International Surgery Journal
Kumar SMH et al. Int Surg J. 2018 Mar;5(3):913-916
http://www.ijsurgery.com
pISSN2349-3305 | eISSN2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20180802

Original Research Article

A study on peripheral neuropathy in patients with diabetic foot ulcers

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Received: 07 February 2018
Accepted: 14 February 2018

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ABSTRACT

Background: Diabetic neuropathies are nerve disorders associated with diabetes. The most common complication of diabetes is caused by hyperglycemia which can damage nerve fibers throughout the body. Depending on the types of nerves involved, diabetic neuropathies can be categorized as peripheral, autonomic, proximal, focal neuropathies.
Methods: A total of 62 diabetic foot patients admitted in general surgery department of Yenepoya medical college and hospital undergo neurological examination. Patients who were having peripheral neuropathy with diabetic foot ulcer between 18 and 85 years of age were included in the study.
Results: On 62 patients with diabetic foot ulcers, 50 were unilateral and 12 were bilateral among which 8 patients had undergone toe amputation prior to examination. Patients were predominantly male 48 (77.4%). There were 14 women and 48 men with an average duration of diabetics being 15.6 and 14.8 years respectively. Women were older than male patient (58.2 v/s 51.7 years). Study of motor and sensory signs men and women patients, abnormal deep tendon reflex and deep sensory loss was high. Abnormal deep tendon reflex was 38 (79.1%) and 11 (78.5%), atrophy was 24 (50%) and 2 (14.2%), loss of pain was 18 (37%) and 4 (28.5%), loss of touch was 32 (66%) and 8 (57%), and deep sensory loss was 42 (87.5%) and 12 (85.7%) in men and women respectively.
Conclusions: Diabetes mellitus leads to neuropathies of more than one type and all contribute to diabetic foot pathogenesis. Clinical symptoms and signs, as well as nerve conduction studies may be different between men and women with diabetic foot. Motor neuropathies may constitute an important prognostic parameter in men. Mononeuropathies sometimes reflect more severe involvement and peroneal and ulnar neuropathy is remarkable among these.

Keywords: Diabetic foot, Nerve conduction study, Peripheral neuropathy, Trophic ulcer

INTRODUCTION

Diabetic neuropathies are nerve disorders associated with diabetes, which affect approximately half of all diabetes patients. The most common complication of diabetes is caused by hyperglycaemia which can damage nerve fibers throughout the body. Depending on the types of nerves involved, diabetic neuropathies can be categorized as peripheral, autonomic, proximal, focal neuropathies. The pathological mechanism of diabetic neuropathy cannot be explained with a single cause, and various hypotheses have been proposed. These are roughly divided into metabolic, vascular, and neuro-regeneration disorder hypotheses. The most common form of neuropathy is distal symmetrical sensorimotor polyneuropathy which can be divided into 3 stages; early, symptomatic and severe. Severe distal sensorimotor neuropathy is manifested by motor involvement and may be accompanied by disabling symptoms and the potential risk for ulceration which can lead to infection, necrosis, gangrene and amputation. Peripheral neuropathy, along with peripheric vascular disease, is a major contributing factor to the formation of

foot ulcer.[1] Although sensory neuropathy has been considered to be more important than other types, motor involvement is also known to cause weakness of intrinsic foot muscles leading to imbalance of weight-bearing function which is also a permissive factor for foot ulceration.[2] Autonomic neuropathy is also reported to increase risk of development of diabetic foot.[3]

Aims and objectives of study

The aim of this study was to assess the prevalence of various forms of diabetic neuropathy, by clinical and electrophysiological tests. Objective was to study the various forms of neuropathy in diabetic foot ulcer patient and to correlate the clinical features of peripheral neuropathy with nerve conduction study.

METHODS

A total of 62 diabetic foot patients admitted in general surgery department of Yenepoya medical college and hospital were undergone neurological examination.

Inclusion criteria

Patients who were having peripheral neuropathy with diabetic foot ulcer who had signed a written informed consent prior to the first study intervention, who were at least 18 and <85 years of age, who had one or more diabetic foot ulcers on the target limb, with only one marked for the study (target ulcer), one who had type I or II diabetes mellitus, one who has like tingling sensation, burning feet, hyperaesthesia, foot ulcer, history of weakness, able and willing to attend the scheduled visits and comply with study procedures will be included for the study for duration of 6 months.

Exclusion criteria

Patients known or suspected disease of the immune system, active or untreated malignancy or active, uncontrolled connective tissue disease, or patients received treatment with immunosuppressive or chemotherapeutic agents, radiotherapy or systemic corticosteroids less than 30 days before enrolment, presence of necrosis, purulence or sinus tracts that cannot be removed by debridement, patients who have undergone revascularization procedure aimed at increasing blood flow in the treatment target limb <4 weeks prior to enrolment were excluded from the study.

RESULTS

A clinical and peripheral neuropathy was done on 62 patients with diabetic foot ulcers, 50 were unilateral and 12 were bilateral among which 8 patients had undergone toe amputation prior to examination. Patients were predominantly male 48 (77.4%). There were 14 women and 48 men with an average duration of diabetics being 15.6 and 14.8 years respectively. Women were older than male patient (58.2 vs 51.7 years).

Table 1: Number, age and average duration of diabetes in men and women.

