

Correlation of the Duration of Diabetes with Nerve Conduction Study and Proprioception in Type 2 Diabetes Mellitus Patients

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ABSTRACT

Introduction: Falls are a common problem in diabetic patients. Patients with diabetic neuropathy have more incidence of postural instability and gait disturbances. These problems become more pronounced as the duration of diabetes increases. Few studies have also demonstrated proprioceptive decline in Type 2 diabetes mellitus patients. The aim of the study was to find the correlation of the duration of diabetes with nerve conduction study and proprioception.

Material and methods: 114 Type 2 diabetes mellitus patients of age group 30-60 years with duration of diabetes not more than five years were recruited. Nerve conduction tests of lower limb nerves was done. Proprioception test in the form of knee joint position sense was tested with a digital inclinometer. Pearson's correlation coefficient was used to analyse the data.

Results: There was a positive correlation between the duration of diabetes and the distal latencies, while there was a negative correlation with the amplitude and conduction velocity. Proprioception errors also had a positive correlation with the duration of diabetes.

Conclusion: Duration of diabetes is a significant risk factor for the development of diabetic peripheral neuropathy and proprioceptive deterioration.

Keywords: Duration of diabetes, Nerve Conduction Study, Proprioception, Joint Position Sense

INTRODUCTION

Diabetes mellitus is a global epidemic with a prevalence of about 425 million in the year 2017 as estimated by International Diabetes Federation.¹ It is also predicted that this number may increase at an alarming pace to 625 million by 2045.¹ This disease poses a significant economic burden and has an adverse effect on the quality of life and productivity of individuals with diabetes.

Diabetes mellitus is a chronic disorder characterized by disturbed glucose metabolism resulting in microvascular and macrovascular complications. Peripheral neuropathy is a very common microvascular complication of Diabetes mellitus. It is also one of the most common cause of diabetic foot complications due to impaired sensibility, leading to gangrene and amputations.²

Falls are a common problem in diabetic elderly individuals with a prevalence of 39% and a recurrence rate of 30.6%.³ It has also been observed that diabetic neuropathy has a strong association with postural instability. Diabetic patients have larger antero-posterior and medio-lateral sway in quiet standing as compared to healthy age-matched individuals.³ Patients with diabetic neuropathy have demonstrated

significant gait changes as measured by various gait parameters. These include decrease in the speed of walking and more variable stride length, especially in elderly diabetic individuals.³ This makes them more prone to falls. Another important observation is that the postural instability in diabetic patients becomes worse with eyes closed.⁴ Proprioceptive sensation plays a major role in postural stability and equilibrium and a disturbance of proprioception increases the risk of falls. Diabetes involves progressive loss of different nerve functions like vibration sense, proprioception, perception of movement and joint position sense.⁵ It is quite possible that proprioception deficit could be a cause of higher incidence of falls in diabetic patients. Lucas et al studied knee joint position sense in a group of Type 2 diabetic patients in which they found significant proprioception deficits.⁶

Proprioception tests are commonly used by clinicians, but for research purpose, various validated equipments like electronic goniometers, digital inclinometers, smartphone applications, and video-controlled isokinetic computer based environments are used. Among the various subdivisions of proprioception tests, like motion sense, dynamic position sense and joint position sense, the latter is commonly used as a standard test of proprioception. This is due to the higher reproducibility and good inter-tester and intra-tester reliability of the joint position test.^{7,8,9}

It is well known that the complications of diabetes become more pronounced as the duration of the disease increases. Daniel NC et al analysed the association between the time of diagnosis of diabetes and the onset of complications and found that both were related to each other.¹⁰ Duration of diabetes has a significant association with chronic microvascular complications, as well as, with diabetic foot.¹¹ Few studies have also shown a deterioration in various nerve conduction study parameters in neurologically asymptomatic diabetic individuals, with an increase in the duration of diabetes.^{12,13}

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Other studies have also shown a strong association between the duration of diabetes and the risk of falls.¹⁴ But there is a paucity of studies which have investigated the relationship between the duration of diabetes and proprioception. The aim of the present study was to find out the correlation of the duration of diabetes with Nerve conduction study and proprioception in the Type 2 Diabetes mellitus patients.

MATERIAL AND METHODS

The study population comprised of 114 Type 2 Diabetes mellitus patients, 73 males and 41 females, between the age group 30-60 years, mean age 47.3 years, and duration of diabetes upto five years. The study was conducted at Physiology Department and the Neurology Department, Indira Gandhi Institute of Medical Sciences, Patna from June 2019 to February 2021. This study has got the approval of the Institutional Ethics Committee.

