ORIGINAL ARTICLE

ELECTRODIAGNOSTIC STUDY IN HEALTHY SUBJECTS AND PATIENTS OF MOTOR NEUROPATHY OF UPPER AND LOWER LIMBS

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Background: A nerve conduction velocity test measures how quickly electrical impulses move along a nerve in order to exclude or detect muscle disorders. The objective of this study was to study the pattern of electrophysiological variables in motor nerves for detection of neuropathy. **Methods:** This experimental study was carried out in the Department of Physical Medicine and Rehabilitation, Jinnah Postgraduate Medical Centre, Karachi from Dec 2010 to Aug 2011. Patients of motor neuropathy (n=30) and normal healthy subjects (n=18) were included. The nerve action potential of normal subjects and patients were recorded with electromyography (EMG). Motor nerve conduction velocity (NCV) and other variables such as proximal latency (PL), distal latency (DL), conduction time (CT), and amplitude of motor action potential (MAP) recorded in median, Ulnar nerves of upper limb and posterior tibial, common peroneal nerves of lower limb by given supra-maximal stimulus of 200–250 volts for duration of 0.2 mSec (6 times higher than motor threshold). Data were analysed statistically on SPSS-17. **Results:** Slow nerve conduction velocity, reduced amplitude of motor action potential and prolong distal latencies in median, ulnar, posterior tibial and common peroneal nerves observed in neuropathic patients. The PL, DL, CT were significantly increased (p<0.01), where as NCV and MAP significantly reduced in all cases of motor neuropathy (p<0.01). **Conclusion:** The study results proved that electrophysiological examination using EMG/NCV is the valuable electro-diagnostic test for early diagnosis of abnormal functions of nerve and its appropriate disorders.

Keywords: Nerve conduction velocity, neuropathies, electromyography, peripheral neuropathy

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INTRODUCTION

A nerve conduction study (NCS) is a test commonly used to evaluate the function, especially the ability of electrical conduction, of the motor and sensory nerves of the human body.[1] Nerve conduction velocity (NCV) is a common measurement made during this test.[1] A nerve conduction velocity test measures how quickly electrical impulses move along a nerve in order to exclude or detect muscle disorders.[2] A healthy nerve conducts signals with greater speed and strength than a damaged nerve.[2]

The conduction velocity of normal motor nerves varies from 50–70 m/Sec in the upper limbs and 40–60 m/Sec in the lower limbs.[3] The peripheral nerves of the upper limb are affected by a number of entrapment and compression neuropathies. These discrete syndromes involve the brachial plexus as well as the musculocutaneous, axillary, suprascapular, ulnar, radial, and median nerves.[3]

In entrapment neuropathy and compression neuropathy the most commonly involved nerves are the median, ulnar, common peroneal and posterior tibial.[4] A reduction in amplitude of motor action potential and increased conduction time found in compression of median nerve.[5] The nerve conduction velocity have been done in 'motor neuron disease' which shows that maximal motor nerve conduction of peripheral nerves are usually normal but in late stages there is mild slowing of maximal NCV.[6] It has been also found that in polyneuropathy, the distal latencies of nerve action potentials increased with mild decrease in conduction velocity.[7] Similar results obtained in diagnosis of CTS in patients with polyneuropathy.[8]

The latencies studies has also been done in normal subjects which showed that the distal latency of upper limbs <4 m/Sec and lower limbs <7 m/Sec.[9] The increased values of distal latencies found upper limb neuropathy.[9] Moreover increased distal latency and reduced amplitude of motor action potential reported in toxic neuropathy.[10] Distal symmetrical polyneuropathy (DSP) in upper limbs also found in diabetic neuropathy.[11]

We extend these observations with Proximal Latency (PL), Distal Latency (DL), Conduction Time (CT), Nerve Conduction Velocity (NCV) and Amplitude of Motor Action Potential (AMAP) in upper and lower limbs of neuropathic patients to obtain the electrophysiological knowledge about the functioning of motor nerves.

MATERIAL AND METHODS

Thirty patients suffering in motor neuropathy of upper and lower limbs age range 30–70 years of either sex were examine with informed consent from Dec 2010 to Aug 2011 in Department of Physical Medicine and

Rehabilitation, JPMC Karachi. They were diagnosed on the basis of patient's history, manual muscle tests, electromyography and biochemical evaluation, i.e., serum creatinine phosphokinase (CPK). After conformation they were included in study.

Eighteen normal healthy subjects without evidence of neuromuscular disorders were selected as control. They were MBBS students of Sindh Medical College and colleagues.

During the test, the nerve was stimulated, with surface electrode attached to the skin. Two surface electrodes were placed on the skin over the nerve. One electrode stimulated the nerve with a supra threshold stimulus of 200–250 volts for 0.2 mSec (6 times greater than motor threshold) and the other electrode recorded it. The resulting electrical activity was recorded and displayed on cathode ray oscilloscope screen. This was repeated for each nerve being tested.

The nerve conduction velocity was then calculated by measuring the distance between electrodes and the time it takes for electrical impulses to travel between electrodes by using formula[12]:

$$\text{NCV} = \frac{\text{Distance (m)}}{\text{Conduction Time (Sec)}}$$

RESULTS

Thirty patients with clinically defined motor neuropathy of upper and lower limb, and 18 normal healthy subjects were examined.

Table-1 shows the comparative values of electrophysiological parameters of median nerve in 18 healthy and 13 neuropathic patients. In these patients proximal latency (PL), distal latency (DL), conduction time (CT) were found significantly increased ($p<0.01$), while values of distance (D), nerve conduction velocity (NCV) and amplitude of motor action potential (AMAP) were significantly decreased ($p<0.01$) when compared with healthy subjects.

