EFFECTS OF HIGH STRENGTH 60 HZ ELECTRIC FIELDS ON MYELINATION OF THE OPTIC CHIASM

by

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ABSTRACT

Previous study of electric field exposure effects using the visually evoked potential has indicated a field-induced decrease in waveform latency. One factor which might affect the speed of conduction is the degree of myelination in the nerve fibers. In order to examine the possibility of myelination changes due to electric field exposure, the optic chiasm, an easily identifiable region along the visual conduction pathways, was studied. The optic chiasm was removed from two groups of 14 day old Sprague-Dawley rats. One group had been born and raised in a 60 Hz 20 kV/m electric field, and the other was born and raised in a sham exposure facility under field-free conditions. The chiasma were sectioned and stained, and the degree of myelination in the two groups was compared.

SUMMARY

Changes in brain activity due to low frequency electric fields have been noted by several investigators. Bawin and Adey[1] and Kaczmarek[2] have found that these fields can alter the efflux of calcium ion and the neurotransmitter γ-amino-butyric acid from brain cells. Jaffe, et al.[3] have detected field induced increases in C-fiber conduction velocity, decreases in the rate of fiber fatigue, and shifts in strength-duration curves which suggest that electric field exposure may increase neuronal excitability. Pilot studies here at Tulane[4] have indicated a field-induced decrease in waveform latency of the visual evoked potential. This difference was found to be most distinct at about 2 weeks of age, with values converging for increasing age.

One factor which affects the speed of signal conduction is the degree of myelination in the nerve fibers. Increased myelination can increase conduction velocity. Since the changes in the visual evoked potential involved pathways between the eye and the occipital region of the brain, we decided to examine myelination of nerve tissue along this axis. The optic chiasm was chosen as an easily identifiable area in this visual conduction system.

The optic chiasm was studied in two groups of Sprague-Dawley rats. One group was born and raised in a 60 Hz 20kV/m electric field, and the other was born and raised in a sham exposure facility under identical but field-free conditions. Rats were sacrificed by decapitation at 14 days of age, and the optic chiasms were removed and placed in a 10% formalin solution. The chiasms were sent to a pathologist for sectioning and staining with a hematoxylin and eosin preparation. The tissue slides were independently coded so that the samples would be blindly analyzed.

The degree of myelination was determined by measuring the area of the myelin sheaths. 35mm slides of the optic chiasms were taken through a light microscope and then projected on a Zeiss MOP-2 Digitizer which computed the myelin area. The means and standard deviations were calculated for each group, and a two-tailed t-test was used to determine significance.

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