

IMPACT OF DURATION OF TYPE 2 DIABETES MELLITUS ON NCS BASED NEUROPATHY

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Published:- 15 December 2025

ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is an increasing worldwide health challenge that is linked to chronic comorbidities, such as diabetic peripheral neuropathy (DPN). The nerve conduction studies (NCS) are said to be a sensitive technique of early detection of neuropathy even in an asymptomatic patient.

Objective: To identify the relationship between nerve conduction study (NCS) parameters and duration of type 2 diabetes mellitus in newly diagnosed diabetic patients.

Methodology: This is a descriptive cross-sectional study, which was carried out at the Medical Ward of Allied Hospital, Faisalabad, within August 2025 and November 2025. Non-probability consecutive sampling was used to select 200 newly diagnosed (within 0-2 years) T2DM patients aged 18 -80 years. Patients who used alcohol, were pregnant, had neuromuscular conditions or acute diabetic complications were excluded. Baseline demographic information (age, gender, BMI, and duration of diabetes) were measured. To determine nerve conduction velocity (NCV) and amplitude (AP), nerve conduction studies were conducted. Data analysis was done with SPSS version 25. Correlation coefficient was used by Pearson to find out the correlation between duration of diabetes and NCS parameters.

Results: The average age of the sample was about 55 11 years old with a minor margin of males predominating. There was a strong negative correlation between NCV and duration of diabetes ($r \approx -0.28$, $p < 0.05$) and other amplitude also demonstrated the trend of decline with the duration of diabetes.

Conclusion: Nerve conduction abnormalities in newly diagnosed T2DM patients exist and become more severe with the progression of the disease. NCS may be a useful screening tool in the early detection of diabetic neuropathy whereby early intervention can be done to minimize the morbidity in the long term.

Keywords: Type 2 Diabetes Mellitus; Diabetic Peripheral Neuropathy; Nerve Conduction Studies; Nerve Conduction Velocity; Duration of Diabetes; Electrophysiology; Subclinical Neuropathy; Glycemic Control.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a long-term metabolic condition marked by the lack of insulin secretion and /or insulin resistance and consequent hyperglycemia. The International Diabetes Federation estimates that there are around 425 million diabetic patients in the world today, thus becoming one of the biggest global epidemics in the 21st century². With chronic hyperglycemia, there is progressive structural and functional damage in various organ systems,

which add to both microvascular and macrovascular complications. Notably, a number of studies have indicated that a significant percentage of patients presenting with T2DM has already been exposed to chronic complications at diagnosis³.

One of the most frequently occurring and disabling complications of diabetes mellitus is diabetic neuropathy that presents with a high level of morbidity, elevated mortality, and high socioeconomic burden. It is a heterogeneous group of clinical syndromes with different parts of the peripheral and autonomic nervous systems. The pathogenesis is multifactorial and involves the activation of the polyol pathway, oxidative stress, dysfunction of the microvasculature, neuronal ischemia and hypoxia, the formation of end-products of advanced glycation, and decreased neurotrophic support, which all play a role in the progressive damage of nerves^{4,11}.

The nerve conduction studies (NCS) is a common objective and sensitive tool that is used to determine the functioning of the peripheral nerves through the speed and the amplitude of the conduction of electrical impulses. NCS is able to identify early and subclinical diabetic peripheral neuropathy (DPN) and as such, it is a useful diagnostic modality to intervene at an early stage. The correlation between the NCS parameters and the clinical and metabolic variables is crucial to understanding the patient disease progression and enhancing patient outcomes^{5,9}.

There is evidence to show that the duration of diabetes is a significant factor in development and progression of neuropathy changes. A number of studies have indicated a gradual deterioration of motor and sensory nerve capabilities with longer periods of T2DM existence⁶. Nevertheless, there is an uneven correlation between the studies. Indicatively, Hamid et al. found no statistical significant association between nerve conduction velocity and time of diabetes ($r = 0.2$, $p = 0.07$) however, patients with a longer history of diabetes and with poor glycemic control had a tendency of showing more severe abnormalities. Such discrepancies indicate that more research should be carried out⁷.

Recent articles also underline the fact that diabetic neuropathy can be considered to be affected by a combination of several interacting mechanisms instead of a linear progression model, and the severity of patient neuropathy might not be only tied to the duration of the disease but also to the metabolic control and personal susceptibility^{8,10}.

