Clinical and Electrophysiological evaluation of patients with diabetic Neuropathy

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ABSTRACT

Diabetic neuropathy (DN) is one of the most common and debilitating complications of diabetes mellitus, affecting nearly half of all individuals with long-standing diabetes. It is a progressive disorder resulting from chronic hyperglycemia, oxidative stress, and microvascular dysfunction, leading to structural and functional damage of peripheral nerves. The condition manifests in various forms, including distal symmetric polyneuropathy (DSPN), autonomic neuropathy, and focal neuropathies, each with distinct clinical and pathophysiological features. Early detection and accurate evaluation of diabetic neuropathy are crucial for timely intervention and management.To study types of neuropathy in Type 2 diabetes and to study the Neurophysiologic patterns in each type of Diabetic Neuropathy and the extent of their clinical correlation.A hospital-based cross-sectional study was conducted in the Department of General Medicine in V.M.K.V. MEDICAL COLLEGE HOSPITAL from January 2024 to November 2024. A total of 150 Type II diabetic patients with a minimum 5-year duration of diabetes will be selected from Vinayaka Mission Kirupananda Variyar Medical College and Hospital Salem for the study. Determination of whether a patient had neuropathy was based on review of the medical record, neurologic tests including bed side autonomic function tests, nerve conduction (NC) abnormalities. Sensorimotor polyneuropathy was the most common form of peripheral neuropathy (58.7%), followed by mixed type peripheral neuropathy (29.3%) and Autonomic Neuropathy (AN) (12.0%). Regarding the grades of diabetic neuropathy, 47.4% had grade 2 diabetic neuropathy, 31.3% had grade 1 and 12.0% ha\d grade 3 of diabetic neuropathy.The clinical and electrophysiological evaluation of diabetic neuropathy provides a comprehensive understanding of disease severity, progression, and prognosis. While clinical assessment identifies symptomatic and functional impairments, electrophysiological studies objectively confirm neuropathy, assess nerve damage, and help rule out other causes of neurpaothy.

Introduction:

Diabetic neuropathy (DN) is one of the most common and debilitating complications of diabetes mellitus, affecting nearly half of all individuals with long-standing diabetes. It is a progressive disorder resulting from chronic hyperglycemia, oxidative stress, and microvascular dysfunction, leading to structural and functional damage of peripheral nerves[1]. The condition manifests in various forms, including distal symmetric polyneuropathy (DSPN), autonomic neuropathy, and focal neuropathies, each with distinct clinical and pathophysiological features. Given its significant impact on quality of life, morbidity, and the risk of foot ulcers and amputations, early detection and accurate evaluation of diabetic

neuropathy are crucial for timely intervention and management[2].

A comprehensive assessment of diabetic neuropathy requires both clinical evaluation and electrophysiological studies. Clinical evaluation involves a detailed history and neurological examination to identify sensory, motor, and autonomic dysfunction. Common symptoms include numbness, tingling, burning pain, and loss of sensation, often in a stocking-glovedistribution. Motor involvement may present as muscle weakness and atrophy, while autonomic neuropathy can affect cardiovascular, gastrointestinal, and genitourinary functions. Various clinical scoring systems, such as the Michigan Neuropathy Screening Instrument (MNSI) and the Neuropathy Disability Score (NDS), help quantify the severity of neuropathy[3].

Electrophysiological studies, particularly nerve conduction studies (NCS) and electromyography (EMG), play a crucial role in confirming the diagnosis, assessing disease severity, and differentiating diabetic neuropathy from other neuropathic disorders[4]. NCS evaluates nerve conduction velocity, latency, and amplitude, providing objective evidence of axonal degeneration and demyelination. EMG is useful in detecting muscle denervation in advanced cases. Additional tests, such as quantitative sensory testing (QST) and autonomic function tests, can further refine the diagnostic approach[5].

By integrating clinical and electrophysiological assessments, healthcare professionals can achieve a more accurate diagnosis and tailor management strategies for diabetic neuropathy[6]. Early recognition enables timely intervention, including glycemic control, pharmacological treatment for neuropathic pain, and lifestyle modifications to prevent complications[7]. As the global burden of diabetes continues to rise, a systematic approach to evaluating diabetic neuropathy remains essential for improving patient outcomes and quality of life.

Aim:

1) To study types of neuropathy in Type 2 diabetes.
2) To examine the Clinical Profile of each type of Diabetic Neuropathy.
3) To study the Neurophysiologic patterns in each type of Diabetic Neuropathy and the extent of their clinical correlation.

Methodology:

A hospital-based cross-sectional study was conducted in the Department of General Medicine in V.M.K.V. MEDICAL COLLEGE HOSPITAL from January 2024 to November 2024. A total of 150 Type II diabetic patients with a minimum 5-year duration of diabetes will be selected from Vinayaka Mission Kirupananda Variyar Medical College and Hospital Salem for the study.

