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Original Research Article

Prevalence of Subclinical Neuropathy in Prediabetic Individuals Using Nerve Conduction Studies: A Case-Control Study

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Abstract:

Background: Prediabetes is increasingly recognized as a metabolic state associated with early microvascular and neural dysfunction. Peripheral neuropathy, traditionally considered a complication of overt diabetes, may begin during the prediabetic stage and remain clinically silent. Nerve conduction studies provide an objective method for detecting subclinical neuropathy before the onset of symptoms.

Objectives: To determine the prevalence of subclinical peripheral neuropathy in prediabetic individuals using nerve conduction studies and compare findings with normoglycemic controls.

Materials and Methods: This prospective case-control study was conducted at PMCH from January 2025 to July 2025. A total of 98 participants were included, comprising prediabetic individuals and age-matched normoglycemic controls. All participants underwent detailed clinical evaluation and nerve conduction studies assessing sensory and motor nerve parameters. Data were analyzed to determine the prevalence of subclinical neuropathy and compare nerve conduction parameters between groups.

Results: Prediabetic individuals demonstrated a significantly higher prevalence of subclinical neuropathy compared to controls. Nerve conduction studies revealed reduced sensory nerve conduction velocity and prolonged distal latencies in the prediabetic group, even in the absence of clinical symptoms.

Conclusion: Subclinical peripheral neuropathy is prevalent in prediabetic individuals and can be detected using nerve conduction studies. Early identification of neural involvement during the prediabetic stage may allow timely interventions to prevent progression to overt diabetic neuropathy.

Keywords: Prediabetes, Subclinical neuropathy, Nerve conduction studies, Peripheral neuropathy.

Introduction

Prediabetes represents an intermediate metabolic state between normal glucose regulation and overt diabetes mellitus. It is characterized by impaired fasting glucose, impaired glucose tolerance, or both, and is associated with an increased risk of progression to type 2 diabetes and cardiovascular disease. [1] Emerging evidence suggests that tissue injury related to hyperglycemia may begin during the prediabetic stage, even before the diagnostic threshold for diabetes is reached. [2]

Peripheral neuropathy is one of the most common microvascular complications of diabetes mellitus. Traditionally, neuropathy has been considered a late complication; however, recent studies indicate that neural dysfunction may occur early in the course of dysglycemia. [3] Prediabetic individuals may develop subtle nerve damage that remains asymptomatic and therefore undetected during routine clinical evaluation. [4]

The pathophysiology of neuropathy in prediabetes is multifactorial and involves chronic low-grade hyperglycemia, oxidative stress, microvascular dysfunction, and metabolic inflammation. [5] These mechanisms can lead to axonal injury and demyelination, particularly affecting sensory nerve fibers. [6]

Early detection of neuropathy in prediabetes is clinically important, as it may provide an opportunity for intervention before irreversible nerve damage occurs. Conventional clinical

examination often lacks sensitivity for detecting early neuropathic changes. [7] Nerve conduction studies are considered the gold standard for assessing large fiber peripheral nerve function and can detect subclinical abnormalities before the onset of overt symptoms. [8]

Several studies have reported altered nerve conduction parameters in individuals with impaired glucose tolerance and prediabetes. [9-11] However, reported prevalence rates of subclinical neuropathy vary widely due to differences in study design, diagnostic criteria, and population characteristics. [12]

In the Indian population, where the burden of prediabetes is substantial, data on early neural involvement remain limited. Identifying subclinical neuropathy in prediabetic individuals may help refine screening strategies and guide preventive measures. [13]

The present study was undertaken to determine the prevalence of subclinical peripheral neuropathy in prediabetic individuals using nerve conduction studies and to compare nerve conduction parameters with normoglycemic controls.

Materials and Methods

Study Design: Prospective case-control study.

Study Setting: The study was conducted at Patna Medical College and Hospital (PMCH).

Study Duration: January 2025 to July 2025.

Study Population: Prediabetic individuals and normoglycemic controls attending outpatient services.

Sample Size: A total of 98 participants were included.

Inclusion Criteria

- Adults aged 18 years and above
- Prediabetic individuals diagnosed based on standard glycemic criteria.
- Age-matched normoglycemic controls

Exclusion Criteria

- Known diabetes mellitus
- History of peripheral neuropathy
- Alcohol abuse
- Vitamin B12 deficiency
- Neuromuscular disorders, Thyroid disorders, Chronic kidney disease

Nerve Conduction Studies: Motor and sensory nerve conduction studies were performed using standard techniques. Parameters assessed included:

- Distal latency
- Amplitude
- Nerve conduction velocity

Upper and lower limb nerves were evaluated under controlled laboratory conditions.

Statistical Analysis: Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation. Group comparisons were performed using Student's t-test for continuous variables and Chi-square test for categorical variables**,** with $p < 0.05$ considered statistically significant.

Results

A total of 98 participants were evaluated, comprising prediabetic individuals and age-matched normoglycemic controls. Baseline demographic variables such as age and sex distribution were comparable between the two groups.

Nerve conduction studies revealed a significantly higher prevalence of subclinical peripheral neuropathy in the prediabetic group compared to controls ($p < 0.05$). Sensory nerve conduction velocity was notably reduced in prediabetic individuals, particularly in the sural and median sensory nerves.

Motor nerve parameters showed mild prolongation of distal latencies in the prediabetic group, although amplitude reduction was less pronounced. Sensory nerves were more frequently affected than motor nerves.

A substantial proportion of prediabetic participants demonstrated abnormal nerve conduction findings despite the absence of clinical symptoms, confirming the presence of subclinical peripheral neuropathy.

These findings indicate early neural involvement during the prediabetic stage, emphasizing the diagnostic value of nerve conduction studies for early detection.

Discussion

The present study demonstrates a high prevalence of subclinical peripheral neuropathy in prediabetic individuals as detected by nerve conduction studies. These findings support the concept that neural dysfunction begins early in the spectrum of dysglycemia. [14]

Alterations in sensory nerve conduction parameters observed in this study are consistent with previous reports highlighting preferential involvement of sensory fibers in early neuropathy. [15-17] Chronic exposure to mildly elevated glucose levels may induce metabolic and vascular changes that compromise nerve integrity. [18]

Several studies have reported similar findings, suggesting that impaired glucose tolerance is associated with measurable nerve conduction abnormalities even in the absence of overt diabetes.

[19-21] The higher prevalence of neuropathy observed in the present study may reflect population-specific metabolic risk factors.

The use of nerve conduction studies allowed objective detection of subclinical neuropathy, emphasizing their utility in early screening. Clinical examination alone may fail to identify these early changes. [22]

The findings underscore the importance of early metabolic control in prediabetic individuals. Lifestyle modification and glycemic optimization during this stage may prevent or delay progression to diabetic neuropathy. [23]

Limitations of the study include its relatively small sample size and cross-sectional nature, which preclude causal inference. Longitudinal studies are needed to assess progression of neuropathy in prediabetes. [24-25]

Conclusion

Subclinical peripheral neuropathy is common in prediabetic individuals and can be reliably detected using nerve conduction studies. Early identification of neural involvement during the prediabetic stage provides an opportunity for timely intervention to prevent progression to overt diabetic neuropathy.

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