SENSORY NERVE CONDUCTION IN DIABETES MELLITUS AND DIABETIC NEUROPATHY

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Summary : Electrophysiological evaluation of conduction in sensory fibres of right ulnar and median nerves were carried out in normal subjects and diabetics with and without neuropathy. The sensory conduction velocities of ulnar as well as median nerves are significantly depressed in both groups of diabetics, particularly in those with neuropathy. The diabetics with or without neuropathy require a higher strength of stimulus for conduction in both median and ulnar nerves as compared to the normal subjects. The amplitude of action potentials is also lowered in both ulnar and median nerves of the two groups of diabetics. Estimation of conduction velocities of sensory fibres can be considered as a more useful parameter than the measurement of amplitude of action potentials in the diagnosis and evaluation of neuropathy in diabetics. It is concluded that assessment of sensory nerve conduction in median nerve is a better indicator than that of ulnar nerve for this purpose.

Key words : sensory nerve conduction diabetic neuropathy

INTRODUCTION

Over the last few decades several workers have been trying to evolve electrophysiological criteria to identify neuropathy in diabetes mellitus (2, 11). Whether neuropathy occurs before or simultaneous with the manifestation of the diabetes along with the frequent occurence of asymptomatic changes in sensory conduction is still not clearly understood. Available data in literature, besides failing to remove the confusion regarding the definition of neuropathy in terms of clinical evaluation is not able to stipulate that the neuropathy develops concomitantly with, and as an integral part of, the metabolic disturbance. The hypothesis of the other school which attributes the neurological manifesta-

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tions to the vascular complications of diabetes mellitus cannot be completely ignored (7). The commonest electrodiagnostic procedures that are being done for evaluation of neuropathy in diabetes comprise of determination of motor and sensory conduction velocity of peripheral nerves and electromyography (2, 12). The present study aims to evaluate different aspects of sensory conduction of median and ulnar nerves in diabetes mellitus with and without clinically overt neuropathy contrasted with normal healthy subjects of same age group.

MATERIAL AND METHODS

Sensory conduction studies in right median and ulnar nerves were carried out in 30 diabetic patients, 15 with clinical neuropathy and 15 without clinical evidence of neuropathy. All the patients were between the ages of 40 and 77 years. The results were compared with normal age–matched controls. The mean age of the patients with neuropathy, without neuropathy and control was 58.1 years, 53.4 years and 51.7 years respectively and the age range in the 3 groups was 40–77 years, 43–62 years and 41–65 years respectively.

The male/female ratio in the 3 groups was 10 : 5, 9 : 6 and 9 : 6 respectively. The cases of diabetes were drawn from the Diabetic Clinic of JIPMER Hospital, Pondicherry, the diagnosis of diabetes having been made with the help of standard biochemical tests. The duration of the disease in the entire series varied from 4 months to 10 years. It should be mentioned that only those cases whose post–prandial blood sugar values (one hr) exceeded 200 *mg/dl* were taken for the study.

Sensory conduction velocities of both median and ulnar nerves were determined by recording bipolarly nerve action potentials using antidromic technique (10). The recording electrodes comprising of 5 *mm* wide silver strips were placed at the fingers II and V on the proximal and distal phalanges. The stimulating electrodes were placed 20 *mm* proximal to the border of flexor retinaculum ulnar to the tendon of flexor carpi radialis in the case of median and 20 *mm* proximal to the pisiform bone radial to the tendon of flexor carpi ulnaris in the case of ulnar nerve. The median and the ulnar nerves were stimulated at the wrist separately using Grass stimulator (S4) with stimulus Isolation Unit (SIU4). The potentials from the digital nerves were recorded on a Cathode Ray Oscilloscope (502 A Tektronix) with time mark generator, after amplification by ac pre–amplifier (Grass). Keeping the duration of stimulation as 1 msec in each case,

the conduction velocities in metres/sec (m/sec) of the respective nerves were calculated from the length of nerve denoting the distance between the recording and stimulating electrodes and the latency. The strength of stimulation in volts (v) and amplitude of action potential in micro volts (μV) were also recorded each time. These 3 parametres were analysed statistically for the individual group. For every case in the study, the skin resistance at the wrist was measured and if it was found high, the area was warmed to lower it.

