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Abnormal parameters of magnetically evoked motor-evoked potentials in patients with cervical spondylotic myelopathy

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Abstract

BACKGROUND CONTEXT: Magnetic stimulation (MS), which is used to evaluate motor pathways, is helpful in evaluating cervical spinal cord compression (cervical myelopathy [CM]). Previous studies have shown that the central motor conduction time (CMCT), which is the time taken for the nerve impulses to reach the cervical spinal roots after the stimulation of the motor cortex, is prolonged in CM. However, the duration of motor-evoked potentials (MEPs) in CM has not been studied in detail.

PURPOSE: To compare the duration, CMCT and amplitude of MEPs by MS between patients with clinical and magnetic resonance imaging (MRI) features of CM and a control group.

STUDY DESIGN/SETTING: A cross-sectional study done at Teaching Hospital, Peradeniya, Sri Lanka.

PATIENT SAMPLE: Consecutive patients with clinical features of cervical spondylotic myelopathy, without coexisting neurological abnormality.

METHODS: Transcranial and cervical spinal magnetic stimulation were performed on 21 patients with clinical and MRI features of spondylotic CM (mean age, 43.5years; range, 36–63 years; 9 men) and 17 healthy volunteers (mean age, 39.05 years; range, 23–54yrs; 6 males) using a circular coil with a Magstim 200 stimulator. MEPs were recorded over abductor digiti minimi muscle on both hands.

RESULTS: Seventeen patients had upper motor neuron (UMN) features in all four limbs; in the others, both lower limbs and one upper limb were affected. The upper limbs with UMN features had shorter duration MEPs compared with the control group. The CMCT and the total motor conduction time were also delayed in the CM group. All three differences were very highly significant ($t=5.75, -3.76, 5.27$; $p<.001$). The amplitudes showed no significant difference between the two groups ($t=1.27$, $p=.208$).

CONCLUSION: This study shows that in addition to the CMCT, the duration of MEPs is also useful in evaluating patients with CM using MS.

Keywords: Magnetic stimulation; Cervical myelopathy; Duration of motor-evoked potentials; Central motor conduction time

Introduction

Cervical spondylotic myelopathy (CSM) is the commonest cause of spinal cord dysfunction in patients over the age of 55 years in the United States [1]. There are two main modalities of investigations available for the confirmation of the diagnosis and further evaluation of a patient with clinical features of CSM: neuroimaging and neurophysiological investigations. Of the neurophysiological investigations, magnetic stimulation is a useful test to evaluate the central motor pathways [2–6].

After the magnetic stimulation of the motor cortex, a motor-evoked potential (MEP) can be recorded over a target muscle. The parameters that can me measured in this MEP

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Table 1
MEP parameters (mean±standard deviation) in control and myelopathy groups

	Total motor conduction time (ms)	Peripheral Motor conduction time (ms)	Central motor conduction time (ms)	Amplitude (mV)	Duration (ms)
Control group	18.39±1.32	12.67±1.36	5.72±0.82	4.58±1.84	21.09±3.59
Myelopathy group	22.18±3.62	13.41±1.04	8.77±3.28	3.77±3.23	17.93±3.41
t value	5.75	1.55	5.26	−1.2	−3.76
p value	<.001	.061	.001	.2	<.001
Mean difference	3.79	0.74	3.05	−0.8	−3.17
95% confidence interval of difference	2.48 to 5.11	0.16 to 1.3	1.89 to 4.2	−2.1 to 0.46	−4.85 to −1.5

are the latency (representing the total motor conduction time), amplitude, and the duration of the MEP. Similarly, in the MEP recorded by stimulating the spinal nerve roots, the peripheral motor conduction time can be measured. The difference between the total and the peripheral motor conduction times represent the central motor conduction time (ie, the time taken for a nerve impulse to travel fro the motor cortex to the proximal spinal root). Previous studies have shown that the amplitude of the MEP is highly variable. For example, if the same strength stimulus were given over the same location on two different occasions, the amplitude of the MEP would show a significant variability. The conduction times, on the other hand, are more consistent.

Previous studies of magnetic stimulation in patients with cervical myelopathy have shown that the central motor conduction is delayed. The amplitude changes have been variable and the third parameter of interest (ie, the duration of the MEP has not been described in detail). Thus, the objective of the study was to compare the parameters of MEPs (central motor conduction time [CMCT], amplitude, and the duration) of patients with clinical features of cervical spondylotic myelopathy with a control group.

Materials and methods

This was a cross-sectional study performed at Teaching Hospital, Peradeniya, Sri Lanka. The study was approved by the Ethical Review Committee of the Faculty of Medicine, Peradeniya, Sri Lanka, and informed written consent was obtained from all patients. The study group comprised patients with clinical features of cervical spondylotic myelopathy (one or more symptoms and signs of CM, Table 1) and evidence of single-level cervical spinal cord compression by T1-/T2-weighed magnetic resonance imaging. Patients with diabetes or a coexisting neurological disorder were excluded. Patients with compression caudal to C6 were excluded. A random blood glucose measurement was obtained by using a glucometer (Accu-check Active, Roche Diagnostics Corporation, Indianapolis, IN) using capillary blood. Patients with random blood glucose more than 10 mmol/L were excluded. Nerve conduction studies of upper limbs (sensory median and ulnar motor median) and lower limbs (motor common peroneal) were performed. Patients with impaired peripheral nerve conduction were also excluded.

After the exclusion of the afore-mentioned patients, the study group comprised 21 patients. There were 9 men and 12 women, with a mean age of 46.5 years (range, 36–63 years). The control group comprised 17 healthy volunteers (6 men and 11 women). There was no significant difference in the age (mean ages in the myelopathy and control groups were 46.5 and 42.2 years, p=0.26) or height (mean height in the myelopathy and control groups were 159 and 156.5 cm, p=.29) between the two groups.

A neurological examination was performed on all subjects. Transcranial and cervical spinal magnetic stimulation were performed by using a circular coil and a magnetic stimulator (Magstim 200, Spring Gardens, Whitland, Carmarthenshire, Wales, UK). Responses were recorded over abductor digiti minimi muscles by using adhesive surface electrodes connected to a to a signal averager (Medtronic, Minneapolis, MN). The stimulus intensity was commenced at 50% and was increased until a consistent waveform appeared. Three traces were superimposed. The MEP parameters recorded were total motor conduction time, peripheral motor conduction time, duration of the M wave of the MEP (measured from the onset to return to the baseline) after transcranial stimulation, and the amplitude of the MEP (peak to peak). The CMCT was calculated by subtracting peripheral motor conduction time from total motor conduction time (Figs. 1–4).

Statistical methods

The parameters of MEPs were compared between the study and control groups by using an independent samples *t* test. The level of significance was set at p<.05.

Table 2
Symptoms and signs of cervical myelopathy

Symptoms	Signs
Paraparesis	Spasticity
Quadruparesis	Motor weakness
Gait abnormality	Hypereflexia
Numbness of limbs	Babinski response
Neck pain/stiffness	Sensory deficit
Sphincter disturbances	
Limb stiffness	