

EVIDENCE OF NEUROPATHOLOGY
IN CHRONICALLY IRRADIATED HAMSTERS
BY 2450 MHz MICROWAVES AT 10mw/cm²



This is an extension of studies reported previously (Albert and DeSantis 1975, 1976). Adult Chinese hamsters were exposed to 2450 MHz microwaves (CW) at 10 and 25 mw/cm² power densities for 14 hours/day for 20 days. Sham irradiated animals were treated exactly in the same manner as experimentals except for exposure to microwaves.

Immediately following the final exposure the animals were anesthetized with phenobarbital (IP), perfusion fixed with buffered formalin via the left ventricle, and the brains were dissected out and processed for neuropathological examination using standard and special stains for dendritic spines, axons, bouton terminals, glia and neurons.

Microscopic examination of serial sections revealed that brains of some experimental animals exposed to 10 mw/cm² power density had fewer dendritic spines, axonal swelling, axonal beading, hyperchromatic neurons, and cytoplasmic swelling of neurons in some parts of the brains. There was no evidence of gliosis, hemorrhage or pyknosis. While no recovery studies were performed, it is this investigators opinion that all of the above observed morphological changes are probably reversible.

Animals exposed to 25 mw/cm² showed similar histological alterations as those irradiated at 10 mw/cm². There was some evidence that quantitatively the effects may be greater in the 25 mw/cm² group. During the first 7 - 14 days of exposure animals exposed to 25 mw/cm² were decidedly more irritable but appeared to become acclimatized as judged by external behavior.

Details of exposure conditions and histopathological procedures will be presented at the symposium.

Albert, E.N. and DeSantis, M. Do microwaves affect central nervous system structure? A light and electron microscopic study. *Annals N.Y. Acad. Sci.* 247:87-108, 1975.

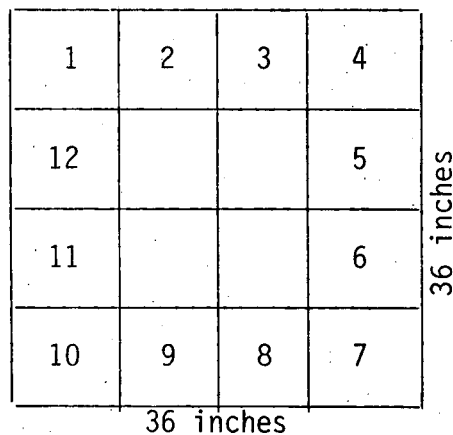
Albert, E.N. and DeSantis, M. Histological observations on central nervous system. In *Biological Effects of Electromagnetic Waves*. Eds.: C. Johnson and M. Shore. HEW Publication (FDA) 77-8010, pp. 299-310, 1975.

Summary

This laboratory has previously reported histological changes in brains of Chinese hamsters exposed to microwaves (cw) at low power densities. These changes consisted of neuronal swelling, cytoplasmic vacuolation, and chromatolysis. Other investigators in Eastern European countries have reported a variety of histological alterations which include axonal degeneration, swelling of terminal boutons and spines, gliosis, and perivascular edema. We have extended our own studies to investigate similar neuropathological changes using special neurocytological staining procedures on serially sectioned brains.

Methodology

Twenty-one day old female Chinese hamsters were exposed to 2450 MHz continuous wave microwaves at 10 and 25 MW/cm². Exposures lasted 14 hours/day for 10 weeks. The control animals were treated exactly like the experimentals except that they were shielded from the microwaves in the chamber. Animals were contained singly in well ventilated containers made of plexiglas rods and measuring 9"x3"x3". These containers were housed in a square styrofoam frame divided into 16 cubicles. (See diagram below.) Only 12 animals were exposed at a time and positions were rotated daily.



At the termination of the experiments, animals were perfused via the left ventricle with buffered 10% formalin for 10 minutes. Brains were dissected out and post-fixed in fresh fixative. After soaking several days in sucrose-formalin, they were then frozen in dry ice and serially sectioned at 25 μ . Adjacent sections were sequentially stained in repeated series using Cajal's gold sublimate, Penfield's, Nauta, cresyl violet, Fink-Heimer, H&E, and Bodian's techniques. This report only concerns the Nauta, Fink-Heimer, and H&E stains. Separate brains were prepared following the Golgi-Cox technique.

Results

Examination of Nauta stains revealed axonal swelling, beading, and varying degrees of degeneration in several areas of the brain in some of the experimental animals. Similar observations were made in Fink-Heimer preparations as well as degenerating terminal boutons. Both stains showed neurons heavily impregnated with silver. These neurons appeared in both small and large groups. Neurofibrillar ring structures not associated with synaptic endings were also observed in greater numbers in experimental animals. Golgi-Cox impregnation techniques revealed that many neurons of the cerebral cortex possessed fewer dendritic spines than the corresponding controls.

These observations are in agreement with some previous reports by other investigators. The morphological changes described in this report were observed in greater frequency in experimental animals. Details of quantitative analysis and functional correlates of the above mentioned changes will be discussed.