Inclusion criteria:

1. Type II diabetic patients with a minimum 5-year duration of diabetes
2. Age 20-60 years

Exclusion criteria:

1. Patient age more than 60 years.
2. Patient with thyroid disease, Chronic Kidney Disease, auto Rheumatoid Arthritis, nutritional and toxic diseases eg. Alcohol and history of taking Neuropathy causing drugs (eg:chemotherapy agents), collagen vascular disease and malignancies.

Data collection method:

A written consent form was obtained from the study participants before the start of the study. Determination of whether a patient had neuropathy was based on review of the medical record, neurologic tests including bed side autonomic function tests, nerve conduction (NC) abnormalities. Three approaches were used to determine whether a neurologic abnormality was due to diabetes mellitus or to another cause: (1) the patient's

history and the medical record were searched (2) additional tests were performed if needed; and (3) judgments were made as to whether the findings were typical of diabetic neuropathy. Systematic questioning, including family history of nondiabetic peripheral nerve disease and the presence of toxic, metabolic, mechanical, and vascular causes ofnerve disease, was conducted. All patients underwent tests for complete blood count and routine serum chemistry including lipid profiles as well as tests for thyroid hormones, HbA1C and E.C.G. History and physical examination were collected. In the sensory examination, the response to each test were considered normal, decreased, or absent. The instruments used were a disposable pin for pain evaluation, a 1) cotton tip for light touch, sensation, and 4) 3) 2) a 128 Hz tuning fork for vibration finger and toe movements with immobilization of the proximal joint to evaluate joint position. The sites examined included the distal toe and distal finger. The motor system was examined manually for individual muscles with a previously used validated grading system. Mechanical devices to evaluate strength may not add precision because they emphasize groups of muscles and because the condition of the joints and periarticular tissues frequently are abnormal in diabetes. Muscle testing is of limited value in assessing mild diabetic neuropathy. Weakness appears late and usually only involves intrinsic foot muscles and ankle dorsiflexors; more proximal muscles are only involved in more severe cases of diabetic polyneuropathy[8,9].

Data analysis:

The data was entered in MS EXCEL 2019 and analyzed using SPSS Statistics 16.0. Quantitative variables were expressed in mean standard deviation and qualitative variables were expressed in proportions.

Results:

Table 1: Demographic profile of the study subjects (N=150)

Variables	Characteristics	Frequency (n)	Percentage (%)
Age in years	25-36	11	7.3
	36-45	28	18.7
	46-55	49	32.7
	>55	62	41.3
Gender	Male	88	58.7
	Female	62	41.3
Duartion of diabetes (in years)	5-10	33	22.0
	11-15	55	36.7
	16-20	39	26.0
	>20	23	15.3
Family History of diabetes	Present	55	36.7
	Absent	95	63.3
BMI	Normal	44	29.3
	Overweight	59	39.3
	Obese	47	31.4
HbA1C	<7%	56	37.3
	>7%	94	62.7
Mode of treatment	OHA	107	71.3
	Insulin	43	28.7

Table 2: Clinic profile of diabetic neuropathy among the study subjects (N=150)

Clinical symptoms	Frequency	Percentage
NUMBNESS OF HANDS AND FEET	110	73.3
PINS AND NEEDLES	77	51.3
SENSATIONS		
BURNING FEET	45	30.0
UNSTEADINESS IN DARKNESS	66	44.0

Table 3: Grades of diabetic neuropathy among the study subjects (N=150)

Grades of diabetic neuropathy	Frequency	Percentage
Grade 0	14	9.3
Grade 1	47	31.3
Grade 2	71	47.4
Grade 3	18	12.0

Table 4: Distal Motor Latency of the study subjects (N=150)

Variable	Normal	Increased	No response	Mean ± SD
Medial	96	37	17	4.3 ± 1.9
Ulnar	105	23	22	3.9 ± 1.1
Tibial	88	44	18	5.4 ± 1.4
Peroneal	86	38	26	5.6 ± 1.3
Facial	143	7	-	-

Table 5: Distal Motor Amplitude of the study subjects (N=150)

Variable	Normal	Decreased	No response	Mean ± SD
Medial	47	86	17	2.7 ± 1.6
Ulnar	49	79	22	3.1 ± 2.0
Tibial	39	93	18	2.4 ± 1.4
Peroneal	38	86	26	1.7 ± 1.3
Facial	145	5	-	-

Table 6: Motor Conduction Velocity of the study subjects (N=150)

Variable	Normal	Increased	No response	Mean ± SD
Medial	106	27	17	46.7 ± 6.9
Ulnar	104	24	22	47.1 ± 7.4
Tibial	89	43	18	39.3 ± 4.7
Peroneal	91	33	26	39.6 ± 2.9

Table 7: Sensory Amplitude and Sensory Conduction Velocity (Sural) of the study subjects (N=150)

Variable	Normal	Decreased	No response
Sensory Amplitude			
Median	77	67	6
Ulnar	88	54	8
Lower limb	39	96	15
Sensory Conduction Velocity (Sural)			
Lower Limb	72	52	26

Table 8: Type of Neuropathies among the study subjects (N=150)

