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Original Research Article

Study of clinical and nerve conduction study correlation in patients of diabetic neuropathy in diabetes mellitus type 2

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ABSTRACT

Background: Diabetes mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia with disturbance of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action or both with an increased risk of neuropathy. Early diagnosis and management of diabetic polyneuropathy (DPN) are crucial as failure to diagnose can lead to serious consequences, including disability and amputation. Present study aimed at investigating the demographic profile and correlation of clinical features with nerve conduction studies in patients with diabetic neuropathy in type 2 diabetes mellitus.
Methods: The cross-sectional study design with total 66 patients of type 2 DM were selected in 30 to 60-year age groups, from Pt. Jawaharlal Nehru Memorial Medical College, Department of Medicine, Raipur (C.G.) (Pt. JNMMC) and associated hospital. Descriptive statistics and χ^2 test were used for analysing the data.
Results: Total 66 patients were selected, Most of the patients are presenting with tingling sensation (n=64, 97.0%) and burning feet (n=52, 78.8%), NCV is mostly absent in the tibial nerve (n=52, 78%), sural nerve (n=63, 95.5%) and planter nerve (n=41, 62.1%) while it is largely normal in median nerve (n=54, 81.8%) and ulner nerve (n=61, 92.4%). Tingling sensation, burning feet, diminished vibration sensation and diminished light touch are significantly associated (p=0.00) with NCV in different nerves.
Conclusions: Limitations of study includes small sample size, lack of general population, and a control group. Diabetes mellitus is a chronic illness with an increased risk of neuropathy. NCS having high sensitivity and specificity for detection of DPN. Understanding the NCS and its correlates in patients with DPN is crucial for early detection and development of effective management and strategies to prevent its complications.

Keywords: Cross-sectional study, Diabetic polyneuropathy (DPN), Nerve conduction studies

INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia with disturbance of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action or both (World Health Organization (WHO), 1999).[1] DM is broadly categorized as type 1 and type 2. Type 1 diabetes is the result of complete or near-total insulin deficiency (American Diabetes Association, 2018) while Type 2 DM is a heterogeneous group of disorders characterized by combination of varying degrees of resistance to insulin action, inadequate insulin secretion, and excessive or inappropriate glucagon secretion.[2-5] The Majority of patients about 90-95% have type 2 DM. Type 2 DM treated with diet modification and regular exercise, moreover, diet is supplemented with oral hypoglycemic agents or may require parenteral insulin for persisting hyperglycemia.[6]

Diabetes mellitus is a chronic illness characterized by increased risk of macrovascular and microvascular

complications and linked with long-standing damage, dysfunction, and malfunction of different organs like the eyes, kidneys, skin, heart, nerves, and blood vessels.[7,8]

Diabetic peripheral neuropathy is defined as "the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after exclusion of other causes".[9] Neuropathies are the most common complication affecting up to 50% of patients with type 1 and type 2 DM which decreases their quality of life (QOL).[10-12] Diabetic neuropathy manifest with a wide variety of sensory, motor, and autonomic symptoms and classified into several clinical syndromes (American Diabetes Association, (APA) 2018).[2] The primary symptoms of neuropathy (include burning, electric shocks, shooting/stabbing down the leg, pins, needles and tingling sensation) are highly unpleasant while the secondary complications (falls, foot ulcers, cardiac arrhythmias, and ileus) are even more severe and can lead to fractures, amputations, and even death in patients with DM.[13,14] The routine evaluation of DPN is based on patient symptoms and physical examination, however, simple screening methods are of limited value for the elderly, in early neuropathy and in the presence of neurological co-morbidities.[15] Early diagnosis and management are crucial to failure to diagnose diabetic polyneuropathy can lead to serious consequences, including disability and amputation.[13]

Nerve conduction studies (NCS) assess the ability of the nervous system to conduct electrical impulses and to evaluate nerve/muscle function to determine the presence of neuromuscular disease. NCS having high sensitivity and specificity for detection of DPN. Understanding the Nerve conduction studies (NCS) and its correlates in patients with DPN is crucial for early detection and development of effective management strategies and prevention of its dreaded complications.[16-18]

Diabetic polyneuropathy is an under-diagnosed condition and there remain substantial unmet needs for the early diagnosis and management in real practice our current study is an attempt toward it to fulfill this lacuna, with the aims and objectives to find out demographic factors and any correlation between clinical features of peripheral neuropathy with nerve conduction velocity in patient with type 2 diabetes mellitus.

