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Original Research Article

Comparative study of detection of diabetic neuropathy by clinical and nerve conduction study in type 2 diabetes mellitus patients

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ABSTRACT

Background: Diabetes mellitus is known for its complications such as retinopathy, neuropathy and nephropathy. Diabetic neuropathy is one of the devastating complication associated with diabetes mellitus. The objective of this study was to detect sensory motor neuropathy in type 2 Diabetes mellitus by clinical examination and nerve conduction study and to correlate clinical features of peripheral neuropathy with nerve conduction study in Type 2 Diabetes mellitus.
Methods: This study was undertaken to study types of neuropathy in type 2 diabetes and to correlate clinical features of peripheral neuropathy with nerve conduction study in type 2 diabetes mellitus.100 patients with diabetes whose onset of diabetes mellitus after age of 30 years and duration of diabetes 5 years or more visiting SGRDIMSR, Vallah, Amritsar were subjected to nerve conduction study to find out peripheral neuropathy.
Results: Eight four percentage patients were found to have neuropathy on NCS whereas only 61% of patients were found to have neuropathy on clinical examination and detection rate with NCS was statistically significant ($p < 0.001$) as compared to clinical examination.
Conclusions: NCS helps in early detection of neuropathy and most common form of diabetic neuropathy is distal symmetrical polyneuropathy.

Keywords: Clinical examination, Diabetic neuropathy, Nerve conduction study, Type 2 Diabetes mellitus

INTRODUCTION

Diabetes mellitus comprises a group of common metabolic disorders that share the phenotype of hyperglycaemia. Depending upon the aetiology, factors contributing to hyperglycaemia may include reduced insulin secretion, insulin action, decreased glucose utilization and increased glucose production.[1] The prevalence of diabetes is rapidly rising all over the globe at an alarming rate. The International Diabetes Federation (IDF) estimated the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025.[2]

There is a long pre-symptomatic phase before appearance of symptoms of type 2 diabetes. Therefore, type 2 diabetes is frequently not diagnosed until complications have already occurred. The chronic complications of DM affect many organ systems and are responsible for the majority of morbidity and mortality associated with the disease. Chronic complications can be divided into vascular and non-vascular complications. The vascular complications of DM are further subdivided into microvascular (retinopathy, neuropathy, nephropathy) and macrovascular complications - coronary artery disease (CAD), peripheral arterial disease (PAD), cerebrovascular disease. Non-vascular complications

include problems such as gastroparesis, infections and skin changes.[3] It may manifest as polyneuropathy, mononeuropathy, radiculopathy and/or autonomic neuropathy. The development of neuropathy correlates with the duration of diabetes and glycaemic control. Because the clinical features of diabetic neuropathy are similar to those of other neuropathies, it is important, that in patients with neuropathy, particularly when severe, the diagnosis should be made only after other possible etiologies are excluded such as neurotoxic medications, heavy metal poisoning, alcohol abuse, vitamin B_{12} deficiency, inherited neuropathies and vasculitis.[4] The diagnosis of diabetic peripheral neuropathy is mainly based on the characteristic symptoms.[5] But symptoms usually develop at any degree of neuropathic impairment or may not develop at all. This indicates the need for doing nerve conduction studies (NCS).[6] Nerve conduction studies (NCS) can document the characteristics of the neuropathy (e.g. axonal, demyelinating) and the localization (e.g. mononeuropathy versus radiculopathy or distal neuropathy) and possibly, the severity and even prognosis for morbidity. These studies can document the characteristics of the neuropathy (e.g. axonal, demyelinating) and the localization (e.g. mononeuropathy versus radiculopathy or distal neuropathy) and possibly severity and even prognosis for morbidity. Studies are commonly performed on upper and lower limbs on motor and sensory nerves.[7,8]

Aims and objectives of this study were to detect sensory motor neuropathy in type 2 Diabetes mellitus by clinical examination and nerve conduction study and to correlate clinical features of peripheral neuropathy with nerve conduction study in type 2 Diabetes Mellitus.

METHODS

100 patients of type 2 diabetes mellitus with age more than 30 years and duration of diabetes 5 years or more visiting SGRDIMSR, Amritsar were taken for the present study excluding type 1 diabetics, chronic alcoholics and due to other causes of peripheral neuropathy. Detailed history regarding symptoms like paresthesias, tingling sensation, burning feet, hyperaesthesia was taken, history of weakness and gait abnormality was noted. Complete central nervous system examination was performed to look for signs such as diminished ankle jerk. Sensory examination for loss of light touch, superficial pain, vibration and joint position was done. Diagnosis of peripheral neuropathy was based on thorough clinical evaluation and nerve conduction study. All diagnosed Type 2 diabetic patients were subjected to nerve conduction study.