In Pakistan and other developing nations, local information about the association between the period of T2DM and the NCS variables is still scarce, especially in newly diagnosed patients. Therefore, this study aims to evaluate the association between nerve conduction study parameters and duration of T2DM. The results can be used to advocate the use of NCS as an early diagnostic tool in combination with regular HbA1c monitoring to facilitate interventions like lifestyle change, glycemic regulation, and medication to prevent or slow down the development of diabetic neuropathy.

OBJECTIVE

To establish the relationship between the length of type 2 diabetes mellitus and the nerve conduction study variables in newly diagnosed T2DM patients.

METHODOLOGY

This cross-sectional descriptive study was done in the medical ward of Allied Hospital Faisalabad from August 2025 to November 2025. The number of patients to be used was 200, which was determined by a correlation coefficient ($r = 0.207$), with a power of the study of 80 and the level of significance of 5. A non-probability consecutive method of sampling of patients was used. The population was comprised of people who fit the set inclusion criteria and presented to the medical ward within the study period.

INCLUSION CRITERIA

Patients aged between 18 and 80 years, newly diagnosed with type 2 diabetes mellitus (within the last two years), and willing to participate in the study were included.

EXCLUSION CRITERIA

Patients with a history of alcohol consumption, smokers, pregnant women and those with acute diabetic complications like diabetic ketoacidosis (DKA) or diabetic foot. Moreover, those who had a history of known neuromuscular disorders or inherited neuropathies were excluded.

DATA COLLECTION PROCEDURE

Informed consent was obtained by all the participants before they could be included in the study after the ethical approval had been obtained. Allied Hospital Faisalabad was used to recruit patients who passed the inclusion criteria in the Medical Ward. Appropriate demographic and clinical information such as age, gender, body mass index (BMI) and length of diabetes were documented. Conduction studies of nerves were conducted under standardized conditions to evaluate nerve conduction velocity (NCV) and amplitude (AP). The presence of neuropathy was determined by abnormal NCS parameters, such as low NCV, long latency, and low amplitude. All the data collected were tabulated using a structured proforma to be analysed.

DATA ANALYSIS

The analysis was done on SPSS version 25. The data were summarized using descriptive statistics where the continuous variables were reported as mean \pm standard deviation and the categorical variables were reported in frequencies and percentages. The relationship between the parameters of nerve conduction studies and diabetes duration was evaluated using Pearson correlation coefficient. Potential effect modifiers that were stratified included age, gender, and body mass index (BMI). Post-stratification analysis was done to determine their effect on the main outcome variables. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

To determine the relationship between duration of diabetes and nerve conduction study (NCS) parameters, 200 newly diagnosed patients with type 2 diabetes mellitus were involved in the study. The average age of the participants was around 55 ± 11 years. The sample consisted of males and females (a small majority of males). The average length of diabetes in participants was 1.4 ± 0.6 years.

Baseline Characteristics

Parameter	Total (n = 200)
Mean Age (years)	55 ± 11
Gender Distribution	Male: ~54%
	Female: ~46%
Mean Duration of Diabetes (years)	1.4 ± 0.6

The distribution of the study population in terms of gender was rather balanced, and the participants had similar baseline characteristics.

Nerve Conduction Study Findings

Outcome	Observation
Nerve Conduction Velocity (NCV)	Reduced in patients with longer duration of diabetes
Amplitude (AP)	Declining trend observed with increasing duration of diabetes

Correlation Between Duration of Diabetes and NCS Parameters

Parameter	Correlation (r)	p-value
Duration of Diabetes vs NCV	-0.28	<0.05
Duration of Diabetes vs Amplitude	Negative trend	<0.05 (significant trend)

The duration of diabetes had a statistically significant negative relationship with nerve conduction velocity, which implies that the longer the period of diabetes, the lesser the nerve conduction velocity. Amplitude also exhibited a decreasing tendency with the duration of disease.

Influence of BMI and Other factors.

Patients who had a high body mass index (BMI) exhibited lower nerve conduction study parameters indicating that an increase in the body mass index was directly related to increased nerve impairment. This was a statistically significant relationship ($p \leq 0.05$). Stratification analysis also showed that age and gender had a modifying effect on nerve conduction parameters.

Interpretation

Findings of the research study suggest that nerve conduction studies abnormalities exist in patients with type 2 diabetes even at the initial stages of the disease and are linked to the length of the disease. There was a strong negative correlation between the nerve conduction velocity and the duration of diabetes and an increasing negative correlation between the amplitude and the disease duration. Moreover, the degree of nerve conduction parameters was worse with increased BMI, and these factors indicate that both the aspect of disease duration and patient-related factors could be related to the evolution and development of diabetic neuropathy. These results underscore the significance of early screening with NCS in newly diagnosed diabetic patients in order to avoid the development of neuropathy and other complications.

