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SENSORY NERVE CONDUCTION STUDY IN NON-INSULIN DEPENDENT DIABETES MELLITUS PATIENTS WITH SUBCLINICAL PERIPHERAL NEUROPATHY

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ABSTRACT Diabetes mellitus (DM) is a major health concern, that if left untreated may predispose to various complications. Most common form of complication in diabetes is the polyneuropathy, a leading cause for disability. Several studies have tried to explore the deranged nerve conduction in diabetic patients but the role of nerve conduction studies in diabetics without symptomatic peripheral neuropathy in improving the disease outcome needs further elucidation. The present study was conducted in the Department of Physiology, S.M.S. Medical College, Jaipur, on thirty-five non-insulin dependent diabetes mellitus patients with disease duration of > 5 to ≤ 10 years, aged 30-50 years, without symptomatic peripheral neuropathy. An equal no. of age and gender matched healthy subjects were recruited as controls. Sensory nerve conduction study of right median nerve was done to assess latency, amplitude, duration, area and nerve conduction velocity. The mean glycosylated hemoglobin level of cases was significantly higher than that of the control. The comparison of mean latency, duration, amplitude and area of right median nerve among case and control group did not differ significantly. The sensory nerve conduction velocity was significantly lower in cases as compared to controls, suggestive of underlying peripheral neuropathy. The decrease in sensory nerve conduction velocity in patients of non-insulin dependent diabetes mellitus without peripheral neuropathy puts the diabetic patients at a higher risk for generalized polyneuropathy and warrants early nerve conduction assessment to improve the disease outcome.

KEYWORDS : Diabetes mellitus, sensory nerve, latency, conduction velocity and peripheral neuropathy.

INTRODUCTION

Diabetes mellitus (DM) with an estimated disease burden of 422 million diabetics is a major health concern (WHO Report, 2016). It is predicted that by 2030, diabetes mellitus may afflict up to 79.4 million individuals in India (Wild et al. 2004; Whiting et al., 2011).

Risk factors involved in the causation of DM include genetic, environmental and behavioral factors, which account for the variation in incidence of type 2 DM from one geographical region to the other (Zimmet, Alberti & Shaw, 2001; Chen, Magliano & Zimmet, 2012). Insulin resistance is the main etiology behind type-2 DM; hence it is also termed Non-Insulin Dependent Diabetes Mellitus (NIDDM).

Patient with fasting plasma glucose ≥ 126 mg/dL or 2-h plasma glucose ≥ 200 mg/dL during oral glucose tolerance test (OGTT), two hours after the oral dose a plasma glucose ≥11.1 mmol/L (200 mg/dL) or HbA1C levels ≥ 6.5% is termed diabetic as per the recommended guidelines (American Diabetes Association, 2019).

Diabetes mellitus represents a group of common metabolic disorders sharing phenotype of hyperglycemia, that if left untreated may predispose to various cardiovascular, ophthalmic, renal and neural complications, culminating into significant disability and mortality (Powers, 2012). The most common complication in diabetes is the polyneuropathy, that is a leading cause for disability due to foot ulceration and amputation, gait disturbance, and fall-related injury. Several studies have tried to explore the deranged nerve conduction in diabetic patients using nerve conduction studies, but the role of NCS in diabetics without symptomatic peripheral neuropathy in improving the disease outcome needs further elucidation (Suzuki et al., 2000; Kang & Lee, 2012; Li et al., 2014; Bagchi, Biswas & Mukhopadhyay, 2014; Yadav et al., 2015; Mankar, Bhagya & Bondade, 2016).

Nerve conduction studies (NCS) provide a non-invasive tool for assessing the functional status of motor as well as sensory nerves. A decrease in amplitude suggests a reduction in the overall number of functioning axons, whereas slowing of conduction velocity is suggestive of peripheral nerve demyelination which may be diffuse or focal. Screening and diagnosing diabetes mellitus at the earliest are an essential step in its management to prevent the disease related complications and improved outcome. Thus, the present study was designed to evaluate the functional status of sensory nerve fibers in terms of sensory nerve conduction indices in non-insulin dependent diabetes mellitus patients without symptoms of peripheral neuropathy.

MATERIAL & METHODS

The present study was conducted in the Department of Physiology, S.M.S. Medical College, Jaipur (Raj.) after obtaining clearance from institutional ethics committee. Thirty-five clinically diagnosed NIDDM patients with disease duration of > 5 to ≤ 10 years, aged 30 to 50 years, without signs and symptoms of peripheral neuropathy were recruited from medical OPD of S.M.S. Hospital, Jaipur as cases and an equal no. of age and gender matched healthy subjects were recruited as controls. Patients suffering from any chronic liver, renal, vascular diseases, myopathies, inflammatory demyelinating neuropathy, traumatic nerve injuries, neuromuscular diseases, inherited neuropathy, stroke or any other acute or chronic inflammatory diseases were excluded from the study. The smokers, alcoholics and patients on medications that are known to cause peripheral neuropathy were also excluded from the study.