RESULTS

In this study 100 cases of type 2 diabetes were taken, and we found that out of 100 patients there were 63% females and 37% males. Age of patients varied from 31-90 years with 63% comprising in middle age group i.e. 41-60 years. Mean age was found to be 57.90 years. Duration of Diabetes varied from 5-25 years. The maximum numbers of patients were in the duration of 5-14 years comprising 75% of the total. Mean duration of diabetes was found to be 10.79±5.38 years. Mean fasting blood sugar was found to be 169.91 mg/dl. 55% of patients presented with tingling sensation and 40% presented with burning feet. Hyperaesthesia and foot ulcers were presenting complaints in only 2% of patients each. None of the patient had any gait abnormality. 47% of patients had loss of ankle jerk, 42% had loss of vibration, 33% had loss of light touch, 21% had loss of joint position and 18 % had loss of superficial pain.

In 100 patients of type 2 diabetes mellitus on clinical examination 43% had involvement of both upper and lower limb followed by only lower limb involvement in 16% patients. Isolated upper limb involvement was seen in 2% cases but on NCS 68% had involvement of both upper and lower limb followed by only lower limb involvement in 14% patients. Isolated upper limb involvement was seen in 2% cases. 16% were found normal on NCS (Table 1).

Table 1: Correlation of limb involvement clinically and on NCS.

Limb involvement	Clinically	On NCS
Upper limb only	2	2
Lower limb only	16	14
Both upper and lower limb	43	68
Normal	39	16
Total	100	100
P value		<0.001

46% patients had symmetrical limb involvement clinically and 15% had asymmetrical limb involvement but on NCS 70% patients had symmetrical limb involvement on NCS and 14% had asymmetrical limb involvement (Table 2). 58% patients had distal polyneuropathy followed by both proximal and distal in 2% patients. Only 1% patient had isolated proximal neuropathy. 39% patients had clinically no neuropathy. Diabetic amyotrophy was present in 3% and absent in 97% subjects.

Table 2: Correlation of pattern of neuropathy clinically and on NCS.

Pattern of neuropathy	Clinically	On NCS
Symmetrical	46%	70%
Asymmetrical	15%	14%
Normal	39%	16%
Total	100	100
P value		<0.001

In the present study clinically, sensory motor type was seen in maximum number of patients i.e. 37% followed

by pure sensory in 14% and pure motor in 10% patients. 39% patients were clinically normal whereas on NCS sensory motor type was seen in maximum number of patients i.e. 64 (64%) followed by pure sensory in 18 (18%) and pure motor in 2 (2%) patients. 16 (16%) patients were normal on NCS (Figure 1).

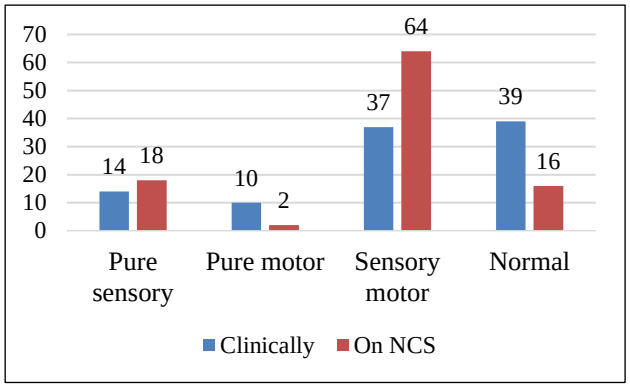

Figure 1: Correlation of type of neuropathy clinically and on NCS.

80 (80%) had axonal type of neuropathy followed by demyelinating type in 3 (3%) and mixed type in 1 (1%) cases. Sixty-six percentage had decreased CMAP and 82% had decreased.

Involvement of sural nerve and tibial nerve was more common i.e. 80% and 62% respectively. Involvement of median nerve, ulnar nerve and deep peroneal nerve was found to be 60%, 52% and 50% respectively. Radial nerve involvement was seen in 41% patients.