DISCUSSION

This paper shows that there are nerve conduction abnormalities already in patients of diabetic type 2 (T2DM) and they increase with the duration of the disease^{1, 6}. Such findings are consistent with other researchers by Govindarajan et al.¹ and Numan et al.⁶ who found the initial electrophysiological changes in diabetic individuals and neuropathic changes may manifest themselves at the initial stages of the condition.

The negative correlation that was taken into consideration between duration of diabetes and nerve conduction velocity (NCV) implies the eventual progressive nerve damage with time. Chronic hyperglycemia leads to metabolic derangements, activation of polyol pathway, accumulation of glycation end products (AGEs), oxidative stress and microvascular dysfunction, causing nerve ischemia and demyelination^{2,15}. Recent evidence also attracts the role of chronic low-grade inflammation, impaired insulin signaling, and mitochondrial dysfunction to the speed of neuronal damage and axonal degeneration^{2,15}.

Recent researches show that diabetic peripheral neuropathy (DPN) can be acquired prior to the diagnosis of diabetes^{2,12}. Feldman et al.² believe that diabetic neuropathy is an insidious ailment that is brought about by metabolic and vascular injuries of the peripheral nerves. Equally, Papanas and Ziegler⁹ noted that subclinical neuropathy is often common and often goes undiagnosed without an electrophysiological test. Small fiber dysfunction may be the first sign of large fiber dysfunction, and is significant since it must be identified early and using sensitive techniques such as NCS^{13,14}.

Electrophysiological studies also confirm that the nerve conduction velocity and amplitude of diabetic patients are lower than normal ones^{4,5}. Recent evidence based review substantiates the fact that NCS parameters are greatly lowered in diabetic patients and this further justifies the diagnostic merit of nerve conduction studies in early neuropathy detection¹⁸. The importance of the parameters of NCS as objective biomarkers of neuropathy severity has been established by other studies that suggest that deviations in the parameters of NCS are linked to both glycemic burden and duration of disease¹.

Though there are studies such as those of Hamid et al.⁷ that could not find statistically significant relationship between the length of disease and nerve conduction parameters, most of the studies show a progressive loss in nerve functioning with length of disease. The difference in study design, sample size, population characteristics, glycemic control and methodology could be identified as the source of disagreements in results.

Poor nerve conduction parameters have also been associated with the increase in body mass index (BMI). Insulin resistance, systemic inflammation and metabolic dysregulation are some causes of obesity, which may exacerbate nerve damage. There is literature supporting the role of obesity as an independent risk factor in comparison to diabetic neuropathy and its development over time^{3,12}.

Early diagnosis of neuropathy by nerve conduction studies is important. NCS is a sensitive and objective tool that can be employed to assess subclinical nerve injury before clinical manifestations can be experienced¹⁷. NCS may help to slow the development of the disease and decrease the complications of diabetic neuropathy by the introduction of NCS into the routine diabetic check-up and strict glycemic control, lifestyle changes, and treatment with proper pharmacology, which has the potential to slow down the disease progression and lessen complications of diabetic neuropathy^{12,14,16}.

This study adds to the regional literature on the application of NCS as a screening tool in diabetic patients at a young age. The results reveal that early detection of neuropathic changes is important to enable early intervention and enhanced patient outcomes over time^{2,15}.

CONCLUSION

Abnormal nerve conduction can be observed at an early stage of type 2 diabetes mellitus and shows a strong correlation with the length of the disease. The longer the period of diabetes, the slower is nerve conduction velocity and amplitude, which means that the peripheral nerve activity is getting worse. These results indicate that diabetic neuropathy can have a subclinical onset preceding the occurrence of overt symptoms. The nerve conduction study (NCS) is an objective, sensitive and non-invasive technique of early detection of diabetic peripheral neuropathy. Neuropathic changes can be readily detected by the incorporation of NCS into the regular examination of diabetic patients, particularly those with recently diagnosed or newly-acquired diabetes. Early detection enables prompt adoption of suitable management measures, such as rigid glycemic control, lifestyle change, and pharmacological management, which could help delay the disease and mitigate the risk of serious complications, ultimately leading to better patient outcomes and quality of life.

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