Experimental Protocol:

The purpose and procedure of the study was explained and a written informed consent was obtained from every subject prior to the commencement of study procedure. Clinical history was obtained and a through physical examination was performed to rule out any other disease. Blood samples were collected for HbA1C and analyzed by latex agglutination inhibition assay method (Randox I-mola).

Nerve conduction study procedure:

Amplitude (μV), latency-1 (ms), latency-2 (ms), duration (ms), area (μVms) and sensory nerve conduction velocity (SNCV) of right median nerve was assessed using antidromic stimulation of median nerve on RMS EMG-2 channel (Recorders and Medicare Systems)

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and analyzed using Salus software.

Test procedure was explained to the subjects and they were made to sit comfortably on a chair in a fully relaxed state. The active electrode was placed around the proximal interphalangeal joint of the second digit on index finger and the reference was placed around distal phalanx of the same digit. The nerve was stimulated at wrist between palmaris longus and flexor carpi radialis tendons at second distal most crease. A ground electrode was placed on dorsum of hand.

Statistical Analysis;

Analysis was done using SPSS version 17.0 (IBM, SPSS Statistics Inc., Chicago, Illinois) Windows software program. Significance of difference in mean in both groups was inferred by unpaired t-test and the significance of difference in proportion in both the groups was inferred by chi-square test. Statistical significance was assigned at p-value of less than 0.05.

DISCUSSION

The diabetes mellitus predisposes the affected individual to various types of complications in the long run and the commonest being the diabetic polyneuropathy, involving the peripheral nervous system (Boulton, 2005).

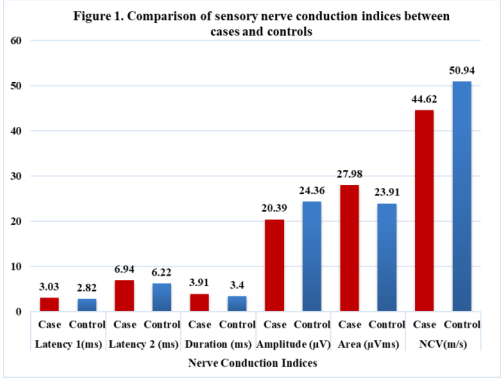

TABLE – 1: COMPARISON OF VARIOUS SUBJECT CHARACTERISTICS BETWEEN CASE AND CONTROL GROUPS

	Mean ± SD of Case (n=35)	Mean ± SD of Control (n=35)	p-value
Age (years)	43.89 ± 4.44	43.6 ± 4.3	0.785
Height (m)	1.66 ± 0.07	1.68 ± 0.07	0.236
Weight (Kg)	65.74 ± 7.37	66.8 ± 8.6	0.582
BMI (Kg/m^2)	23.92 ± 2.34	23.67 ± 2.87	0.691
HbA1c (%)	7.93 ± 1.27	5.94 ± 0.31	<0.001*

*Unpaired 't' test, significant

TABLE – 2: COMPARISON OF SENSORY NERVE CONDUCTION INDICES OF MEDIAN NERVE AMONG CASE AND CONTROL GROUPS

Sensory nerve conduction indices	Mean ± SD of Case (n=35)	Mean ± SD of Control (n=35)	p-value
Latency 1 (ms)	3.03 ± 1.66	2.82 ± 1.21	0.547
Latency 2 (ms)	6.94 ± 2.66	6.22 ± 2.01	0.206
Duration (ms)	3.91 ± 1.34	3.4 ± 1.01	0.077
Amplitude (μV)	20.39 ± 13.57	24.36 ± 16.14	0.269
Area (μVms)	27.98 ± 28.5	23.91 ± 17.45	0.474
SNCV (m/s)	44.62 ± 12.32	50.94 ± 11.8	0.032*

*Unpaired 't' test, significant

The mean age of cases was 43.89 (±4.55) year and that of controls was 43.60 (±4.30) year. The mean body mass index among cases (23.92 ± 2.34 Kg/m^2) and controls (23.67 ± 2.87 Kg/m^2) did not differ significantly. The mean glycosylated hemoglobin level of cases (7.93 ± 1.27%) was significantly higher than that of the control (5.94 ± 0.31%) (Table No. 1).

Sensory nerve conduction indices of median nerve:

The comparison of mean values of latency-1, latency-2, duration, amplitude and area of right median nerve among cases and control group did not show any significant differences (p>0.05). The most important finding of this study was significantly decreased sensory nerve conduction velocity of right median nerve in cases (44.62 ± 12.32 m/s) as compared to control group (50.94 ± 11.80 m/s), indicating a definite delay in conduction, suggestive of peripheral neuropathy (Table No. 2, Figure 1).

