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RESEARCH ARTICLE

Electrophysiological analysis of subclinical peripheral neuropathy in cases with type I diabetes mellitus

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ABSTRACT

Background: Diabetic neuropathy termed as an existence of peripheral nerve dysfunction in cases with diabetes mellitus (DM). Type 1 DM (T1DM) is commonly associated with diabetic neuropathy. Nerve conduction assessment plays key role evaluate the electrophysiological response of the nervous system to different stimuli. **Aim and Objective:** This study was designed to assess the subclinical central and peripheral neuropathy in cases with T1DM. **Materials and Methods:** A total of 120 cases diagnosed clinically with T1DM with no history of neuropathy were recruited. Demographic details, clinical history, and details of glycemic status were recorded from all the study participants. Nerve conduction study in sural nerve and visual evoked potentials were assessed. **Results:** The mean difference of sural nerve conduction velocity and amplitude on the right leg and left leg was statistically significant between diabetic cases and control subjects ($P < 0.005$). The mean difference of P_{100} latency and amplitude on the right leg and left leg was statistically significant between diabetic cases and control subjects ($P < 0.005$). **Conclusion:** Electrophysiological analysis is the most reliable and non-invasive modalities in the early diagnosis of changes in optic pathways and peripheral sensory nerves in T1DM. Nerve conduction assessment is considered as a gold standard technique in the quick diagnosis of diabetic neuropathy.

KEY WORDS: Nerve Conduction Velocity; Sensory Nerve; Visual Evoked Potential; Type 1 Diabetes Mellitus

INTRODUCTION

Diabetic peripheral neuropathy is a heterogeneous group of nerve disorders and is a major clinical complication in cases with type 1 diabetes mellitus (T1DM).[1] It is affecting 30% of cases with DM and prevalence in children and adults ranges between 57% and 7%, respectively. Disease prevalence is influenced by dyslipidemia, smoking, obesity, uncontrolled glucose levels, and duration of disease.[2-4] Around 60–70% of cases with DM have some form of neuropathy. If neuropathy is central, it influences visual pathway or else peripheral that it shows the impact on peripheral nerves.[5] Nerve conduction assessment and visual evoked potentials are non-invasive procedures to evaluate the electrophysiological response of the nervous system to different stimuli.[6]

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Nerve conduction studies, especially to sensory nerves, help to evaluate the deformity in peripheral nerves. The involvement of sensory nerves leads to loss of sensation over affected foot and develops foot ulcers. The nerve conduction studies in the nerves of limbs were highly correlated. Assessment of motor and sensory nerve conduction function can, therefore, be restricted to the most sensitive test. Peripheral neuropathy and autonomic neuropathy are stronger than the traditional risk factors for future mortality.[7]

Still, there is a lack of the literature on the subclinical neuropathy in the early adults and adult age group. With reference to the above literature, this study was designed to assess the subclinical central and peripheral neuropathy in cases with T1DM.

MATERIALS AND METHODS

In the present prospective observational study, 120 cases with T1DM attending the outpatient department of Kamineni Academy of Medical sciences and Research Centre, Hyderabad, between April 2019 and January 2020, between 21 and 40 years, were recruited. A total of 30 age- and sex-matched control subject were considered. Cases diagnosed with type 1 diabetes for a period not <5 years with no history of neuropathy were included in the study. Cases with hypertension, type 2 diabetes, diabetic retinopathy, traumatic neuropathy, and other ocular complications were excluded from the study. Informed consent was obtained from all the study participants and the study protocol was approved by the Institutional Ethics Committee (No: KAMSR/IEC/12/49).

All cases were undergone with a detailed clinical and neurological examination. Demographic details, clinical history, and details of glycemic status were recorded from all the study participants. Nerve conduction study in sural nerve and visual evoked potentials were assessed using standardized and computerized nerve conduction test equipment in the neurology outpatient department. The collected data were compared between cases and control subjects. For these analyses, data analysis was conducted using SPSS statistical software.

RESULTS

The observations made in the present study are described in Tables 1–3.

DISCUSSION

Subclinical diabetic peripheral neuropathy is a common clinical condition in T1DM than T2DM.[8-10] Diagnosis is difficult due to its asymptomatic nature. Therefore, early diagnosis is important to prevent associated complications and disabilities. The ideal diagnosis of diabetic peripheral neuropathy depends on electrophysiological changes and clinical observations. Diabetic peripheral neuropathy is associated with nerve dysfunctions. Nerve conduction studies help in the diagnosis of subclinical diabetic peripheral neuropathy.[11] This study was designed to assess the subclinical central and peripheral neuropathy in cases with T1DM. A total of 120 cases and 30 age- and sex-matched control subjects between the age group 20 and 45 years were recruited. Based on the onset duration of type 1 diabetes, cases were allocated into three groups, that is, 0–5 years, 6–10 years, and 11–15 years. The mean age of T1DM in disease duration 0–5 years was 24.21, in 6–10 years was 26.38, and in 11–15 years was 37.84. The mean age in the control subjects was 25.02 years. The mean difference in age between cases and controls was statistically not significant ($P > 0.005$). The sural nerve conduction velocity in the right leg was 50.32 m/s in 0–5 years diabetic group, 45.27 m/s in 6–10 years diabetic group, and 39.81 m/s in 11–15 years diabetic group. The sural nerve conduction velocity in the left leg was 50.18 m/s in 0–5 years diabetic group, 46.02 m/s in 6–10 years diabetic group, and 38.26 m/s in 11–15 years diabetic group. The mean difference of sural nerve conduction velocity and amplitude on the right leg and left leg was statistically significant between diabetic cases and control subjects ($P < 0.005$) [Table 2]. The mean difference of P_{100} latency and amplitude on the right leg and left leg was statistically significant between diabetic cases and control subjects ($P < 0.005$) [Table 2]. The mean BMI in three groups of T1DM and controls was 23.20, 23.38, 23.89, and 23.11, respectively. The mean difference in BMI was statistically not significant ($P > 0.005$) [Table 1]. The mean difference of fasting blood glucose and postprandial blood glucose was statistically significant between cases and controls ($P < 0.005$) [Table 1].

