Clinical Neurophysiology 122 (2011) 414–422

Contents lists available at ScienceDirect

Clinical Neurophysiology

journal homepage: www.elsevier.com/locate/clinph

Lower motor neuron involvement examined by quantitative electromyography in amyotrophic lateral sclerosis

Christian Krarup *

The Department of Clinical Neurophysiology, The Neuroscience Center, Rigshospitalet and the University of Copenhagen, Copenhagen, Denmark

See Editorial, pages 211–212

ARTICLE INFO

Article history:
Available online 24 July 2010

Keywords:
ALS
EMG
Motor unit potentials
Collateral sprouting
Reinnervation
Denervation
Fasciculations

ABSTRACT

Objective: The diagnosis of amyotrophic lateral sclerosis (ALS) includes demonstration of lower motor neuron (LMN) and upper motor neuron (UMN) involvement of bulbar and spinal muscles. Electromyography (EMG) is essential to confirm LMN affection in weak muscles, and to demonstrate changes in clinically non-involved muscles. The aim of the study was to determine the relative importance of ongoing (active) denervation, fasciculations, chronic partial denervation with reinnervation at weak effort and loss of motor units at maximal voluntary contraction (MVC) in ALS.

Methods: EMG was carried out in weak and non-weak muscles in 220 patients suspected of ALS using concentric needle electrodes. Denervation activity and fasciculations in 966 muscles was quantified, the mean durations and amplitudes of motor unit potentials (MUPs) were compared to controls in 745 muscles, and the amplitudes and recruitment patterns at maximal voluntary effort were measured in 939 muscles. Twenty-five percent of patients had clinical involvement of 1 region, 42% of 2 regions and 33% of 3 regions. Clinically 65% had UMN involvement. Eighty-six percent of the patients had died on follow-up.

Results: Denervation activity occurred in 72% of weak muscles but in only 45% of non-weak muscles. Fasciculations occurred in 56% of weak muscles and in 65% of non-weak muscles. MUPs showed reinnervation in 87–91% of weak and non-weak muscles and in 44% of muscles neurogenic MUPs occurred in the absence of denervation activity. In patients with clinical involvement of 1 region, combined EMG criteria increased the number of affected regions in 93%, and in 40% of patients with clinical involvement of 2 regions EMG increased the number of involved regions.

Conclusions: Quantitative EMG confirmed widespread LMN involvement in patients with early ALS including clinically non-involved regions. These findings suggest that the maintenance of force is due to compensatory reinnervation in early disease and that this capacity may decline at later stages of ALS.

Significance: These findings support a recent consensus report (the Awaji criteria) that EMG should have equivalent weight to clinical manifestations to indicate LMN involvement. The findings strongly indicate that spontaneous activity is insufficient to show LMN involvement in non-affected muscles at early stages of disease, and that analysis of MUPs are needed to document the distribution of LMN involvement.

© 2010 International Federation of Clinical Neurophysiology. Published by Elsevier Ireland Ltd. All rights reserved.

1. Introduction

Amyotrophic lateral sclerosis (ALS) is a fatal disorder characterized by progressive weakness due to combined upper and lower motor neuron degeneration. In early stages of the disease the variable lower motor neuron (LMN) and upper motor neuron (UMN) involvement (Bouche et al., 1999) can make the diagnosis of ALS challenging (Rocha et al., 2005; Traynor et al., 2000). Due to the absence of specific disease markers (Turner et al., 2009) clinical diagnostic criteria have been established based on the presence and distribution of LMN and UMN involvement (Brooks, 1994). The El Escorial criteria have subsequently been updated (Brooks et al., 2000), recognizing the importance of laboratory results, including electrophysiological studies, to support the diagnosis. Due to the

* Address: Department of Clinical Neurophysiology NF3063, Rigshospitalet, Blegdamsvej 9, 2100 Copenhagen, Denmark.
E-mail address: ckrarup@rh.dk

1388-2457/$36.00 © 2010 International Federation of Clinical Neurophysiology. Published by Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.clinph.2010.06.027

limitations of these clinical criteria an expert consensus group advocate that electrophysiological evidence for LMN involvement (so called Awaji criteria) should carry the same weight as clinical criteria (de Carvalho et al., 2008). The recommendations of the Awaji meeting are not based on quantitative data, and it is not clear which abnormalities are most useful in ALS. The main purpose of the present study was to assess the importance of EMG criteria to demonstrate LMN involvement in ALS. The distribution and frequencies of denervation activity, fasciculations, motor unit potential (MUP) changes, and the recruitment pattern during maximal voluntary effort (MVC) have been compared in 220 patients with suggestion of ALS.

EMG is of diagnostic value if it can reveal LMN involvement in clinically silent regions and that it can confirm that weakness is due to LMN involvement. Before the significance of EMG can be ascertained, it is necessary to determine the relative extent of ongoing (active) denervation and reinnervation at early stages of the disease. Variable presentation may derive from initially restricted involvement of motor neurons in the brain, brainstem or spinal cord. EMG and motor unit number estimation (Mitsumoto et al., 2007) have indicated changes in the early stage of the disease consistent with LMN affection before muscle weakness. The possibility, however, remains that motor neurons at early stages of the disease have degenerated in some areas of the central nervous system whereas they are as yet not affected in other areas (Ravits et al., 2007). Preliminary results have been published (Krarup, 2007).

