

NEUROLOGICAL ASPECTS OF THE VIBROACOUSTIC DISEASE

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SUMMARY

Mood and behavioral abnormalities are the most common initial findings related to the Vibroacoustic Disease. Other signs and symptoms have been observed in these patients. Brain MRI discloses small multifocal lesions in about 50% of the subjects with more than ten years of occupational exposure to high intensity and low frequency noise. However there are no studies to globally integrate all the neurological aspects and imaging and neurophysiological data of the VAD patients. This is the main goal of this study. Sixty male Caucasians diagnosed with the VAD were neurologically evaluated in extreme detail in order to systematically identify the most common and important neurological disturbances within the VAD. In this population there are cognitive changes, identified through psychological and neurophysiological studies (ERP P300), vertigo and auditory changes, visual impairment, epilepsy and vascular-cerebral diseases. Neurological examination reveals pathological signs and reflexes, most commonly, the palmomental reflex. A vascular pattern underlying the multifocal hyperintensities in T2, with predominant involvement of the small arteries of the white matter, is probably the visible organic substratum of the neurological picture. However other physiopathological mechanisms are involved in epileptic symptomatology.

INTRODUCTION

The multitude of clinical signs and symptoms observed in subjects occupationally exposed to high sound pressure level/low frequency noise, has been termed the Vibroacoustic Disease, the object of this research team since 1980. Although neurological disorders are not common among the earliest symptoms of the VAD, they were the first to be identified and associated with occupational exposure to high-intensity, low-frequency noise (7). These disorders may produce the most disabling situations, such as stroke, vertigo and epilepsy, and so it became important to systematically evaluate all the neurological disturbances associated with this disorder. The goal of this report is to describe the most frequent neurological symptoms, emphasizing the clinical picture as supported by imaging and neurophysiological methods. Cognitive decline was also analyzed by neuropsychological methods.

POPULATION AND METHODS

We followed 60 workers at an aeronautical industry plant over a period of 10 years of occupational activity involving engine test cells, aircraft run-up procedures, rotary-wing aircraft and large industrial equipment. The entire population was male Caucasian with an average age 43.8 years (range 34-58). All who were occupationally exposed to high intensity/low frequency noise for more than 15 years, working in engine test cells, aircraft run-up procedures and operating rotary-wing aircraft, have signs of the Vibroacoustic Disease. The average occupational exposure time for these individuals is 23.3 years (range 10-36). Noise characterization at these workplaces revealed Leq values ranging from 80 dB (A) to 110 dB (A) and the energy spectral content was mainly concentrated in the low frequency bands of below 500 Hz. A full characterization of the different workplaces was the object of an independent study by Bento Coelho et. al. (3). There seems to be evidence of subsonic components in the radiated noise. We assessed the clinical and occupational medical files of these workers, in which all medical information is stored from their first day of employment. All neurological data were analyzed in a chronological order. Clinical history and physical examinations were performed, including psychological and neurological evaluations. Each employee received a topographic EEG, multi-modal evoked potentials including event-related potentials, brain MRI, and transcranial Doppler vascular evaluation. On 18 subjects who evidenced psychological and behavioral problems, we performed additional psychological evaluations. These included psychometric tests, Wechsler Memory Scale, and the Toulouse-Pieron Test. Since MRI revealed ischemic-like lesions, we excluded all the subjects who had risk factors for vascular diseases, such as diabetes, dyslipidemia, heavy smokers (> 20 cigarettes a day), high alcoholic consumption and permanent hypertension medication.

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RESULTS

We established 5 main groups for the clinical findings: 1 - Visual changes. 2 - Balance and auditory disorders. 3 - Psychological disturbances. 4 - Epilepsy, 5 - Stroke.

1 - VISUAL CHANGES

We found a progressive impairment of visual acuity, asymmetric and non-correctable, in 6 individuals. In Table I we present a clinical summary regarding the 6 individuals with visual symptoms, as well as the topography of the imaging changes visualized by MRI. In all these cases we found changes in ocular angiography. The visual deficit occurred suddenly in one of these subjects. The earliest of these complaints began 11 years after beginning to their occupational activity. We found no visual field defects by confrontation. Fundoscopy examination was abnormal in 2 individuals who presented optic disk atrophy, confirmed by fluorangiography of the retina. Given these results we decided to study the entire population using retinal fluorangiography, but only 30 subjects volunteered (including the six patients that impairment of visual acuity). In these 30 subjects there were inactive or mixed lesions of the retinal pigmented epithelium in 14 cases. We also found changes in retinal circulation in 4 cases, optic neuropathy in 3 cases and macular detachment in one case (29).