Type 2 Diabetes mellitus patients of age group 30-60 years of less than five years duration of diabetes and those consenting to participate in the study were included. Informed consent was obtained after explaining the procedure to them.

Patients with history of demyelinating polyneuropathies, thyroid disorders, and lumbar radiculopathies, history of lower limb pain or injury or knee osteoarthritis were excluded from the study. Also smokers, chronic alcoholics, history of occupational heavy metal exposure, and use of medications which could cause neuropathies (Isoniazid, Anticancer and Antiretroviral drugs) were also excluded.

The nerve conduction study of patients' lower limb nerves was done using the standardized procedure. Tibial motor, Peroneal motor and Sural sensory nerves were tested. Parameters observed were distal latency, amplitude and the conduction velocity. Patients' knee joint position sense was tested with the help of a digital inclinometer according to the protocol suggested by Relph et al.⁹ The procedure of the joint position test was explained to the patients so that they were comfortable being blindfolded. Inclinometer was fixed on the dominant leg with the help of straps, knee joint was

passively brought to an angle of 45 degrees and the patient was told to memorise this position for five seconds. The leg was brought back to resting position and then the patient was asked to reposition the knee back to the same angle. Three trials were taken and the mean error score was noted down as the absolute error of knee joint position sense (JPS).

The data were recorded in an excel spreadsheet and Pearson's correlation coefficient, SPSS version 26 (IBM) was applied in order to analyse the correlation of the duration of diabetes with the nerve conduction study and knee joint position sense.

RESULTS

The results of this study clearly show that there is a correlation between the duration of diabetes and the nerve conduction study parameters. There was a positive correlation with the distal latencies whereas a negative correlation was observed with the amplitude as well as the conduction velocity.(Table 1) Moreover a strong positive correlation was observed between the duration of diabetes and joint position sense errors.(Table 2)

DISCUSSION

In the present study, a significant correlation was observed between the duration of diabetes and the nerve conduction study in Type 2 diabetes mellitus patients with the duration of diabetes not more than five years. There was an increase in distal latencies, decrease in amplitudes and conduction velocities as the duration of diabetes increased. These findings are similar to previous research studies in Type 2 diabetes patients.^{12,13} Bansal et al found a deterioration in the form of decrease in the amplitude and reduction in conduction velocity with the increase in the duration of diabetes. They also concluded that the duration of diabetes is a significant non-modifiable risk factor for deterioration of nerve conduction test results.¹⁴ With a prolonged duration of the disease, there is more production of glycosylation end products leading to more metabolic derangements.¹⁵

Duration of diabetes	Nerve Conduction Study	Nerve	Correlation Coefficient	Significance
	Latency (ms)	Tibial nerve	0.288**	<0.01
		Peroneal nerve	0.201*	0.03
		Sural nerve	0.236*	0.01
	Amplitude (mV)	Tibial nerve	-0.322**	<0.01
		Peroneal nerve	-0.233*	0.01
		Sural nerve	-0.205*	0.03
	Conduction velocity (m/s)	Tibial nerve	-0.386**	<0.01
		Peroneal nerve	-0.381**	<0.01
		Sural nerve	-0.277**	<0.01

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed)

Table-1: Correlation of Duration of diabetes and Nerve conduction study (NCS)

Duration of diabetes	Proprioception error score	Correlation Coefficient	Significance
		0.687**	<0.01

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed)

Table-2: Correlation of Duration of diabetes with Proprioception error score

On investigating the relation between duration of diabetes and joint position sense test, it was observed that there is deterioration in the proprioceptive sensibility as the duration increases. This finding confirms the observations of previous study done by Lucas et al, which had shown that patients with Type 2 diabetes mellitus experience proprioception decline in knee joint.⁶ Guney et al found that there was a deterioration in the ankle joint proprioception in Type 2 diabetes mellitus patients.⁵ As per our knowledge, the present study is probably the first of such kind assessing the relation of duration of diabetes with proprioception. This finding is important as it could possibly explain the reason for an increase in the incidence of falls in diabetic patients having a longer duration of diabetes, as observed in previous studies.¹⁵

CONCLUSION

The present study showed that duration of diabetes is an important risk factor for development of diabetic neuropathy in Type 2 diabetic patients. This proves the importance of assessment of nerve function, including proprioception, in all diabetic patients as a routine test. Moreover interventions to prevent falls should be planned from the time of diagnosis, by implementing proprioception training exercises in the routine care management of all diabetic patients. This will improve their quality of life and reduce their physical as well as economic burden. Future studies aimed to investigate the effect of proprioceptive training programs on the proprioception and incidence of falls in diabetic populations can be undertaken.

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