RESULTS

The stimulus strength, conduction velocity and amplitude of action potential in the sensory fibres of median and ulnar nerves of the three groups of subjects - control, diabetics and diabetics with neuropathy are shown in the table. The diabetics with or without neuropathy require a significantly higher strength of stimulus for conduction in both median and ulnar nerves as compared to the normal subjects. In the case of median nerve diabetics with neuropathy require a significantly higher threshold when compared to uncomplicated diabetics. The same is not true in the case of ulnar nerve. The sensory conduction velocities are significantly depressed in both groups of diabetics studied in case of ulnar as well as median nerves. The dimunition in conduction velocity of median nerve is further demonstrable in the neuropathy group in contrast to uncomplicated diabetics, the difference being highly significant statistically. This feature is notably absent in the case of ulnar. The amplitude of sensory action potentials is considerably lowered in both ulnar and median nerves of diabetic subjects irrespective of the co–existence of neuropathy. This depression in amplitude does not significantly vary in the 2 groups of diabetics.

DISCUSSION

It is obvious from the above data that abnormalities in sensory conduction which can be demonstrated electrophysiologically can occur in diabetes mellitus even before neuropathy manifests clinically. Lal *et al.* had earlier reported from our laboratories that there is depression in the conduction velocity of motor fibres of ulnar nerve in diabetes mellitus (6). It is the contention of Mayer *et al.* (8) that changes in sensory conduction precede those in motor nerve and have been proved to be the most sensitive indicator of sub–clinical neuropathy in diabetes (7). It is also interesting to note a similar pricture of peripheral neuropathy in uraemia, particularly in light of fact that the renal complications

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Table : showing stimulus strength, conduction velocity and amplitude of action potential in sensory fibres of median (M) and ulnar (U) nerves of different subiects. Mean ± S.E. and 'P' values.

Mean skin temperature near the nerves was 34.1°C.

Group	*Nerve*	*Stimulus strength (Volts)*	*Conduction velocity (Meter/Second)*	*Amplitude (Micro-Volts)*
Control (I)	M	88.3±5.6	51.25±0.97	34.66±2.67
	U	91.3±7.23	45.7±1.47	35.3±2.7
Diabetes	M	107±4.8	47.1±1.7	23.3±2.2
Mellitus (II)	U	125±4.7	38.5±2.96	23.3±2.82
Diabetes Mellitus (III)	M	126±6.4	33.8±4.0	21.0±2.6
with Neuropathy	U	117±5.47	35.3±2.7	25.0±2.9
P' values				
I—II	M	0.02	0.025	0.005
	U	0.001	0.025	0.005
I—III	M	0.001	0.001	0.001
	U	0.01	0.005	0.015
II—III	M	0.02	0.005	N.S.
	U	N.S.	N.S.	N.S.

N.S. = Not Significant

are common in diabetes mellitus. Studies carried out by Schubert (9) conclude that lower limb nerves get affected even before the nerves of the upper limb. The results of the present study point out that the abnormalities in the median nerve are more advanced than those of ulnar nerve in the same patient. This implies that the median nerve can serve as more sensitive an indicator than ulnar nerve in the diagnosis and assessment of neuropathy in diabetes. The reason for this selective involvement is not clearly understood. The controversy over the inaccuracy of determination of sensory nerve conduction by antidromic versus orthodromic method has been extensively reviewed by Buchthal *et al.* (1) who compared antidromic responses recorded bipolarly with orthodromic responses recorded unipolarly and found no significant difference in the conduction times. Thus the results of the present study obtained by bipolar antidromic recording can be considered as accurate parameters. Similar studies carried out by Viswanath *et al.* (12) who have done orthodromic sensory nerve conduction only for right median are consonant with our findings. It is, therefore, pertinant to conclude that the neuropathy

occurs almost simultaneous with the early manifestation of diabetes as evidenced from electrophysiological abnormalities in sensory conduction. This work however, cannot exclude the role of vascular factor in the genesis of diabetic neuropathy. Estimation of the strength of stimulation and conduction of velocities of the sensory fibres particularly for median nerve can be considered as more useful parameters than the measurement of amplitude of sensory action potentials in the diagnosis and evaluation of neuropathy in diabetes. No correlation could be established between abnormalities in sensory conduction and the duration or severity of diabetes.

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