2- BALANCE AND AUDITORY DISORDERS

Exposure to occupational noise is well known to damage hearing. Its effects range from auditory fatigue to profound deafness, depending on the type of sound and the duration of exposure. In our study group there was enough exposure time to high intensity noise to warrant concern about hearing loss, but the main frequencies of the noise were in the lower bands. We found some auditory impairment in 23 individuals, frequently associated with tinnitus. Some degree of noise intolerance was common to all these individuals, but Metz tests confirmed recruitment in only 3 cases. Vertigo was a symptom in 14 of these individuals; in 4, symptoms were severe enough to require emergency hospital assistance. These complaints occurred in workers with over 15 years of occupational exposure. Transient balance and instability while walking are very common in these subjects, especially after a longer period of noise exposure, but must not be mistakenly classified as vertigo disorders. Recent studies revealed that the frequency of balance disturbances is associated with asymmetries in the brainstem auditory evoked potentials, and with the existence of lesions visualized through brain MRI (22).

3 - PSYCHOLOGICAL DISORDERS

This kind of disorder is well documented in the medical literature (6, 19, 23, 25). In clinical interviews of these patients, we found mood changes in 42 cases (70%). Memory and attention problems were very common and were associated with complaints of depression in 34 patients (56%). When the clinical files were evaluated we found the record of a frequent need of ambulatory psychiatric assistance. The onset of the complaints was extremely variable: in very few it began in the first year of professional activity but after 11 years of activity 29 patients needed psychiatric support. Current psychological evaluation revealed anxiety in 39%, depression in 52%, paranoid ideas in 39%, sexual problems in 33%, social dysfunction in 39%, intellectual impairment in 32% and memory deterioration in 28%. In 36 of these individuals (60%) these findings were related to abnormal MRI's. All were easily irritated. This was not always acknowledged by the individual himself, yet it was confirmed by interviews of family and friends. In 4 cases, aggressive behavior was significant, being triggered by intense and sudden noise. These 4 subjects were not aware of their aggressive behavior and when there were serious consequences, they were surprised and completely ignorant of their actions.

4 - EPILEPSY

Six individuals had partial or generalized epileptic seizures. All these cases had their first occurrence in adulthood, about 10 years after beginning their occupational activity. There are no references in their past histories to any occurrences suggesting similar episodes, even in childhood, and so they were considered to have a late onset epilepsy. One of the patients also had transitory global amnesia. The EEG taken at rest between seizures presented abnormal recordings in only three individuals. Table III shows other data associated with epilepsy in these subjects.

5 - STROKE

Unique and sudden episodes of non-convulsive neurological deficits occurred in 5 individuals. These were diagnosed as ischemic cerebral vascular accidents. Two patients had a transitory event, and in 3 the ischemic neurological deficit was reversible. Two of these subjects had labile hypertension (no medication), and only one of them smoked. All five individuals presented multiple T2 hyperintensities in the MRI. One patient had ischemic infarcts of the cerebral medial right artery and T2 hyperintensities in the subcortical white matter. Table IV shows a summary of the clinical signs and other findings associated with stroke. The whole population of 60 workers was given a careful neurological evaluation every six months. Within this group we found 9 individuals with deficits of the pyramidal pathways, 3 others with cerebellar tremor, and 4 with postural tremor. The most frequent pathological sign encountered was the primitive palmo-mental reflex. We found this in 30 individuals, of whom 18 had lesions visualized through MRI. Five of these patients showed facial dyskinesia induced by auditory stimuli during auditory evoked potentials. They are not aware of these abnormal movements, which ceased as soon as stimuli were terminated (25).

DISCUSSION

This study confirms the results presented in a previous note (18). The Vibroacoustic Disease is a clinical entity of a systemic nature that goes beyond the normal, well-known auditory impairments or osteoarticular lesions. Cardiovascular pathology is present in the entire group (2, 17, 29). The visualized CNS lesions are not unique to this disease (5, 9-11); in fact, they present a common picture of gliosis, ischemia and demyelination that is not indicative of any specific disease (27). There are multiple references in the literature regarding cognitive impairment associated with this type of lesions (5, 9-16, 27). Much more difficult to understand are the epileptic manifestations. There must be some specific characteristic related to individual susceptibility.

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