	Men	Women	All patients
Number of patients	48 (77.4%)	14 (22.5%)	62
Mean age of patients	51.77	58.28	56.38
Average duration of diabetes in years	14.84	15.64	15.16

Study of motor and sensory signs men and women patients, abnormal deep tendon reflex and deep sensory loss was high. Abnormal deep tendon reflex was 38 (79.1%) and 11 (78.5%), atrophy was 24 (50%) and 2 (14.2%), loss of pain was 18 (37%) and 4 (28.5%), loss of touch was 32 (66%) and 8 (57%), and deep sensory loss was 42 (87.5%) and 12 (85.7%) in men and women respectively.

Table 2: Motor and sensory signs men and women patients.

	Men (n=48)	Women (n=14)	All patients (n=62)
Abnormal DTR	38 (79%)	11 (78.5%)	49 (79%)
Atrophy	24 (50%)	2 (14.2%)	26 (41.9%)
Loss of pain	18 (37%)	4 (28.5%)	22 (35.4%)
Loss of touch	32 (66%)	8 (57%)	40 (64.5%)
Deep sensory loss	42 (87.5%)	12 (85.7%)	54 (87%)

NCS is the most fruitful component of the electrodiagnostic evaluation, so a simple, noninvasive, objective, and sensitive measurement which is intended as a gold standard test for corroborating the diagnosis of peripheral neuropathy. There is no general consensus for

polyneuropathy criteria in NCS in the face of multiple performed investigations. Because of DPN is length-dependent neuropathy, lower extremity nerves are probably involved more, we designed present study accordingly. NCS consists of bilateral peroneal and tibial nerves compound muscle action potential (CMAP) and sural nerves sensory nerve action potential (SNAP), nerve conduction velocity (NCV), amplitude, and distal latency.

Table 3: Frequency of neuropathy based on involved nerve.

Nerve	Amplitude	Latency	NCV
Right tibial	43.2 %	3.2 %	26.4 %
Left tibial	48.8 %	4.8 %	29.6 %
Right peroneal	68 %	35.2 %	40 %
Left peroneal	75.2 %	29.6 %	52 %
Right sural	49.6 %	17.6 %	25.6 %
Left sural	51.2 %	21.6 %	24 %

Table 4: Electrophysiological findings in female and male patients.

Electrophysiological findings	Male		Female	
	No.	%	No.	%
Peroneal nerve				
Absent	22	45.8%	2	14.2%
Reduced CMAP amp.	24	50%	7	50%
MCV <70% of normal range	28	58.3%	5	35.7%
Tibial nerve				
Absent	18	37.5%	4	28.5%
Reduced CMAP amp.	9	18.7%	2	14.2%
MCV <70% of normal range	7	14.5%	3	21.4%
Median nerve				
Absent	-	-	-	-
Reduced CMAP amp.	5	10.4%	5	35.7%
MCV <70% of normal range	29	60.4%	7	50%
Ulnar nerve				
Absent	-	-	-	-
Reduced CMAP amp.	16	33.3%	6	42.8%
MCV <70% of normal range	33	68.7%	8	57.1%

(CMAP: compound muscle action potential; MCV: motor nerve conduction velocity)

Motor nerve conduction abnormalities were more frequent and severe in males with diabetic foot. Peroneal nerve in excitability, ulnar axon loss and severely decreased ulnar nerve conduction velocities were almost two times more frequent and reduced median conduction velocity was more frequent in males. Absence of peroneal nerve motor response was a part of length dependent polyneuropathy (PNP) rather than focal entrapment mononeuropathy. However, prolonged distal latency of median palmar nerve was predominant in females and showed focal involvement at the wrist. These findings are presented in Table 4.

DISCUSSION

Male gender predominance is consistent with earlier reports. Among the 21 patients with recurrent diabetic foot studied by Young et al men constituted 76.5%, and among the 49 patients studied by Negrin and Lelli 53%.[4,5] Recent studies also demonstrated male predominance of up to five times.[6,7] However, since we did not include a control group, it is impossible to suggest that male gender is a risk factor for diabetic foot. Also, we do not know if there was a difference between males and females regarding glycaemic control.

Negrin and Zara reported that only severe peroneal nerve involvement has a prognostic value when it is considered together with clinical neurological signs in the natural history of diabetic neuropathy.[8] Regarding median and ulnar nerve involvement in diabetic PNP, male patients in our cohort were more likely to have ulnar nerve involvement which is probably associated with the onset of severe complications as well. Severe ulnar motor neuropathy was already reported to be common in male patients with diabetes and multiple system complications. In these patients the etiology was suggested to be ischemic rather than simple compression.[9] Median palmar involvement was due to carpal tunnel syndrome.

Albers and Kelly reported that men had reduced amplitudes and conduction velocities with longer latencies than those of the women and that gender continued to be a significant predictor of conduction velocities and latencies even when corrected for height.[10]

In present cohort, motor neuropathy was more common in men and sensory neuropathy in women. Electrophysiological findings in diabetic PNP vary in a wide range depending on inclusion or exclusion criteria of patients with DF.[11]

CONCLUSION

Diabetes mellitus leads to neuropathies of more than one type and all contribute to diabetic foot pathogenesis. Clinical symptoms and signs, as well as nerve conduction studies may be different between men and women with diabetic foot.

Motor neuropathies may constitute an important prognostic parameter in men. Mononeuropathies sometimes reflect more severe involvement and peroneal and ulnar neuropathy is remarkable among these.

ACKNOWLEDGEMENTS

Authors would like to thank Yenepoya Medical College and Hospital, Deralakatte, Mangalore, Karnataka, India.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kumar SMH, Moosabba MS, Koppad SN. A study on peripheral neuropathy in patients with diabetic foot ulcers. Int Surg J 2018;5:913-6.