Dementia, Amyotrophy, and Periodic Complexes on the Electroencephalogram

A Diagnostic Challenge

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Background: The clinical diagnosis of neurodegenerative diseases is a challenge to the neurologist. In many cases the diagnosis becomes neuropathological only after the autopsy. Several consensus criteria have been defined for the clinical diagnosis of different neurodegenerative diseases, among them the various types of dementia as well as prion-induced diseases. When compared with neuropathological findings, these criteria have proved to be reasonably accurate for regular practice, research, and epidemiological studies. The problem arises when a combination of complementary and clinical data are obtained that do not easily match these diagnostic criteria.

Case Description: We describe a patient with dementia and periodic complexes on an electroencephalogram, suggesting a diagnosis of sporadic Creutzfeldt-Jakob disease.

Results: When the condition progressed, signs and symptoms of a motoneuron disease appeared. Thus, 2 different diagnoses were proposed: (1) an amyotrophic variant of a prion-induced disease; or (2) an ELA dementia syndrome with periodic complexes on the electroencephalogram, a finding that previously has not been described.

Arch Neurol. 2001;58:1669-1672

The diagnosis of neurodegenerative disorders remains difficult for physicians. In many cases, a definite diagnosis is reached only after the postmortem examination. Several consensus criteria have been developed for the diagnosis of different types of dementia (including frontotemporal dementia) and for Creutzfeldt-Jakob disease (CJD) by ad hoc panels of experts. The neuropathological correlation of these diagnostic guidelines has yielded an appropriate level of accuracy, both for practice and for research purposes. However, some patients exhibit atypical clinical or paraclinical symptoms that do not meet the proposed diagnostic criteria.

We describe a patient who had cognitive and behavioral disorders associated with periodic sharp complexes on the electroencephalogram (EEG), suggesting sporadic CJD. Later, in an advanced phase of the disease, he manifested overt signs and symptoms of a diffuse inferior motoneuron disease plus pyramidal signs. We were faced with a diagnostic dilemma between an amyotrophic variant of CJD, a condition yet to be proved, vs a dementia amyotrophic lateral sclerosis syndrome with periodic EEG discharges, a previously non-reported association. The postmortem examination produced a final diagnosis of frontal lobe degeneration with associated motoneuron disease.

REPORT OF A CASE

A 62-year-old man was referred to us by his family physician in April 1999 reporting a progressive short-term memory impairment, which had started 4 months earlier. The only medical antecedent was a history of angina pectoris treated with sublingual nitroglycerin. He did not have any other vascular risk factors. His mother had a record of parkinsonism, but there was no family history of other neurodegenerative disorders.

At the age of 53 years, the patient was laid off from his job. Moderate depressive symptoms were then observed and symptomatically treated by a psychiatrist. Because the patient was treated in another hospital, we lack any additional information about his psychiatric case history. Subsequently he found a job cleaning up a parking lot, and his mood improved and stabilized. His cultural level was low, he was not interested in reading newspapers or watching the news on television, and he did not pursue any hobbies.
In addition to memory loss, his family observed a striking psychological change in the patient. He did not take part in conversations and refused to socialize at all. No other behavioral disorders were observed.

The results of the neurological examination were unremarkable. The patient’s cognitive status as determined by the Mini-Mental State Examination was in the lower-normal limit for his age and cultural level (23/30). The patient was partially oriented with regard to time and had evidence of short-term memory impairment as well as delayed retrieval. Verbal fluency was moderately reduced. He was unable to subtract 7 from 100 and made errors in simple arithmetic calculations and when reciting backward the months of the year. Ideomotor and constructive praxis (cube and clock drawing) were normal. In contrast, he was unable to follow simple hand motor sequences. His insight was poor, and he could not interpret a common proverb. His mood was dysphoric, slightly moric, and disinhibited. His thought was perseverant and disturbed by hypochondriac and paranoid ideas.