2. Methods

2.1. Patients

The 220 patients included 123 males and 97 females (ratio 1.3:1), aged 62 ± 1 years (mean ± SEM, range 26–87 years) at the time of examination, and aged 61 ± 1 (range 26–87 years) at the onset of symptoms, in whom the diagnosis of motor neuron disease was considered most likely. Patients referred with this diagnosis in whom clinical or electrodiagnostic findings or both were inconsistent with motor neuron disease were excluded from the analysis. Patients with additional competing peripheral nerve involvement including radicular disease, diabetes mellitus, or severe alcohol abuse were excluded. In two included patients radiculopathy had been suspected as the cause of the disease; however, this was not confirmed as both patients had widespread disease in 2–3 regions, and both had died. In other series cervical radiculopathy has frequently been misdiagnosed in ALS (Srinivasan et al., 2006). Moreover it was examined whether there was a positive family history of neuromuscular disease, and available biochemical laboratory studies were reviewed. In 27 patients additional diagnoses without relation to LMN included Parkinson disease in 1, dementia in 7, epilepsy in 3, childhood encephalitis in 1, and other diagnoses in the remaining patients. Two years after the end of inclusion, survival and the time of death of patients were ascertained.

2.2. Clinical evaluation

At the time of EMG the presenting symptoms, their duration and progression within and between regions were determined. The clinical evaluation included inspection for fasciculations, determination of muscle force (MRC scale 0–5) in bulbar and extremity muscles, signs of atrophy (scale 0–3), and sensory examination (touch, pin-prick, vibration and position sense). The distribution of weakness was localized to muscles innervated by bulbar, cervical or lumbosacral segments, and the number of affected regions was determined. The clinical examination showed involvement of 1 region in 25%, of 2 regions in 42%, and of 3 regions in 33% of the patients (Table 1). Sensory symptoms and examination were normal in 95% of patients, the remaining having minor complaints or findings or both.

Patients were evaluated for signs of UMN involvement with increased reflexes, spasticity, and extensor plantar reflexes. Reflexes were assessed as increased if hyperactive or brisk in weak atrophic muscles. Clinical UMN affection occurred in 65%: 30 of 55 patients with involvement of 1 region, 56 of 92 with involvement of 2 regions, and 57 of 73 with involvement of 3 regions had UMN signs (Table 1). Accordingly using modified El Escorial criteria, 21% of 143 patients had possible, 39% had probable, and 40% definite ALS, whereas 77 patients could not be clinically diagnosed with ALS in the absence of UMN signs.

Between the time of first symptoms and the time of electrophysiological examination progression between regions did not occur in patients with clinical involvement of 1 region whereas all had experienced worsening of presenting symptoms. One patient complained of widespread fasciculations but had no weakness or signs of UMN involvement. Progression to other region(s) occurred in all except one patient with involvement of 2 or 3 regions (Table 1).

The delay before patients were referred for EMG was similar in the different clinical groups (15 ± 1 months, range 2–120 months, $P > 0.9$, ANOVA). When records were examined 2 years after study of the last patient, 189 of the 220 patients had died with a median survival time of 29 months. A larger proportion of patients with involvement of 2 or 3 than of 1 region had died and they had had a shorter median survival time (Table 1, Fig. 1). Among the 31 patients who were alive at the time of enquiry, 12 patients with involvement of 1 region had a survival time of 39–162 months, the 14 patients with involvement of 2 regions a survival time of 42–190 months, and the 5 patients with involvement of 3 regions a survival time of 51–162 months and these survival times did not differ among the groups. Ninety-one percent of the 127 patients with bulbar involvement had died with a median survival time of 26 months while 79% of the 73 patients with only spinal involvement had died with a median survival time of 38 months ($P < 0.0005$, Mann–Whitney U).

Table 1
Features in 220 patients with clinical involvement of one, two, or three regions.

Clinical diagnosis (number of patients)	Bulbar (%)	Upper limbs (%)	Lower limbs (%)	Progression between regions (%)	Upper motor Neuron (%)[b]	Deceased (%)[c]	Median survival (range) (months)[d]
One region involved (55)[a]	29	38	31	0	55	78	38 (6–89)
Two regions involved (92)	41	92	66	99	61	85	31 (8–155)
Three regions involved (73)	100	100	100	100	78	93	25 (4–104)

[a] One patient had only fasciculations on clinical examination, no weakness, normal reflexes, and she was still alive 97 months after presentation of symptoms.
[b] The frequency of upper motor neuron involvement (increased tendon reflexes or extensor plantar reflexes or both) differed significantly in the different clinical groups ($P < 0.01$, Kruskall–Wallis test).
[c] The frequency of death differed significantly in the different clinical groups ($P = 0.05$, Kruskall–Wallis).
[d] The survival distributions varied in patients with different number of involved regions ($P < 0.001$, Log Rank).

Download English Version:

https://daneshyari.com/en/article/3044996

Download Persian Version:

https://daneshyari.com/article/3044996

Daneshyari.com