

CHRONIC EXPOSURE OF RATS TO 100-MHz (CW): ASSESSMENT OF
BIOLOGICAL EFFECTS



A multidiscipline approach was employed to assess the possible biological effects of chronic exposure of rats to 100-MHz radio-frequency radiation (RF). A group of 20 time-bred rats were exposed in a transverse electromagnetic mode (TEM) transmission line, to 100-MHz at a forward power of 500 W (50 mW/cm²) starting on day 6 of pregnancy, under controlled temperature and humidity conditions. Dams were exposed for 4 hours per day 7 days per week. On day one post-partum litters were normalized to 4 male pups and these rats were subsequently exposed following the same regimen as the dams. Specific absorption rates (SARs) for rats of various masses (ages) were determined by twin-well calorimetry. No significant differences in SAR's were observed for rats of different mass or for the position of rats in the 100-MHz chamber. The mean SAR for rats was 2.8 mW/g. An equal number of control rats were simultaneously sham-exposed and handled in the same manner as exposed rats. Growth, neurological development, and locomotor activity of the pups were assessed; no difference was observed for any of these parameters between sham and exposed rats. At 21 and 41 days of age pups from each litter were evaluated for possible changes in hematology and immune function. No difference was observed between sham and exposed rats for complete blood counts, for the mitogen-stimulated response of lymphocytes, for the frequency of T- and B-lymphocytes or for the antibody response to Streptococcus pneumoniae capsular polysaccharide. There was no mutagenic effect on sperm cells caused by exposure of male rats in utero through 90 days of age as determined by the Dominant Lethal Test. There were, however, significant changes in regional brain acetylcholinesterase activities in the brains of rats chronically exposed to 100-MHz.

SUMMARY

The purpose of this study was to determine if chronic pre- and post-natal exposure of rats to 100-MHz (CW) radiofrequency (RF) radiation is of biological consequence. The decision to use a frequency of 100-MHz was predicated on the fact that the FM radio band is one of the frequencies that makes the greatest contribution to ambient RF radiation levels to which the public is exposed. Also, this frequency is very close to the resonant frequency (70-80 MHz) for man. It is not known if this frequency band poses any threat to the health and well being of the general population at the power density levels found in the environment. It was hoped that through the present study a qualitative estimate of the interaction of RF radiation and several biological systems would be gained.

A multidiscipline approach was employed to assess the possible bio-effects of chronic exposure of rats to 100-MHz radiation. During the course of this study several parameters were examined and a comparison between sham-exposed and 100-MHz exposed rats was made. The parameters investigated included growth, neurological development, locomotor activity, mutagenicity, hematology, immunology, and neurochemistry.

Twenty time-bred rats (Charles River, CD) were exposed in a temperature- and humidity-controlled environment to 100-MHz (CW) radiation. The 100-MHz facility is a transverse electromagnetic mode (TEM) transmission line (Crawford cell). Rats were exposed at a forward power of 500 W which is equivalent to an incident power density of approximately 50 mW/cm^2 at the center of the line. Actual SAR values for rats ranging in age/mass size from neonates to pregnant dams were determined by twin-well calorimetry. No significant differences in SARs were observed for rats of different mass or for the position of rats in the 100-MHz chamber. The mean SAR for rats was $2.8 \pm 1.5 \text{ mW/g}$. An equal number of control rats were simultaneously sham-irradiated and handled in the same manner as irradiated rats.

Daily irradiation of pregnant dams (4 hours per day, 7 days per week) commenced on day 6 of pregnancy and continued until parturition. All dams (both exposed and sham exposed) were maintained at 22°C and 50% relative humidity (RH). On day 1 post-partum litters were normalized to 4 male pups each. These pups were subsequently irradiated following the same exposure regimen as the dams. Pups 1-14 days of age were maintained at 26.7°C and 50% RH (approximate nest temperature) during the 4 hour exposure period, thereafter the environment was maintained at 22°C and 50% RH. Two pups from each litter were euthanized at 21 days of age, one pup from each litter at 41 days of age and the remaining male from each litter was exposed through adolescence (> 90 days).

Growth of pups was determined by weighing all pups individually on days 1, 4, 7, 10, 13, 16, 19, 21 and then once per week through adolescence. Developmental tests of righting reflex, eye opening and startle reflex responsiveness were performed on two pups/litter between the ages of 9 and 21 days. Pups euthanized at 21 and 41 days of age were evaluated for possible changes in hematologic (complete blood counts), immunologic (mitogen-stimulated response of lymphocytes, frequency of T- and B-lymphocytes, and response to immunization with capsular polysaccharide of S. pneumoniae), and neurochemical parameters (acetylcholinesterase activity). The locomotor residential maze activity of pups was assessed at 35 and 84 days of age. At approximately 90 days of age, the rats were tested for mutagenic effects on sperm cells using the Dominant Lethal Assay. At the conclusion of breeding rats were sacrificed for evaluation of neurochemical changes.

The results of this study indicate that there were no differences between sham-exposed rats for the various endpoints examined which included: growth, neurological development, locomotor activity, hematology, immunology, or mutagenicity. Changes in acetylcholinesterase activity in some brain regions were observed. However, the functional significance of these alterations remains to be determined.