A blood cell count and routine biochemical analysis yielded normal results. A very mild dilatation of the anterior frontal and temporal sulci was observed on the computed tomographic scan and magnetic resonance imaging study of the brain. A striking bilateral frontotemporal hypoperfusion was detected with single-photon emission computed tomography (Figure 1).

No significant clinical changes were observed in the next 6 months. His family noted apathy, bradypsychia, and sporadic aberrant behavior. In September 1999, slurred speech and amyotrophy of both hands caused readmission. The patient’s cognitive level had deteriorated. A gross impairment in attention and concentration precluded a detailed neuropsychological evaluation. Results of the neurological examination were within normal range. Findings from the basal EEG were normal except for an overload of θ-waves. During sleep there were frequent bursts of sharp, generalized, symmetric, biphasic or triphasic waves of approximately 1 Hz, which increased during the rapid eye movement stage of sleep (Figure 2).

By January 2000 the motor deterioration was severe, and the patient’s cognitive status remained almost unchanged (Mini-Mental State Examination score, 20/30); other neuropsychological tests were impossible to perform because of severe dysarthria and early fatigue. Dysphagia appeared, so he could swallow only soft foods. Decubitus intolerance forced the patient to sleep in an armchair. His cough was feeble, and secretions accumulated in the oropharynx. Amyotrophy had spread to the scapular girdle and cervical muscles; both arms were pellucious, and the patient was wearing a cervical collar because of a bent head. Muscle reflexes were weak in both arms but brisk in the legs, with ankle clonus. No Babin斯基 sign was observed. A serial EEG depicted a progressive slowing of background activity but no periodic complexes. A gastrostomy was performed, but the patient refused artificial ventilation. He died on February 22, 2000, 18 months after the disease began.

Following the safety rules proposed by experts for performing high-risk autopsies in patients with possible prion diseases, only the brain was removed. The uppermost segments of the spinal cord were retrieved through the foramen magnum. After formalin fixation, the brain was cut following the coronal plane while the brainstem and cerebellum were cut following the horizontal plane. Representative fragments were selected from all areas of the central nervous system. They were preventively decontaminated in formic acid and embedded in paraffin. Histological sections of 5 µm were stained with hematoxylin-eosin, cresyl violet, and luxol fast blue and immunostained for ubiquitin, τ-protein, and protease K-resistant prion protein following standard methods and using commercially available monoclonal antibodies (anti-prion protein: DAKO Clone 1/30; DAKO Diagnosticos SA, Barcelona, Spain; antiubiquitin: DAKO...
lar inclusions were observed in a few pyramidal neurons. Outside of the frontotemporal cortex and hippocampus, very few ubiquitin-positive inclusions were found in the larger neurons of the caudate nuclei and putamen. Findings from ubiquitin immunostaining were negative in the substantia nigra, in the motor nuclei neurons in the brainstem, and in the anterior horn of the spinal cord. The neuropathological diagnosis was frontotemporal degeneration with motor neuron disease and associated ubiquitin-positive inclusions.

The patient we describe had cognitive impairment and behavioral disorders suggesting frontal or frontotemporal lobe dysfunction. Secondary symptomatic dementia was ruled out by an extensive work-up. Neuroimaging studies indicated the absence of a macroscopic structural lesion in the frontotemporal lobes. In contrast, a profound anterior brain hypoperfusion was observed with single-photon emission computed tomography, in correlation with the clinical picture. Thus, a frontotemporal type of dementia was our first clinical diagnosis for the patient. However, focal deficits of perfusion have been described in early stages of CJD. This hypoperfusion is detected at the frontal level in some patients. Unexpectedly, the polysomnographic EEG detected bursts of periodic sharp biphasic or triphasic waves, resembling the typical pattern observed in sporadic CJD. According to the current diagnostic criteria developed in Europe, the association between rapidly evolving dementia and a periodic EEG pattern supports the clinical diagnosis of probable sporadic CJD. If 2 of the following neurological abnormalities are also present: pyramidal, cerebellar, or extrapyramidal signs, myoclonus, abnormal vision, or akinetic mutism. Such presumed cases of CJD should be reported to the respective National Prion Disease Registry following the recommendations of the European Concerted Action Project. Our patient fulfilled various clinical criteria for possible or probable CJD.