DISCUSSION

Diabetic neuropathy is one of the most commonly occurring microvascular complications accounting for 28% of all the complications in diabetics. It is a progressive process that has a long asymptomatic stage. It is important to identify neuropathy in the asymptomatic stages as the disease progresses to the diabetic foot, a highly morbid condition that arises from the infection and the ulceration of the foot finally leading to amputation.[9] Therefore, it is necessary to identify the "at risk diabetic patients" for neuropathy. Nerve conduction studies are one of the important methods for assessing nerve functions in Diabetic neuropathy. There are many mechanisms by which hyperglycaemia causes nerve damage. Hyperglycaemia leads to elevated intracellular glucose and cellular toxicity in the endothelial cells of the capillaries associated with peripheral nerves.[10] Another proposal is that the hyperglycaemia induces formation of neurotropin like nerve growth factor (NGF) and contributes to neuropathy by preventing normal axonal repair and regeneration.[10] In addition, intracellular glucose can be converted to so called Amadori product, and these in turn can form advanced glycosylated end products (AGEs), which cross-link matrix proteins. This damages the blood vessels. This results in ischemia to the nerves of the patient which may be responsible for neuropathy. The present study has detected types of neuropathy in type 2 diabetes and correlated clinical features of peripheral neuropathy with nerve conduction study. In this study mean age of patients who are enrolled is 57.90±9.74 years. Prasad N et al conducted a similar study to test the hypothesis of alteration in electro physiologic parameters of nerve before actual manifestations of neuropathy in type 2 diabetic patients in which mean age of patients was found to be 55.72±7.12 years.[11] The present study detected association of diabetic neuropathy with duration of Type 2 diabetes and glycaemic control. Mean duration of diabetes is 10.79±5.38 years and mean HbA1c is 9.51±2.16. Similar study was conducted by Nisar MU et al in which mean duration of diabetes was 9±6.76 years and mean HbA1c was 6.5±2.18.72.[12]

In this study tingling sensation is most common presentation of diabetic neuropathy followed by burning feet then hyperaesthesia and foot ulcers. Kakrani AL et al did a study on total of 50 diabetics, whose onset of diabetes after the age of 30 years was studied. History of symptoms like paresthesias, tingling sensation, burning feet, hyperaesthesia, foot ulcers, history of weakness and gait abnormality was noted. Complete central nervous system examination was performed to look for signs such as diminished ankle jerk, diminished power. Sensory examination for loss of light touch, superficial pain, temperature sense, vibration and joint position was done. Nerve conduction studies were performed. 46 patients i.e. 92% presented with complaints of tingling sensation and 32 patients i.e. 64% had burning feet.[13]

Most common signs are loss of ankle jerk followed by loss of vibration then light touch and joint position. Shehab DK et al conducted a study to assess the performance characteristics of ankle reflex in detecting diabetic peripheral neuropathy (DPN) by evaluating the sensitivity, specificity and the predictive ability of the ankle reflex, a component of Neuropathy Disability Score (NDS) with reference to Nerve Conduction Studies (NCS). Taking NCS as the gold standard, ankle reflex yielded the highest sensitivity and specificity, closely followed by that of vibration sense. It was found ankle reflex is a powerful screening tool with high sensitivity and negative predictive value, but a combination of ankle reflex and vibration sense has superior sensitivity and specificity compared with either of them done alone for the detection of DPN in clinical settings.[14]

In the present study it is found that detection of neuropathy is earlier and significant with NCS compared to clinical examination ($p < 0.05$). Holinger I et al conducted a study to evaluate the prevalence of diabetic peripheral neuropathy in patients with diabetes mellitus and examined whether the neurological examination validly diagnoses diabetic peripheral neuropathy as compared with the gold standard of nerve conduction velocity in these patients. Sensitivity and specificity of

the neurological examination for the diagnosis of diabetic peripheral neuropathy were 40% and 100%, respectively. The corresponding positive and negative predictive values were 100% and 72.7%, respectively. It was found that patients with diabetes mellitus, diabetic peripheral neuropathy is highly prevalent, but in the majority of patients it is subclinical. Sensitivity and negative predictive values of the neurological examination are low. Therefore, routine nerve conduction velocity measurement for the assessment of diabetic peripheral neuropathy appears to be warranted in these patients.[15]

CONCLUSION

Thus, author conclude that detection of neuropathy is earlier and significant with NCS compared to clinical ($p < 0.05$).

Tingling sensation is most common presentation of diabetic neuropathy followed by burning feet then hyperaesthesia and foot ulcers. Most common signs are loss of ankle jerk followed by loss of vibration then light touch and joint position.

Simultaneous involvement of both upper and lower limb is significantly more than single limb involvement by both NCS ($p < 0.05$) and clinical examination ($p < 0.05$) followed by only lower limb involvement. Only upper limb involvement is minimum i.e. 2% in both NCS and clinically.

Distal symmetrical polyneuropathy is most common form of diabetic neuropathy as compared with other forms of sensory/ motor neuropathy as detected by both NCS and clinically($p<0.05$). Involvement of sural nerve and tibial nerve are more common in diabetic neuropathy. Axonal type of neuropathy is the most common type of neuropathy in diabetics.

Sensory motor type of neuropathy is most common type of neuropathy in type 2 diabetics detected on both NCS and clinically ($p<0.05$).

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