

Lower Motor Neuron Hyperexcitability in Amyotrophic Lateral sclerosis: Analysis Using Motor Evoked Potentials

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Background & Objectives: Hyperexcitability of motor system is a well-established characteristic pathophysiologic finding of amyotrophic lateral sclerosis (ALS). Whereas little is known about the source of excitability according to the progression of the disease. We evaluated the excitability and its source in advanced ALS patients using transcranial magnetic stimulation (TMS).

Material & Methods: Motor evoked potentials (MEP) by TMS were recorded for abductor pollicis brevis muscles in 20 patients, 11 men and 9 women, with ALS. Mean age was 54.2 ± 12.1 years, and mean disease duration was 13.9 ± 13.4 years. Serial magnetic stimulations were applied to get the parameters; excitability threshold (ET), amplitude and latency of MEP. We also had a facilitated MEP (fMEP).

Results: The parameters were analyzed according to the clinical settings. ET was higher in ALS (mean 63.5 ± 18.1) than normal control (mean 46.0 ± 8.4 , $p < 0.01$). Amplitudes of MEP were reduced in ALS (2.6 ± 3.6 mV; control 6.5 ± 3.1 mV, $p < 0.01$). Duration of the disease and ET showed significant inverse correlation (Spearson correlation coefficient = -0.57 , $p < 0.01$). Duration of the disease and fMEP/MEP ratio showed less but also significant inverse correlation (Spearson correlation coefficient, $r = -0.52$, $p < 0.05$).

Conclusions: Lower ET in advanced ALS patients, in spite of decreased fMEP/MEP ratio, may indicate the hyperexcitability of lower motor neurons in these patients. This study suggests that lower motor neurons is hyperexcitable due to upper motor neuron dysfunction at advanced stage.

Key Words: Amyotrophic lateral sclerosis, Motor evoked potential, Hyperexcitability

가 (transcranial magnetic stimulation)¹⁻⁴
가 (excitability threshold)^{1,7,8}
가^{5,6}
가^{1,9-11}

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(excitotoxicity)
 가¹²⁻¹⁵ () ()
 가¹⁻⁴
 1.
 가^{16,17} 20
 ‘ EI Escorial
 (definite ALS) 12
 가^{16,17} (probable ALS) 8
 3
 3
 (cervical
 spondylosis) (multifocal
 motor neuropathy)
 1 1
 가
 18,19 1-4 10
 18,19
 2.
 20~23

Table 1. Clinical features of patients

	Control	Patients
Age, years	30.8 ± 4.6	54.2 ± 12.1
Female sex, (%)	1/10(10)	9/20(45)
Symptom duration, months	-	13.9 ± 13.4

Table 2. Means of electriophysiologic parameters of patients compared with normal control

	Control	Patients	<i>p</i> value
MEP amplitude, mV	6.5 ± 3.1	2.6 ± 3.6	<i>p</i> < 0.01
MEP latency, msec	21.2 ± 0.8	23.7 ± 2.7	<i>p</i> < 0.01
MEP/M ratio	0.4 ± 0.3	0.3 ± 2.8	NS
fMEP/MEP ratio	-	4.1 ± 2.7	-
Cortical threshold, %	46.0 ± 8.4	63.5 ± 18.1	<i>p</i> < 0.01

MEP; motor evoked potential, MEP/M; ratio of motor evoked potential to M-wave, fMEP/MEP ratio; ratio of facilitated motor evoked potential to motor evoked potential

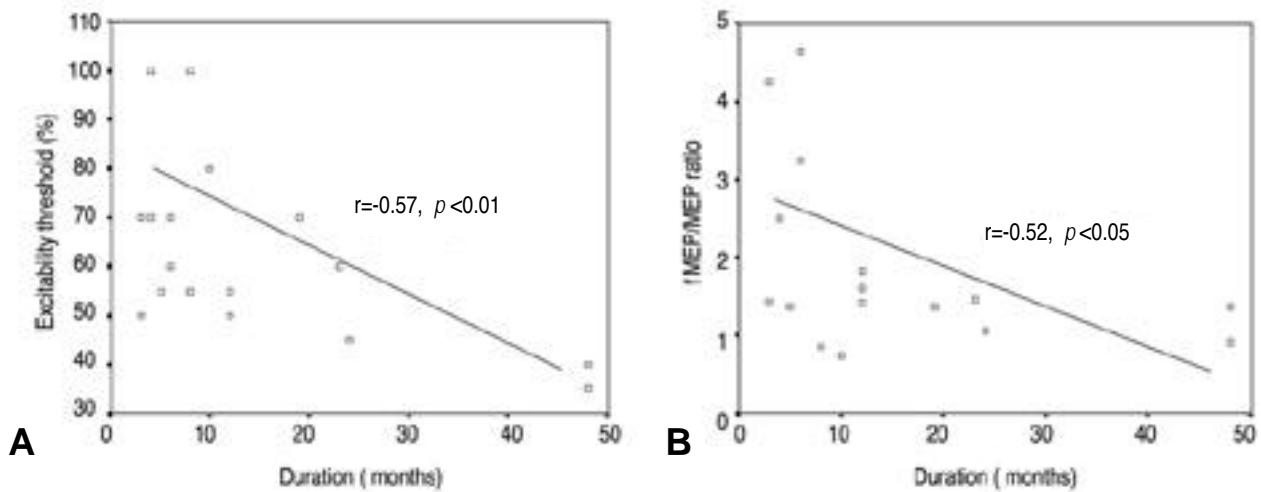


Figure 1. Correlation between duration of disease and excitability threshold (ET) (A) and between duration of disease and amplitude ratio of facilitated motor evoked potential to motor evoked potential (fMEP/MEP ratio)(B). ET and fMEP/MEP ratio of patients are inversely correlated with the duration of the disease (Spearman correlation, 2-tailed)

Magstim 200 (Novamatrix Medical Systems Inc., Whitland, Wales) 2 tesla, coil 9 cm Abductor Pollicis Brevis(APB) coil 20% 5~10% 가 2 가 75% 100%, 25% 가 peak - to - peak (facilitated MEP; fMEP) APB /M (MEP/M ratio), / (fMEP/MEP ratio) (Fig. 1 - A, B).

M - F - 3. ± Mann - Whitney U test, Spearman's correlation test 1,7,21,22 가 가 가 Hugon ²²

가 APB

가 가 , MEP/M (Fig. 1-A)

가 가 가 가 1,21

가 가 가 27

가 2,11,23가 (intracortical inhibition) 9,11,24-26 (fMEP/MEP) 2

가 2 drive

21 가 가 2,21,23 fMEP/MEP ratio (Fig. 1-B)(Spearman correlation coefficient=-0.52, p<0.05). , fMEP/MEP ratio가 drive가 가

가 가 (Spearman correlation coefficient=-0.62, p<0.01), 가 가 , 가 (syn-

가 가 volley , , (spasticity) 1,28

가 가 (MEP/M) (fMEP/MEP) 가 fMEP/MEP 가 가

가 MEP/M

80% M 가

MEP/M ratio 가

MEP/M (Spearman correlation coefficient=-0.21, p>0.05). 가 가

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