Many studies have been conducted to establish the sensitivity and specificity of EEG abnormalities in the diagnosis of CJD. Because the EEG complexes vary with the patient's level of attention, sensitivity depends on factors such as the number, length, and time of the proce-
specificity of the EEG was 86%. Periodic EEG complexes have been observed in degenerative dementias such as Alzheimer and Parkinson diseases. However, in a recent and comprehensive study, the specificity of the EEG relies on patient selection and the extension of the work-up to rule out the many known causes of a similar EEG pattern (Table). The specificity of the EEG relies on patient selection and the extension of the work-up to rule out the many known causes of a similar EEG pattern (Table). The specificity of the EEG was 86%. Periodic EEG complexes have been observed in degenerative dementias such as Alzheimer disease and dementia with Lewy bodies, although they have not been described in frontotemporal dementia.

Recently, an assay of 14-3-3 protein in the cerebrospinal fluid has been introduced as a useful tool to endorse the diagnosis of sporadic CJD (it often produces a negative result in hereditary cases). The sensitivity and specificity of the 14-3-3 test have been estimated to be as high as those of the EEG. In our patient this test result was negative, in contrast with the positive EEG finding.

Later in the course of his illness, our patient had fully developed lower motoneuron disease. He had severe, widespread weakness and amyotrophy in both arms, prominent fasciculations, bulbar palsy, tongue atrophy, and diffuse signs of denervation on the electromyogram with normal nerve conduction velocity. He also had a pyramidal syndrome with ankle clonus and brisk muscular reflexes in his legs. This upper motoneuron syndrome is common to both CJD and amyotrophic lateral sclerosis. In contrast, the characteristic lower motoneuron involvement of amyotrophic lateral sclerosis has been disputed in CJD. Although some authors have proposed an amyotrophic variant of CJD, other experts have rejected such a clinicopathologic phenotype, holding that amyotrophy in CJD is just a terminal phenomenon in emaciated patients with dementia. However, in a recent and exhaustive review of the literature, Worrall et al found 50 cases of sporadic or familiar prion disease positively confirmed, in which clinically significant amyotrophy and electromyographic denervation were well documented. They concluded that "amyotrophy is occasionally a prominent feature of Creutzfeldt-Jakob disease and underscores the importance of documenting lower motor function and the crucial role of examining the spinal cord in cases of prion diseases." This proposal differs from the current recommendation that only the brain should be removed in the autopsies of patients with suspected prion diseases. In cases of frontal dementia plus amyotrophic lateral sclerosis, a complete autopsy can be performed following the routine safety measures; the literature data10-12 have concluded that this syndrome is not due to prion. Our case supports the validity of this conclusion even if transient periodic EEG complexes are observed, provided the 14-3-3 test of the cerebrospinal fluid yields a negative result.

Accepted for publication June 28, 2001.

The authors thank Isidro Alfè, PhD, for his help in preparing the manuscript.

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**REFERENCES**


**Conditions, Other Than Prion Diseases, in Which Triphasic or Biphasic EEG Complexes Have Been Observed**

- Hyponatremia and hypernatremia
- Metabolic encephalopathies (hypoglycemia, hyperammonemia, hepatic failure, and Hashimoto disease)
- Exogenous toxic encephalopathies (intrathecal metrizamide injection, bismuth, lithium, baclofen, neuroleptics, and tricyclic antidepressants)
- Degenerative dementias (Alzheimer and Parkinson diseases)
- Posttraumatic injuries
- Focal epilepsies
- Strokes
- Subacute encephalopathy with seizures in alcoholics

*EEG indicates electroencephalogram.*