METHODS

The study was conducted at the Department of Medicine, Pt. JLNMMC, and Dr. BRAM Hospital Raipur, Chhattisgarh from February 2016 to October 2017.

Inclusion criteria

- Patients presented in the hospital who diagnosed as type 2 diabetes Mellitus as defined by WHO (Diabetic care 2014)
- Having symptom suggestive of peripheral neuropathy with onset after the age of 30 years
- aged less than 70 years
- Willing and capable to provide informed consent.

Exclusion criteria

- Patients with type 1 Diabetes
- Chronic alcoholic
- CVA and peripheral neuropathy due to any other known cause
- Peripheral artery disease or evidence of limb ischemia
- Patients refused to give informed consent.

Measure

A detailed Informed consent was obtained from patients before data collection, following data were collected in a predetermined proforma. A detailed history of neuropathy was recorded. Symptoms of neuropathy like paraesthesia, tingling sensation, burning feet, hyperaesthesia, foot ulcer, history of weakness and gait abnormality was noted, and complete Central Nervous System examination performed to look for signs such as diminished ankle jerk, diminished power. Sensory examination for the loss of light touch, superficial pain, temperature sense, vibration and the joint position was performed.

Nerve conduction studies (NCV)

Nerve conduction studies were performed using the Clarity Octopus NCV machine. The patient's limb was placed in a relaxed position to prevent any limb movement, the limb was kept warm, room temperature was maintained between 21- 23°C. Electrode impedance was reduced by applying electrode gel under the electrode and fixed with adhesive tape to the skin. Nerve conduction study was performed in tibial, sural, medial plantar and lateral plantar nerves in the lower limb and median and ulnar nerve in the upper limb.

Statistical analysis

The patient's socio-demographic detail was analyzed using descriptive statistics. The descriptive statistics were expressed as frequency (N, %) and mean ± standard deviation. The association between symptoms of neuropathy with NCV in different nerves was assessed by using Pearson's χ^2 correlation.

RESULTS

The study was conducted at the Department of Medicine, Pt. JLNMMC and Dr. BRAM Hospital Raipur, Chhattisgarh and included total 66 patients with type 2 diabetes Mellitus.

Table 1: Demographic profile of the subjects with DPN.

Variables		Frequency	Percent
Age (years)	Mean ± SD	51.80 (±10.24)	
	Range	35-60	
Gender	Female	23	34.8
	Male	43	65.2
Diet	Non-veg	47	71.2
	Veg	19	28.8
Past history	Associated condition	DM 66	100
	Treatment history	OHA 66	100

Table 2: Symptoms of neuropathy in subjects with DPN.

Symptoms		Frequency	Percent
Tingling sensation	No	02	3.0
	Yes	64	97.0
Burning feet	No	14	21.2
	Yes	52	78.8
Diminished ankle jerk	No	35	53.0
	Yes	31	47.0
Diminished vibration sense	No	46	69.7
	Yes	20	30.3
Diminished light touch	No	50	75.8
	Yes	16	24.2
Diminished joint position sense	No	58	87.9
	Yes	08	12.1

Table 3: Random blood glucose level of the subjects with DPN.

RBS (mg/dl)	Frequency	Percent
</=140	22	33.3
141-200	44	66.7

Table 1 shows demographic profile of the subjects with DPN and it reveals that the mean (±SD) age (Years) of the patients is 51.80 ((±10.24) with the range of 35-60 years, most of them are male (n=43, 65.2%) and non-vegetarian by dietary habit (n=47, 71.2%), all the subject having past history of diabetes mellitus and on oral hypoglycemic agents.

