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EFFECTS OF 60 HZ ELECTRIC FIELDS ON RODENT ADRENAL TISSUE: IN VITRO AND IN VIVO

by

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ABSTRACT

The in vitro response of adrenal cortical tissue to 60 Hz high intensity electric field exposure was studied. Adrenal glands were immediately removed from freshly sacrificed male Sprague-Dawley rats and placed in physiological solution. Adrenal cortical tissue was then sliced away from the intact adrenal gland and placed in a superfusion system. Physiological Krebs-Henseleit-glucose solution was passed over the tissue and pumped through an analytical system which continuously monitored the corticosterone output of the tissue. An electric field exposure system was placed in situ around the adrenal tissue, set at an initial strength of 45 kV/m, and regularly incremented. The corticosterone output response to ACTH stimulation was compared between the field-on and field-off conditions. In addition, we will report on studies of adrenal gland weights between field-exposed and sham-exposed rats.

SUMMARY

The sensitivity of the hypothalamic-pituitary-adrenal axis to environmental influences allows an animal to survive stressful alterations in its external environment. If an animal senses a change of sufficient magnitude, the central nervous system will initiate the production of corticotrophin releasing factor (CRF) which stimulates cells of the anterior pituitary to produce adrenal corticotrophic hormone (ACTH). ACTH is carried through the peripheral bloodstream to cells of the adrenal cortex where it stimulates production of cortisol and corticosterone. These two steroid hormones are potent physiological effectors which interact with most cells of the body. Some investigators have noticed field related changes in these hormones. Marino, et al.[1] have reported significant elevations of the circulating adrenal cortical hormones as well as increased adrenal and pituitary weights in rats subjected to a 60 Hz 15 kV/m electric field. They have suggested that such fields act as a biological stressor. Noval[2], however, reported a decrease of corticosterone output under exposure conditions. Pilot studies here at Tulane have indicated a subtle increase of adrenal but not pituitary weights with field exposure.

In order to determine if there were any direct electric field effects on adrenal cortical function, an *in vitro* analysis was designed which measured corticosteroid production. Since the *in vitro* preparation is devoid of sensory inputs, any alteration in adrenal output must reflect structural or biochemical changes and not a psychological stress. 100-400 gm Sprague-Dawley rats were sacrificed by decapitation, and their adrenals were removed and placed in warm (35°C) physiological solution. Adrenal cortical tissue was sliced away from the intact adrenal glands and approximately 8-10 mg of the tissue was placed in a glass tube. The tube and tissue were then inserted in a continuous flow analytical system as described by Saffran, et al.[3]. In this procedure, physiological Krebs-Henseleit-glucose solution was pumped over the tissue by a Technicon Autoanalyzer Pump I. Corticosteroids formed in the

tissue entered the superfusate as it flowed over the tissue. Past this point, the superfusate underwent an extraction with methylene chloride. This extract then mixed with ethanolic sulfuric acid, after which the mixture passed through a Turner fluorometer. The degree of fluorescence of the superfusate was proportional to the levels of corticosterone present. Fluorometric responses were recorded on a Linear recorder. 10 mU doses of ACTH were added to the superfusion solution every 100 minutes in order to test adrenal cortex responsiveness.

An electric field exposure system was placed in situ. Parallel plate electrodes, separated by 1.2 cm, were placed around the tube of tissue and energized to a field strength of 45 kV/m in air. Comparisons of corticosterone output were made between the field-on and field-off trials. The field strength was incremented at regular intervals to obtain a strength-response profile.

We will also report on our pilot study of pituitary and adrenal weights covering 4 generations of chronically exposed and sham exposed rats.

REFERENCES

1. Marino, A.A., T.J. Berger, B.P. Austin, R.O. Becker, F.X. Hart, "In vivo Bioelectrochemical Changes Associated with Exposure to Extremely Low Frequency Electric Fields," Physiol. Chem. Phys. 9(4-5): 403-411, 1977.

2. Noval, J., "Biochemical Effects in Rats Exposed to Extremely Low Frequency Non-Ionizing Radiations," Ann. Meeting of Am. Soc. of Neurochemistry, New Orleans, LA, March 1974.

3. Saffran, M., E.K. Matthews, F. Pearlmutter, "Analysis of Response to ACTH by Rat Adrenal in a Flowing System," Recent Progress in Hormone Research 27: 607-630, 1971.