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Case report

AMYOTROPHIC LATERAL SCLEROSIS AND EFFECTS OF VIBRATIONS

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ABSTRACT

Amyotrophic lateral sclerosis (ALS) is a severe and fatal neurodegenerative disorder affecting both the upper and lower motor neurons. We present the clinical cases of four patients with ALS and vibration syndrome. All patients had over 20 years of exposure to general and local vibrations and common subjective complaints: pain, paresthesia, twitching and weakness of limb muscles. Evidence of ALS syndrome was demonstrated by the abnormal neurological examination (pseudobulbar syndrome and pyramidal signs) as well as by neurophysiological studies (peripheral motor neuron degeneration). We discuss the possible relationship between the exposure to general and local vibrations and the ALS syndrome in our patients, and the role of vibrations as a possible risk factor for the disease. Occupational contact with chemicals and pesticides is also discussed as a risk factor.

Keywords: amyotrophic lateral sclerosis, general and local vibrations, chemicals, pesticides

INTRODUCTION

Amyotrophic lateral sclerosis (ALS) is a fatal degenerative disease that causes progressive weakness and wasting of voluntary muscles. The clinical presentation can be of bulbar or spinal onset, and there can be different degrees of upper and lower motor neuron involvement. According to the El Escorial criteria, ALS cases are classiûed as deûnite, probable, or possible. The World Health Organization (WHO) categorizes ALS as a major subset of motor neuron disease (MND). All subsets of MND share an identical International Classiûcation of Diseases (ICD) code. Therefore, in the biomedical literature, both terms – MND and ALS – are used to indicate the same disease. Misdiagnosis or misclassiûcation may affect about 10% of all ALS cases [1].

Among the principal features of ALS are spastic paralysis, flaccid muscle weakness, wasting, and fasciculations. The disease spares the sensory, autonomic, and oculomotor neurons. ALS is the most common of the MND syndromes in adults. Recent population-based epidemiological studies have confirmed the existence of many different subtypes of ALS, comprising a wide clinical and pathological spectrum.

Significant changes in the epidemiology of ALS have been observed over the last few years. The incidence in Europe is about 2/100'000 [2], the prevalence is 5.4/100'000 [3], and the overall lifetime risk of developing ALS is 1:350 for men and 1:400 for women [4].

Although the cause of ALS is unknown, there is evidence that the excitatory neurotransmitter glutamate plays an important role in neuronal cell death. Mutations of the Cu, Zn-superoxide dismutase (SOD1) gene are responsible for approximately 20% of the familial cases (1–2% of the overall ALS patient population), but for most sporadic cases the causes are not known [18]. The transition metals zinc and copper regulate SOD1 protein stability and activity. Disbalance of the homoeostasis of these metals has therefore been implicated in the pathogenesis of ALS. In a study, muscle biopsy specimens revealed neurogenic changes, with 10% ragged-red fibers and 3% cytochrome-C oxidase (COX)-negative fibres. The activities of the respiratory chain complexes were normal in a muscle extract. Southern blot analysis of mtDNA showed no large-scale rearrangement or depletion, whereas the more sensitive "long polymerase chain reaction" revealed abnormal bands indicative of multiple mtDNA deletions [16].

About 90% of all ALS patients have the sporadic form which has unknown etiopathogenesis. It seems likely that the disorder is multifactorial and probably multigenic.

Numerous other potential risk factors have been described in the literature [5-15], including physical activity, occupations requiring repetitive/strenuous work; trauma with multiple injuries to the head and spinal cord (high risk for amyotrophic lateral sclerosis among professional soccer players); low frequency electric and magnetic fields (EMF); exposure to metals: lead, mercury, cadmium, selenium, etc.; agricultural chemicals (pesticides); solvents. Increased risk of ALS was found among 1991 Gulf War veterans. Wang et al. (2017) identified one genetic factor

(ATXN2) and five environmental factors (previous exposure to heavy metals including lead, previous exposure to pesticides, history of trauma / electric shock, and previous exposure to organic solvents) with relatively strong associations with the onset of ALS [7].