Table 2 shows symptoms of neuropathy in subjects with DPN and it reveals that the majority of the patient presented with tingling sensation (n=64, 97.0%) and burning feet (n=52, 78.8%), while other symptoms are present in a lesser amount which includes diminished ankle jerk (n=31, 47.0%), diminished vibration sense (n=20, 30.3%), diminished Light touch (n=16, 24.2%), and diminished joint position sense (n=8, 12.1%).

Table 3 shows the random blood glucose level of the subjects with DPN and it reveals that the most of the subjects are at hyperglycemic state (n=44, 66.7%).

Table 4 shows nerve conduction study results in different nerves in the study subjects and it demonstrates the NCV is mostly absent in tibial nerve (n=52, 78%), sural nerve (n=63, 95.5%) and planter nerve (n=41, 62.1%) while it is largely normal in median nerve (n=54, 81.8%) and ulner nerve (n=61, 92.4%).

Table 4: Nerve conduction study results in different nerves in study subjects with DPN.

NCV study		Frequency	Percent
NCV in tibial nerve	absent	52	78.8
	normal	14	21.2
NCV in sural nerve	absent	63	95.5
	normal	03	4.5
NCV in plantar nerve	absent	41	62.1
	normal	25	37.9
NCV in median nerve	absent	12	18.2
	normal	54	81.8
NCV in ulnar nerve	absent	05	7.6
	normal	61	92.4

Table 5 shows the association of symptoms of neuropathy with NCV in Tibial nerve and the findings reveals that Tingling Sensation, burning feet and diminished light touch were significantly associated (P<0.00*, P<0.00*, P<0.00* respectively) with NCV in Tibial Nerve. Rest of the symptoms i.e. diminished ankle jerk, diminished vibration sense and diminished position sense were not significantly associated with NCV in tibial nerve.

Table 5: Association of symptoms of neuropathy with NCV in tibial nerve.

Symptoms		NCV in tibial nerve		Df	χ^2 test	P value
		Absent	Normal			
Tingling sensation	N	02	00	2	1.88	0.00*
	Y	50	14			
Burning feet	N	11	03	2	1.39	0.00*
	Y	41	11			
Diminished ankle jerk	N	28	07	2	1.92	0.43
	Y	24	07			
Diminished vibration sense	N	35	11	2	1.9	0.45
	Y	17	03			
Diminished light touch	N	39	11	2	1.14	0.00*
	Y	13	03			
diminished position sense	N	44	14	2	0.954	0.76
	Y	08	00			

Notes: χ^2 test was done to obtain the *P*-value; * *P*-value was significant (P<0.05).

Table 6 shows the association of symptoms of neuropathy with NCV in Sural nerve and the findings reveals that

Tingling Sensation and diminished ankle Jerk were significantly associated (P<0.00*, P<0.00*respectively) with NCV in Sural Nerve, rest of the symptoms i.e. burning feet and diminished vibration sense were not significantly associated with NCV in Sural Nerve.

Table 6: Association of symptoms of neuropathy with NCV in sural nerve.

Symptoms		NCV in sural nerve		df	χ^2 test	P value
		Normal	Absent			
Tingling sensation	N	0	02	2	1.55	0.00*
	Y	3	61			
Burning feet	N	0	35	2	1.69	0.10
	Y	3	28			
Diminished ankle jerk	N	2	44	2	0.882	0.65
	Y	1	19			
Diminished vibration sense	N	1	49	2	1.45	0.00*
	Y	2	14			

Notes: χ^2 test was done to obtain the *P*-value; * *P*-value was significant (P<0.05).

Table 7: Association of symptoms of neuropathy with NCV in planter nerve.