A study by Toopchizadeh *et al*. included 40 cases with a mean age 12.73 years and mean duration of diabetes was 6.63 years.[8] A study by Mohamed *et al*. included 50 children with T1DM with mean age 10.5 years. Among the study, 12% of cases were diagnosed with diabetic neuropathy.[12] A study by Prakash *et al*. noticed abnormal nerve conduction in 20 cases. Among the cases, 2 had diabetes <5 years and 18 had diabetes >5 years.[11] A study by Al-Taweel *et al*. found that the frequency of subclinical neuropathy was 61.7% in T1DM cases and disease frequency was high in cases with disease

Table 1: Demographic data and glycemic status of the study participants

Parameters	T1DM (*n*=120) (Mean±SD)			Controls (*n*=30) (Mean±SD)	*P*-value
	0–5 years	6–10 years	11–15 years		
Age (In years)	24.21±4.18	26.38±4.07	37.84±3.63	25.02±2.89	0.033
Sex (Male:Female)	19:15	22:16	24:24	15:15	-
BMI	23.20±1.65	23.38±1.23	23.89±2.61	23.11±1.98	0.448
Fasting blood glucose	93.78±5.32	91.28±7.82	93.09±9.55	86.22±3.74	0.005
PPPG (mg/dl)	299±86.2	309±92.69	331±93.54	94±10.84	0.005

T1DM: Type 1 diabetes mellitus

Table 2: Comparison of sural NCV and amplitude in the right and left leg

Parameters	T1DM (*n*=120) (Mean±SD)			Controls (*n*=30) (Mean±SD)	*P*-value
	0–5 years	6–10 years	11–15 years		
Right leg					
NCV (m/s)	50.32±0.58	45.27±0.65	39.81±0.68	52.29±0.52	<0.005*
Amplitude (μv)	16.16±0.44	13.98±0.62	11.33±0.23	18.08±0.35	<0.005*
Left leg					
NCV (m/s)	50.18±0.59	46.02±0.74	38.26±0.43	51.37±0.27	<0.005*
Amplitude (μv)	16.38±0.55	14.01±0.48	11.85±0.59	18.16±0.43	<0.005*

NCV: Nerve conduction velocity, T1DM: Type 1 diabetes mellitus

Table 3: Comparison of P_{100} latency and amplitude between in the right and left eye

Parameters	T1DM (*n*=120) (Mean±SD)			Controls (*n*=30 (Mean±SD)	*P*-value
	0–5 years	6–10 years	11–15 years		
Right eye					
P_{100} latency (ms)	103.26±0.58	105.37±0.62	106.85±0.63	98.86±0.522	<0.005*
Amplitude (μv)	6.94±0.571	5.28±0.502	5.26±0.496	8.35±0.418	<0.005*
Left eye					
P100 latency (ms)	103.48±0.21	108.25±0.48	111.39±0.45	98.92±0.57	<0.005*
Amplitude (μv)	6.82±0.54	5.22±0.77	3.18±0.60	7.58±0.61	<0.005*

T1DM: Type 1 diabetes mellitus

duration >5 years.[13] Based on the nerve conduction studies in 57% of cases, Nelson *et al*. found diabetic neuropathy with a disease duration of <5 years.[14] A study by Moser *et al*. diagnosed 11% of cases as diabetic peripheral neuropathy by nerve conduction analysis.[15] A study by Amer *et al*. found that about 59% of cases had diabetic neuropathy as diagnosed by nerve conduction assessment.[16] A study by Parkhad and Palve on 100 diabetic cases found that the nerve conduction velocity progressively decreased from control subjects (49.0 ± 3.9) to diabetic cases with controlled glycemic status (47.2 ± 2.8) to uncontrolled glycemic status (45.3 ± 3.1).[17]

Studies suggest that routine assessment of nerve conduction velocity in cases with T1DM is beneficial for early diagnosis of disease-associated complications.[18] In this study, demographic factors have no significant relation with the occurrence of diabetic neuropathy. The level of glycemic index was significantly associated with diabetic neuropathy. This study has a limitation with a minimal number of participants. Cases with T1DM shown less interest to participate in the study because nerve conduction studies were painful.

CONCLUSION

The results of this study conclude that the assessment of routine nerve conduction velocity is beneficial in the evaluation of subclinical diabetic neuropathy. The electrophysiological analysis is the most reliable and non-invasive modalities in the early diagnosis of changes in optic pathways and peripheral sensory nerves in T1DM. Nerve conduction assessment is considered as a gold standard technique in the quick diagnosis of diabetic neuropathy.

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