The associations that perhaps warrant further investigation include farming, mechanical and electrical traumas, heavy labour and toxins or chemicals. Over the last ten years, exogenic factors have been analyzed within the framework of specific lifestyle factors such as place of residence, smoking habits, or certain diet practices. The most recent conceptions suggest that interactions between genetic and environmental factors depend on the age at exposure and its duration.

CASE REPORT

We describe the clinical cases of 4 patients who had occupational exposure to general and local vibrations, as well as environmental exposure to chemicals and pesticides. All subjects were workers who developed progressive MND that clinically resembled an ALS-like syndrome or possible ALS.

CASE 1: Tractor driver, 34 years of exposure

In 2001, a 56-year-old man complained of weakness in the right hand, which progressed proximally. The progression was rapid, and 9 years later the neurological examination revealed diffuse fasciculations and amyotrophy of the hands. Deep tendon reflexes were present in the wasted muscles. Plantar responses were flexor. Spasticity developed. There were no signs of impairment of the cranial nerves. Cognitive and sensory functions were normal. Complete blood count, blood chemistry and urinalysis were normal. Serial electromyographic tests showed progressive denervation at spinal levels, which were consistent with motor neuron disease. MRI showed C4-5/C5-6 osteohondrosis and thinning of the spinal cord.

CASE 2: Truck driver, 29 years of exposure

In 2007, a 49-year-old man noted weakness of both hands. The symptoms progressed rapidly, and 3 months later the neurologic examination revealed diffuse fasciculations and amyotrophy of both hands, distal more than proximal, and worse on the right. Deep tendon reflexes were brisk in the 4 limbs, with bilateral Babinski signs. Electromyography revealed diffuse denervation in the 4 limbs. The disease continued its progressive course, and 1 year later there were weakness and amyotrophy of the 4 limbs. There were no signs of impairment of the cranial nerves. Sensory and cognitive functions were normal. Complete blood count, blood chemistry and urinalysis were normal.

CASE 3: Miner, 14 years of exposure

In 1994, a 48-year-old man complained of weakness affecting the upper limbs. Amyotrophy of the hands was noted 6 months later. Fasciculations in the 4 limbs appeared one year after the disease onset. Electromyography demonstrated diffuse denervation with fibrillations and fasciculations in the 4 limbs. The disease progressed slowly. Deep tendon reflexes were brisk even in the wasted areas. Bilateral extensor plantar responses were present.

CASE 4: Tractor driver, 38 years of exposure

In 2005, a 60-year-old man noted gait trouble with mild bulbar involvement. The first symptom was dysarthria, followed soon by dysphagia. He had dysphonia, diffuse fasciculations, and amyotrophy of the 4 limbs and the tongue. He had signs of impairment of the cranial nerves. Cognitive and sensory functions were normal. Complete blood count, blood chemistry and urinalysis were normal. Deep tendon reflexes were brisk even in the wasted areas, with bilateral extensor plantar responses. Serial electromyography showed progressive denervation changes, which were consistent with motor neuron disease. The retrospective examination of the medical records demonstrated that clinically and electromyographically the patient had typical characteristics of ALS.

DISCUSSION

We discuss the exposure to general and local vibrations (multiple injuries of the head and spinal cord) as a possible risk factor for ALS in men under 60 years of age. This presumption is in line with the findings of recent studies demonstrating that for subjects with multiple injuries of the head and the spinal cord, the risk for ALS is increased more than 11 times [17]. An association between physical trauma and ALS has been suggested in many case reports and has been evaluated in several case-control studies. In some studies, the nature of the physical trauma was not clearly specified, and in others, the definitions varied, from fractures, mechanical injuries, and electric shock, to surgery. Proposed mechanisms include trauma-related neurologic inflammation and microglial activation, disruption of the blood-brain barrier, mitochondrial dysfunction, excessive production of oxidative and nitric radicals [19], and accumulation of tau protein [20]. Past exposure to chemicals such as Tetraethyl lead in truck drivers and pesticides in farm workers, as well as exposure to organic solvents in miners, can be discussed as risk factors.

CONCLUSIONS

The exposure to general and local vibrations causing multiple injuries of the head and spinal cord can be discussed as a possible risk factor for ALS. This should be evaluated and confirmed in future studies of the problem.

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