Symptoms		NCV in plantar nerve		Df	χ^2 test	P Value
		Absent	Normal			
Tingling sensation	N	02	00	2	1.33	0.00*
	Y	39	25			
Burning feet	N	22	13	2	1.89	0.55
	Y	19	12			
Diminished ankle Jerk	N	28	18	2	1.67	0.00*
	Y	13	07			
Diminished vibration sense	N	31	19	2	1.7	0.346
	Y	10	6			
Diminished light touch	N	36	22	2	0.993	0.81
	Y	05	03			

Notes: χ^2 test was done to obtain the *P*-value; * *P*-value was significant (P<0.05).

Table 7 Shows the association of symptoms of neuropathy with NCV in planter nerve and the findings reveals that tingling sensation and diminished ankle jerk were significantly associated (P<0.00*, P<0.00*respectively) with NCV in planter nerve, rest of the symptoms i.e. burning feet, diminished light touch and diminished vibration sense were not significantly associated with NCV in planter nerve.

Table 8 Shows the association of symptoms of neuropathy with NCV in median nerve and the findings reveals that tingling sensation and diminished light touch significantly associated (P<0.00*, P<0.00*respectively) with NCV in median nerve, rest of the symptoms i.e. burning feet, diminished ankle jerk was and diminished vibration sense were not significantly associated with NCV in median nerve.

Table 8: Association of symptoms of neuropathy with NCV in median nerve.

Symptoms		NCV in median nerve		Df	χ^2 test	*P* Value
		Absent	Normal			
Tingling sensation	N	09	37	2	1.34	0.00*
	Y	03	17			
Burning feet	N	08	42	2	2	0.65
	Y	04	12			
Diminished ankle Jerk	N	09	49	2	1.89	0.74
	Y	03	05			
Diminished vibration sense	N	00	02	2	1.62	0.33
	Y	12	52			
Diminished light touch	N	00	02	2	1.92	0.00*
	Y	05	59			

Notes: χ^2 test was done to obtain the *P*-value; * *P*-value was significant (P<0.05).

DISCUSSION

The majority of our subjects are over 50 years of age. Hence the result cannot be generalized and applicable only to this age group. Our study group is comparable to other studies who used the same age group of subjects.[19] Most of the subjects are male and taking oral hypoglycemic agents, demographic studies also show a higher prevalence of DM in male patients compared to females.[2]

Tingling sensation and burning feet are the predominant symptoms of diabetic neuropathy, while other symptoms are present in a lesser amount which includes diminished ankle jerk, diminished vibration sense, diminished Light touch, and diminished joint position sense.[2,13,14] At the time of study, our majority of patients having a poorly controlled diabetic state which reflects the need for proper education and management of patients. NCV is mostly absent in tibial nerve, sural nerve and in planter nerve while it is largely normal in median nerve and ulner nerve. These findings are in line with other studies.[16,17] which reflects that the tibial nerve, sural nerve and planter nerve are the best candidate for NCV studies in diabetic neuropathy. Tingling sensation, burning feet, diminished light touch and diminished vibration sensation are significantly associated with NCV in different nerves. These findings were in line with other studies, it signifies the role of NCV in the patient of diabetes, which can be used to detect neuropathy early with high sensitivity and specificity.1[6,18] If any diabetic patient presenting with symptoms suggestive of neuropathy, NCV can be used early detection and management of it which can help to prevent any complication related to it.

CONCLUSION

To conclude "present study shows that diabetic neuropathy is more common in middle and elderly age. We also conclude that diabetic neuropathy is proportion

to duration of diabetes. Severity of diabetic neuropathy was positively relating with higher blood glucose level. Tingling sensation and burning feet were most common found symptoms. Diminished ankle jerk and loss of vibration senses were most common found signs and distal symmetrical types of polyneuropathy was the common types in our study. Tibial and sural nerve were more commonly involved. Hence, authors propose that early detection of diabetic neuropathy through detailed assessment of lineal features and nerve conduction velocity testing of diabetes patients, to reduce the burden of complication in the form of neuropathy and to improve the quality of life in diabetics.

Despite authors best effort, there are limitations of present study, which includes small sample size, study have not taken general population, and lack of a control group. These limitations can be overcome in the future studies.

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