BE-27

STUDIES CONCERNING THE EFFECTS OF NON-THERMAL PROTRACTED PRENATAL 2450 MHz MICROWAVE IRRADIATION ON PRENATAL AND POSTNATAL DEVELOPMENT IN THE RAT.

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ABSTRACT: Twenty-four Wistar rats were exposed 8 hours daily throughout pregnancy to a 20 mW/cm^2 dosage level of microwave radiation at a frequency of 2450 MHz (total mean exposure time was 108 hours). Previous initial exposures indicated that dosage levels up to 20 mW/cm^2 did not induce an increase in body temperature as measured by a rectal thermocouple probe. Eight rats served as concurrent controls. On the 22nd day of gestation half of the rats in each group were killed for teratologic evaluation, while the other half were allowed to raise their offspring for postnatal behavioral and physiologic evaluation. Fifty-nine baseline control litters (686 fetuses and neonates) were used to control for operative and environmental conditions (baseline controls). Teratologic studies were performed on 103 irradiated fetuses, 31 concurrent control fetuses, and 314 baseline control fetuses for the following parameters: maternal weight gain, fetal and placental weights, litter size, resorption rates, and abnormality rates. Postnatal studies included: 1. rebreeding of mothers and teratologic evaluation of resultant litters, 2. four reflex tests on F_1 offspring, 3. one neonatal physiologic development test, 4. six adult behavioral tests, and, 5. breeding of the F_1 offspring and analysis of the resultant F_2 litters. The results indicate that a non-thermal dosage level of 2450 MHz microwave radiation does not appear to significantly alter prenatal or postnatal growth and development as determined by the above mentioned parameters.

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SUMMARY:

The major emphasis of the present study is psycho-biological. Accurate dosimetry is of paramount importance, however, in obtaining meaningful biologic data. Antenna patterns were verified in an anechoic chamber by measuring the power field at 25 equally spaced points in a 1 square meter platform. All measurements were made inside an animal cage constructed of the same material (Acrylite) used during the irradiation of the experimental animals. The RF field was measured without rotating the antenna. The more realistic approach was to rotate the antenna. In this manner, the E and H components of the propagated wave would be rotating, and would closely approximate the effects of the mode stirrer in a microwave oven. Incident power densities were calculated with the antenna rotating at 30 rpm. comparison results indicate that measurements of incident field density were valid and remained reasonably insensitive to antenna rotation.

With the antenna field established, tests were initiated to determine the incident field required which would not produce a thermal reaction in the experimental animals. At various times during the initial irradiation experiments the microwave generator was shut down and rectal temperatures of the exposed animals were taken within 30 seconds. A nominal 20 mW/cm^2 incident power dose was selected based on studies which were initiated at 25 mW/cm^2 and reduced in power until little, if any, temperature rise due to radiation could be shown; i.e., temperature fluctuations were within the ranges measured in control animals. Additionally, the protocol included the following specifications and restrictions designed to minimize the variables observed during preliminary dosimetry experiments:

(1) The number of experimental animals was limited to a maximum of four per irradiation run. If the animals in the group were positioned too closely to each other, field perturbations affected dosimetry due to reflections from the animals.

(2) Dosimetry was established on a daily basis prior to irradiation of the animals.

(3) The antenna was rotoated at 30 rpm during testing of both the experimental and control groups.

(4) Experimental animals were sequentially rotated on a daily basis in different positions on the platform in order to equalize the dosage during the gestation period.

(5) Rectal temperatures were measured 3 times daily to insure that thermal excitation was not taking place.

Each morning, prior to irradiating the animals, the incident power to each position was measured using a Narda monitor. A referenced power reading was recorded by means of a directional coupler in the coaxial line from the antenna.

Following maternal irradiation for 21 days of gestation, half the animals (11 irradiated, 3 concurrent controls, 30 baseline controls) were killed and classical teratologic evaluations were completed. These data included analyses of maternal weight and weight gain, litter size, fetal and placental intrauterine position and weights, resorption rates, and abnormality rates based on Wilson's cross-sectional dissection technique. The remaining 12 irradiated, 4 concurrent control, and 29 baseline control mothers were allowed to rear their young (122, 43, and 330 F_1 offspring, respectively), until weaning at 30 days of age. Postnatal growth data were accumulated weekly for each F_1 animal beginning at 3 days of age.

Reflex studies were initiated at 3 days of age and included surface righting, auditory startle, air righting, and visual placing. One physiologic developmental parameter (eye opening) was also recorded. Ten days after weaning the exposed mothers were rebred and classical teratologic evaluations were made on the resultant litters.

At 60 days of age adult behavioral tests were initiated. Each F_1 offspring was tested utilizing at least 3 behavioral parameters. Selection of the animals to be tested and the tests given were statistically randomized. All animals received either the conditioned avoidance response test (52 irradiated, 22 concurrent control, 48 baseline control), or the water T-maze test (54 irradiated, 21 concurrent control, 73 baseline control). All offspring randomly received 2 of the following 4 tests in a random sequence: activity wheel (54 irradiated, 21 concurrent control, 78 baseline control); hanging (54 irradiated, 21 concurrent control, 84 baseline control); open field (53 irradiated, 22 concurrent control, 102 baseline control); swimming (53 irradiated, 22 concurrent control, 94 baseline control). The irradiated F_1 offspring were then cross-bred with control offspring or other irradiated offspring and the resultant F_2 litters were subjected to teratologic evaluation. All data were statistically analyzed using standard analysis techniques.

No significant alterations due to exposure throughout pregnancy to 2450 MHz microwave radiation at 20 mW/cm^2 were observed using these indices of prenatal growth and development and postnatal psychomotor development.