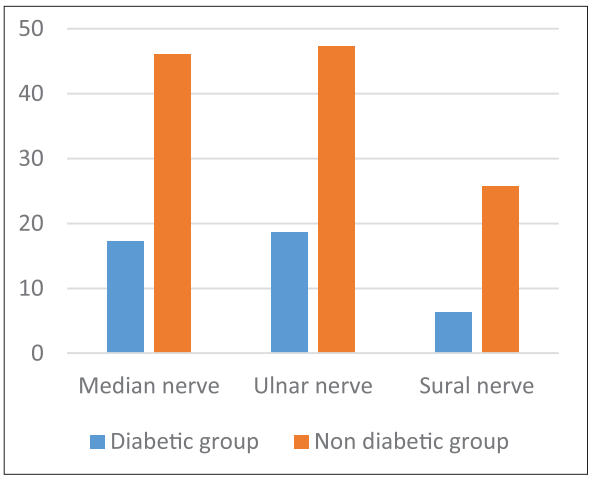

Figure 4: Bar diagram showing the sensory amplitudes in diabetic and non-diabetic groups

Regression analysis along with ANOVA was performed. Duration of diabetes was considered as independent variable and other parameters (motor velocity, motor amplitude, sensory velocity and sensory amplitude) as dependent variables. Significant correlation was not found between the duration of diabetes mellitus and the nerve conduction velocities and amplitudes.

DISCUSSION

Early detection of neuropathy in the asymptomatic stages is very important as the disease process progresses to the diabetic foot which is a highly morbid condition that arises from the infection and the ulceration of foot, finally leading to amputation.[6] Diabetic neuropathy can be diagnosed in subclinical level by using electrophysiological techniques. Impairment of sensory motor axons and the myelin sheath at the distal end already exists in the early stages of diabetic peripheral neuropathy, before symptoms arise.[7] The slowing of nerve conduction velocities indicates the on-going damage to the myeline sheaths and the amplitude decrease with the axonal loss which indicates rising HbA1c levels.[8] Sensory nerves were affected to a great extent than the motor nerves, indicating that the sensory nerves are more vulnerable to damage than motor nerves in diabetic peripheral neuropathy. Diabetic group extent of nerve fiber lesions in the lower extremities is more severe than that in the upper extremities.[7]

In this study, we compared motor nerve conduction velocities, amplitudes of ulnar, median, common peroneal, tibial nerves and sensory conduction velocities, amplitudes of median, ulnar and sural nerves. The sensory components of sural nerve were more affected than ulnar and median nerves. The motor components of common peroneal and tibial were affected more than the median and ulnar nerves. The present study results were similar with Kakrani *et al.*, they performed nerve conduction study on 50 patients of diabetic neuropathy out of which all patients, i.e., 100% had involvement of lower limb and only 24 patients, i.e., 48% had involvement of upper limb. They performed nerve conduction study in tibial, sural, medial plantar and lateral plantar nerves in the lower limb and median and ulnar nerve in upper limb and found that the involvement of tibial and sural nerve was more common than the other nerves. Isolated involvement of sural nerve percentage was higher and isolated involvement of upper limb nerves were not found.[6] Killian and Foreman, Turgut *et al.*, and Leventoglu *et al.*, concluded that the dorsal sural nerve conduction study can evaluate the most distal segments of the extremities and can be considered an alternative method for the diagnosis of polyneuropathy in the early stages of diabetes mellitus.[7,9,10]

CONCLUSION

Lower limb nerves are affected more than the upper limb nerves. Sensory nerve conduction values of sural nerve were significantly lower than the ulnar and median nerves. Nerve conduction tests on the sural nerve may help the physicians to detect the diabetic neuropathy in the early stage. Nerve conduction tests should be routinely examined in diabetic patients for early detection of diabetic neuropathy and prevention of the complications. Further studies can be carried out with larger sample size and matching age groups in cases and controls.[11,12]

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