The results of present study corroborate with findings of Verma et al. (2015) that revealed conduction delay in terms of decreased sensory nerve conduction velocity in non-insulin dependent diabetes mellitus patients without symptomatic peripheral neuropathy when compared to healthy controls (Verma, Mahajan & Khadayate, 2015). A similar finding was also reported by Singh et al. (2015), that suggested decreased median nerve sensory conduction velocity in newly diagnosed diabetics with sub-clinical neuropathy (Singh et al., 2015). The sensory nerve conduction impairment has been found to be more prominent in diabetics as compared to motor abnormalities (Zhang et al., 2014; Lakra, Mohapatra & Satapathy, 2017).

CONCLUSION:

The decrease in sensory nerve conduction velocity in patients of non-insulin dependent diabetes mellitus without peripheral neuropathy puts the diabetic patients at a higher risk for generalized polyneuropathy and warrants early initiation of neuroprotective therapies in these high-risk patients, to halt its progression. Nerve conduction studies at an earlier stage in diabetics may help in improving the overall prognosis.

REFERENCES

1. World Health Organization. Global report on diabetes. Geneva: 2016. Available at: http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf?ua=1.
2. Whiting, D. R., Guariguata, L., Weil, C., & Shaw, J. (2011). IDF Diabetes atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes Research and Clinical Practice, 94, 311–21.
3. Zimmet, P., Alberti, K. G., & Shaw, J. (2001). Global and societal implications of the diabetes epidemic. Nature, 414(6865), 782-787.
4. Chen, L., Magliano, D. J., & Zimmet, P. Z. (2012). The worldwide epidemiology of type 2 diabetes mellitus: present and future perspectives. Nature reviews. Endocrinology, (8), 228-236.
5. American Diabetes Association. (2019). Standards of medical care in diabetes - 2019. Diabetes Care, 42(suppl 1), S1-193.
6. Powers, A. C., Diabetes Mellitus. In: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J, editors. (2012). Harrison's principles of internal medicine. (18th ed.). New York: McGraw Hill.
7. Suzuki, C., Ozaki, I., Tanosaki, M. & Baba, M. (2000). Peripheral and central conduction abnormalities in diabetes mellitus. Journal of the Peripheral Nervous System, 54(10), 1932-7.
8. Kang, J. H., & Lee, Y. S. Sensory nerve conduction studies in the diagnosis of diabetic sensorimotor polyneuropathy: electro physiological features. (2012). Journal of Physical Therapy Science, 24(1), 139-42.
9. Li, G, Sun, C, Wang, Y, Liu, Y, Gang, X, Gao, Y,…Wang, G. A clinical and neuropathological study of Chinese patients with diabetic peripheral neuropathy. (2014). PloS one, 9(3), e91772.
10. Bagchi, H., Biswas, A., & Mukhopadhyay, A. K. A Study of Somatic Nerve Functions in Diabetic and Normal Persons. (2014). Indian Medical Gazette, 148(10), 365-368.
11. Yadav, N., Shete, A., Yadav, P., Yadav, N. T., & Khan, S. Study of Nerve Conduction Velocity in Type II Diabetes Mellitus. (2015). National Journal of Integrated Research in Medicine, 6(4), 36-43.
12. Mankar, K., Bhagya, V., & Bondade, S. Y. A Comparative Peripheral Nerve Conduction Study in Type-2 Diabetics with Symptoms of Polyneuropathy with Age and Sex Matched Normal Subjects. (2016). International Organization of Scientific Research-Journal of Dental and Medical Sciences, 15(7), 75-82.
13. Wild, S., Roglic, G., Green, A., Sicree, R., & King, H. (2004). Global prevalence of diabetes: estimate for the year 2000 and projections for 2030. Diabetes Care, 127(5), 1047-1053.
14. Boulton, A. J. (2005). Management of Diabetic Peripheral Neuropathy. Clinical Diabetes, 23(1), 9–16.
15. Verma, A., Mahajan, S., & Khadayate, P. (2015). Sensory Nerve Conduction Studies in Non-Insulin Dependent Diabetes Mellitus (NIDDM) Patients Without Symptoms of Peripheral Neuropathy and Healthy Volunteers: A Comparative Study. International Journal of Basic and Applied Physiology, 2(1), 158-62.
16. Singh, R. B., Chandel, K., Kumar, S., & Singh, R. B. (2015). Nerve conduction study findings of subclinical diabetic neuropathy in newly diagnosed diabetic patients. Indian Journal of Neurosciences, 1(1), 1-7.
17. Zhang, Y., Li, J., Wang, T., & Wang, J. (2014). Amplitude of sensory nerve action potential in early stage diabetic peripheral neuropathy: an analysis of 500 cases. Neural Regeneration Research, 9(14), 1389.
18. Lakra, B., Mohapatra, S., & Satapathy, U. (2017). Study on Electrophysiological Changes of Peripheral Nerves in Type 2 Diabetes Mellitus. Journal of Medical Science and Clinical Research, 5(5), 22604-22611.