EFFECTS OF EXPOSURE TO 60 HZ ELECTRIC FIELDS ON GROWTH AND DEVELOPMENT IN THE RAT

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A series of three replicated experiments was performed to determine the effects of exposure to an electric field on reproduction and on fetal or postnatal growth and development in the rat. A system was built for exposing rats to a uniform, 100 kV/m vertical, 60 Hz electric field. Other rats were contemporaneously sham exposed under identical environmental and housing conditions.

Reproductive behavior, fecundity, and fetal development were studied in the first experiment. A 6-day exposure prior to mating and continued exposure during the mating period did not affect the reproductive performance of either males or females. Continued exposure of the mated females through 20 days of gestation did not affect fetal mortality, size, or morphology. The males and unmated females were kept in the field for a total of 30 days. The unmated females were removed from the field and subsequently allowed to mate; no effects on breeding performance, fertility, or fetal development were seen. Evaluations of males indicated no effects on mating behavior or on the morphology and DNA properties of the epididymidal sperm.

The second experiment evaluated the postnatal sequelae of prenatal exposure. Females were introduced into the field on the morning following mating, maintained through parturition and removed from the field, with offspring, when the pups reached 8 days of age. The pups were periodically weighed, examined, and subjected to a battery of tests to evaluate reflex development and general neurological status. The only effect observed was a higher percentage of exposed offspring showing motile behaviors and a lower percentage exhibiting righting reflexes at 14 days. Subsequent studies in which randomly selected offspring were mated and re-exposed using the same protocol as in the first experiment did not indicate any significant effect on reproductive behavior, fertility, or fetal development.

A third experiment examined the effects of exposure during late gestation and throughout the suckling period. Exposure or sham exposure began at 17 d.g. and was terminated when the offspring reached 25 days of age, using the same battery of postnatal development measures. The growth curves and various maturational indices were similar to those in the second experiment and again showed no consistent differences between the two groups.

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A series of three replicated experiments were undertaken to determine the effects of exposure to electric fields on reproduction and on fetal or postnatal growth and development in the rat. A system was built for exposing rats to a uniform, vertical, 60 Hz electric field capable of simultaneously exposing 144 rats individually housed in plastic cages. The same number of rats could be sham exposed under environmental and housing conditions indentical to those of the exposed animals. Contemporaneous groups of Wistar derived rats were housed within the system and exposed or sham exposed for 21 hours per day for approximately 30 days.

Reproductive behavior, fecundity, and fetal development were studied in the first experiment, which was performed as three independent replicates. Within each replicate eight randomly assigned female and two male rats were exposed for 6 days in individual cages. Groups of four females and one male were then transferred to mating cages and allowed to cohabitate in these cages for 5 days; exposure continued during this mating period. Vaginal smears were taken each morning; no further smears were taken from the sperm-positive females.

At the end of this period of cohabitation, the males and females were returned to their individual home cages for continued exposure. At 20 days of gestation (d.g.) mated females were sacrificed for uterine and fetal evaluation. All living fetuses were measured, weighed, sexed, and examined for external malformations. They were then randomly assigned to two groups for examination of internal malformations. One group was fixed in Bouin's fluid, transferred to 95% ethyl alcohol and examined for visceral malformations using thin razor-blade sections. The other fetuses were fixed in ethyl alcohol, cleared and stained by the alizarin red technique and examined for skeletal defects. No effects on fetal viability, size or morphology were observed.

Unmated females and the males were kept in the field for a total of 30 days. The females were subsequently allowed to mate; mated females were killed at 14 d.g.. No effects on breeding performance, fertility, or embryonic development were seen. The males were allowed a 3-week period for progression of the spermatogenic cycle after removal from the field. They were then mated to surgically sterilized females (1 male with 4 females), and sacrificed for analysis for morphology and DNA properties of the epididymidal sperm. Exposure of the males did not affect their mating performance of these measures of sperm properties.

The second experiment evaluated the postnatal sequelae of prenatal exposure and was performed in four replicates. Females were introduced into the field on the morning following mating,

maintained through parturition and removed with offspring from the field when the pups were 8 days of age. When possible, litters were reduced and maintained at 8 pups, with an even distribution of the sexes. At 1 day and several subsequent times the pups were weighed, examined and subjected to a battery of tests to evaluate reflex development and general neurological status. Exposure during gestation had no effect on litter size, survival of offspring, or subsequent growth of the offspring. Neuromuscular development of exposed offspring was normal except for a transitory effect at 14 days of age; a higher percentage of exposed offspring showed motile behaviors (moving, grooming, and standing) and a lower percentage exhibited righting reflexes. Exposed and sham exposed groups were indistinguishable upon retesting at 21 days of age.

At about 2 months of age four female offspring from each litter, together with one randomly selected male, were reintroduced into the sham exposure or exposure field and the protocol of Experiment 1 was repeated. No detectable effect on reproductive behavior or fertility was produced by subjecting the offspring to a second exposure. Necropsy of other animals, which included the weight of several organs, also failed to demonstrate differences between exposed and sham exposed groups.

A third experiment to examine the effects of exposure during late gestation and throughout the suckling period was performed in five replicates. The protocol, experimental conditions, and measures of effect were identical to those used in Experiment 2 except that exposure was initiated at 17 d.g., and terminated when the offspring reached 25 days of age (4 days postweaning). These animals were sacrificed at 42 days of age. No consistent differences between the exposed and sham exposed groups were found.

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