Type of Neuropathies	Frequency	Percentage
SYMMETRIC SENSORIMOTOR	86	57.3
PAINFUL DISTAL SENSORY	33	22.0
DIABETES WITH AIDP	4	2.7
DIABETES WITH CIDP	6	4.0
LUMBOSACRAL RALICULO	5	3.3
MONONEURITIS MULTIPLEX	4	2.7
CRANIAL NEUROPATHIES	7	4.7

In the present study, the majority of the study subjects belonged to the age group of more than 55 years (41.3%) followed by 32.7% belonged to the age group 46-55 years, 58.7% of the study subjects were males and 41.3% were females. Regarding the duration of diabetes, 36.7% of subjects had 11-15 years of diabetes, 26.0% of subjects had 16-20 years of diabetes and 22.0% had 5-10 years of diabetes. Most of the study subjects had no family history of diabetes (36.7%) and 63.3% had family history of diabetes. Regarding the BMI, 39.3% of the study subjects had overweight and 31.4% of the study subjects had obese. Most of the study subjects had OHA (71.3%) and 28.7% had insulin as a mode of treatment.

In the current study, Sensorimotor polyneuropathy was the most common form of peripheral neuropathy (58.7%), followed by mixed type peripheral neuropathy (29.3%) and Autonomic Neuropathy (AN) (12.0%). Regarding the grades of diabetic neuropathy, 47.4% had grade 2 diabetic neuropathy, 31.3% had grade 1 and 12.0% had grade 3 of diabetic neuropathy.

Poor glycemic control was found in 94 patients (62.7%) while 56 (37.3%) were well controlled. In the present study 81 patients had autonomic symptoms, most common autonomic symptom is postural hypotension 25 patients. Majority of the patients (52.0%) were hypertensive while hyperlipidemia was found in 32.0% of the patients and a history of smoking in 41 patients (27.3%). Normal NCS were found in 27 patients (18.0%) and abnormal NCS were found in 123 patients (82.0%).

Discussion:

Diabetic neuropathy is a significant complication that contributes to the morbidity of diabetic patients. Evidence suggests that early diagnosis of subclinical diabetic neuropathy can help reduce the incidence of diabetic foot ulcers and amputations. Additionally, there is a strong correlation between polyneuropathy, the duration of diabetes, and HbA1C levels, highlighting the importance of maintaining near-normal glycemic control as a precautionary measure to delay the onset or progression of polyneuropathy[10].

Electrophysiological studies, particularly nerve conduction studies (NCS) and electromyography (EMG), are the gold standard for confirming diabetic neuropathy. These tests help assess the extent, severity, and pattern of nerve involvement, providing valuable insights into disease pathophysiology. While clinical symptoms of diabetic neuropathy often correlate with electrophysiological findings, discrepancies can occur[11]. Some patients may have electrophysiological abnormalities without significant symptoms, whereas others may have debilitating symptoms despite relatively mild nerve conduction changes. This highlights the importance of using both clinical and electrophysiological assessments in combination to achieve a more accurate diagnosis and classification[12]. The present study aimed to the study types of neuropathy in Type 2 diabetes and to examine the Clinical Profile of each type of Diabetic Neuropathy.

In the present study, the majority of the study subjects belonged to the age group of more than 55 years (41.3%) followed by 32.7% belonged to the age group 46-55 years, 58.7% of the study subjects were males and 41.3% were females. Pechmann LM et al[13] study found that the mean age of the study population was 65.6 ± 8.6 years, 64.4% were male and 35.6% were female. Regarding the duration of diabetes, 36.7% of subjects had 11-15 years of diabetes, 26.0% of subjects had 16-20 years of diabetes and 22.0% had 5-10 years of diabetes. Most of the study subjects had OHA (71.3%) and 28.7% had insulin as a mode of treatment. Similarly, Takahashi et al[14] study reported that the mean duration of diabetes was 14.1 ± 10.0 years and Mori et al[15] study found that the mean diabetes duration of the patients was 16.6 ± 11.5 years. There were no significant relation between Diabetic neuropathy and sex, BMI, hypertension or hyperlipidemia which is in agreement with the findings of Hillson et al[16] and Maser et al[17].

In the current study, the various clinical types of PN in this study correlate well with most studies all over the world, with sensorimotor polyneuropathy — diagnosed in 57.3%—being the most common. Symptoms of PN manifested at a significantly older age in the present study. In contrast study, Vondrova and coworkers in Czech[18], who found that diabetic polyneuropathy manifested at a younger age. Fernandez Castaner et al[19] had reported that 53% of an unselected series of diabetics had symptoms suggestive of autonomic dysfunction.

Conclusion:

The clinical and electrophysiological evaluation of diabetic neuropathy provides a comprehensive understanding of disease severity, progression, and prognosis. While clinical assessment identifies symptomatic and functional impairments, electrophysiological studies objectively confirm neuropathy, assess nerve damage, and help rule out other causes of neuropathy. A combination of these methods is crucial for early diagnosis, timely intervention, and improved patient outcomes. As research continues to evolve, integrating newer diagnostic modalities with traditional methods will further enhance the precision and effectiveness of diabetic neuropathy evaluation.

Conflict of interest: None

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