Table-2 shows the variations in values of electrophysiological parameters of ulnar nerve of 10 patients. The significant increased values are found in PL, DL, D ($p<0.01$) where as significant decreased result obtained in NCV and MAP ($p<0.01$).

Table-3 shows the comparative electro-physiological variant of posterior tibial nerve of 11 patients. The significant increased values obtained in PL, DL ($p<0.01$, $p<0.05$) respectively, whereas significant decreased values are found in NCV and AMAP ($p<0.05$, $p<0.01$) respectively.

Table-4 shows the differences in electro-physiological values of common peroneal nerve of 9 patients as compare to healthy subjects. Significant increased were found in PL and DL ($p<0.05$, $p<0.01$) respectively. The values of NCV and AMAP were found significantly decreased ($p<0.01$).

Table-1: Comparative values of PL, DL, CT, NCV and AMAP of median nerve of normal subjects and patients of upper limb motor neuropathy (Mean±SEM)

Subjects	PL (mSec)	DL (mSec)	CT (mSec)	D (Cm)	NCV (m/Sec)	MAP (mV)
Normal (18)	7.44±9.16	3.33±0.07	4.11±0.12	32.96±0.68	58.33±0.84	6.57±0.50
Patients (13)	9.24±0.35*	4–11±0.16*	5.12±0.28*	24.11±0.90*	46.82±1.25*	2.25±0.41*

*$p<0.01$ compared to normal subjects

Table-2: Comparative values of PL, DL, CT, NCV and AMAP of Ulnar nerve of normal subjects and patients of upper limb motor neuropathy (Mean±SEM)

Subjects	PL (mSec)	DL (mSec)	CT (mSec)	D (Cm)	NCV (m/Sec)	MAP (mV)
Normal (18)	7.15±0.14	2.71±0.06	4.27±0.12	25.22±0.32	58.04±1.26	4.80±0.27
Patients (10)	10.13±0.43*	4.02±0.23*	6.10±0.30*	26.78±0.56*	43.45±1.19*	1.64±0.45*

*$p<0.01$ compared to normal subjects

Table-3: Comparative values of PL, DL, CT, NCV and AMAP of Posterior tibial nerve of normal subjects and patients of lower limb motor neuropathy (Mean±SEM)

Subjects	PL (mSec)	DL (mSec)	CT (mSec)	D (Cm)	NCV (m/Sec)	MAP (mV)
Normal (18)	13.49±0.14	5.20±0.19	8.10±0.36	37.06±0.75	46.71±1.14	4.35±0.33
Patients (11)	15.44±0.66**	6–18±0.32*	9.27±0.48	37.54±1.35	41.17±1.93*	2.20±0.46**

*$p<0.05$ as compared to normal subjects, **$p<0.01$ as compared to normal subjects

Table-4: Comparative values of PL, DL, CT, NCV and AMAP of common Peroneal nerve of normal subjects and patients of lower limb motor neuropathy (Mean±SEM)

Subjects	PL (mSec)	DL (mSec)	CT (mSec)	D (Cm)	NCV (m/Sec)	MAP (mV)
Normal (18)	9.31±0.30	4.64±0.11	4.62±0.23	25.71±0.77	59.94±1.30	2.35±0.18
Patients (9)	13.89±1.68*	6.00±0.17**	7.89±1.65	24.44±0.79**	38.33±3.98**	0.80±0.14**

*$p<0.05$, **$p<0.01$ as compared to normal subjects

DISCUSSION

In clinical practice, the most commonly studied nerves are the median, ulnar, peroneal and tibial. Motor NCS have the distinct advantage of studying several segments along an individual nerve, which can help to localise a nerve lesion, particularly in the case of focal motor conduction abnormality due to entrapment neuropathy.

Electro-diagnostic studies also allow to judge whether the main site of damage is the axon or the myelin sheath. Knowing whether a patient has a disease affecting the nerve axons ('axonal neuropathy') or the myelin sheaths (demyelinating neuropathy) helps to guide the physician to a diagnosis among the many causes of peripheral neuropathy.[2,6,9]

It has been investigated that NCV, distal latency (DL) and amplitude of motor action potential (MAP) have useful diagnostic value.[4,5,13] The present work mainly concerned with the study of various electro-diagnostic parameters, i.e., PT, DL, CT, NCV, and amplitude of MAP in patients of peripheral motor neuropathy and normal healthy subjects for comparison.

The electrophysiological parameters when studied in peripheral motor neuropathy, the NCV and amplitude of MAP were found significantly reduced, where as conduction time (CT) showed increased values when compared to normal in all four nerves. This could be due to the impairment of normal functions, caused by compression or nerve injury.[4,8,14,15]

In motor nerve conduction studies of upper and lower limbs an absolute fall in amplitude of MAP and increased conduction time is recorded which may be due to the demyelination of axon.[16] In this study, there was a trend towards reduced NCV, decreased amplitude of MAP and increased CT in all motor nerves of both upper and lower limbs which reflect the functional state of axon and severity of disease.[17–19]

Utility of electrodiagnostic studies is an important component of the evaluation of patients with suspected peripheral motor nerve disorders. The pattern of findings and the features that are seen on the motor nerve conduction studies can help to identify the type of neuropathy, severity of neuropathy as well as define the underlying pathophysiology (axonal or demyelination), and ultimately help to narrow the list of possible causes, if tests are performed by skilful examiner using consistent method.[19]

CONCLUSION

Neuropathies of median, ulnar, common peroneal and posterior tibial motor nerves are the most common disorders of peripheral neuropathies. Electrodiagnostic testing provides unique information to physician on underlying pathological processes. For determination of degree of denervation in muscle, electromyography by needle electrodes is also recommended.

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