THE EFFECT OF CHRONIC, LOW-LEVEL MICROWAVE RADIATION ON THE TESTICLES OF MICE

Sterling J. Haidt and Arthur H. McTighe*
Division of Biological Effects, Bureau of Radiological Health, FDA, USPHS, Rockville, Maryland 20852

(*Present address: Department of Pathology, Yale University School of Medicine, New Haven, Connecticut)

Abstract

Testicular damage has occurred in mice which were exposed to 2.45 GHz CW whole-body radiation at an average exposure of 6.5 mW/cm^2 for a total of 230 hours over a two-month period. No post-irradiation increase in rectal temperature was noted.

Introduction

Previous studies of the biological effects of whole-body microwave radiation have concentrated on acute exposure situations associated with a post-exposure rise in rectal temperature. Studies of specific organs, such as the testicles or eyes, have used near-field exposures directed at the organ in question. A relatively untouched area of microwave bio-effects research has been the study of the chronic, low-level (i.e., insufficient to cause an increase in core temperature) effects of microwaves on experimental animals together with a post-irradiation pathological examination of critical tissues.

Previous authors have noted histological changes in dog testicles associated with exposure to 10 cm. microwaves at 5 mW/cm^2. These experiments were done with the microwaves directed specifically at the testicles and resulted only when the testicular temperature was increased (1). Other experimenters have examined the effects of whole-body radiation on testicular morphology of the rat but have used high exposures (60 mW/cm^2) associated with increased rectal temperature (2).

The present study was designed to assess the effect of chronic, low-level microwave radiation on an inbred strain of mouse which is used for studying genetic cataracteous effects (3). One of the target organs examined for evidence of biological damage was the testicles.

Experimental Design

Eighteen male mice were divided into experimental and control groups. Sham exposures were given to the control group in which conditions were identical except for the absence of radiation. The experimental group was exposed to CW radiation of 2.45 GHz for 18-hour periods. The interval between exposures alternated between 30 and 90 hours. Using this schedule, the mice were exposed for 230 hours (12 exposures) over a 2-month period. During exposures, the mice were allowed restricted movement in a styrofoam cage which was placed in the center of a plexiglas environmental chamber. Environmental conditions were 22°C, 50 per cent relative humidity with the air in the environmental chamber exchanged 14 times a minute. The exposure distribution was sampled uniformly over the volume which could be occupied by the mice (without the mice being present) using a NBS-BRH developed three-dimensional probe. Exposures were non-uniform and ranged between 0.5 and 25 mW/cm^2 with the mean of measurements in 54 locations being 6.5 mW/cm^2. Rectal and scrotal skin temperature remained unchanged following irradiation.

At 4 days post-irradiation, 14 out of the 18 mice were sacrificed and the testicles examined. The remaining 4 mice were sacrificed at 30 days post-irradiation.

Results

Histological specimens from the testicles of each of the 18 mice were submitted for pathological examination in a "blind" manner. Pathological examination disclosed that 7 out of the 9 exposed testicles showed evidence of microwave damage while only 2 out of the 9 control testicular slides showed similar pathological changes. The results are statistically significant at the $P \cong .06$ level. The typical pathological changes consisted of scattered lesions noted near the surface of the testicles. Within these lesions (see Figure 1), various stages of tubular degeneration were found. Within affected tubules, the various cellular layers were disorganized and the normal spermatogenic cycle disrupted. In some cases, vacuole formation occurred and giant cells were present. The interstitium appeared congested and Sertoli cells appeared prominent. Interstitial (Leydig) cells appeared normal. Tubules near the center of the testicles appeared similar to controls (see Figure 2). The pathological changes in the 30 day post-irradiation testicles were similar to the 4 day post-irradiation testicles.

Discussion

Other microwave bio-effects researchers have demonstrated that the microwave energy absorbed by different biological structures is different for identical exposure rates (mW/cm^2) (4,5). Since absorbed energy is responsible for the biological effect observed, comparisons between exposure situations are valid only if one knows the dose (i.e., absorbed energy) effect relationship. Since dose was not determined in this experiment, it is impossible to estimate to what degree extrapolation to the human situation is possible. Hopefully, future experiments will include determinations of distributed and integral absorbed dose in the experimental animal.

Conclusion

Testicular damage has occurred in mice exposed to a dose of low-level chronic microwave radiation insufficient to cause a rise in rectal temperature. Considering the spotty distribution of the damage, it is unlikely that infertility would result. However, additional work is needed to characterize the low-level testicular effects of microwaves and study the period of biological recovery.

References

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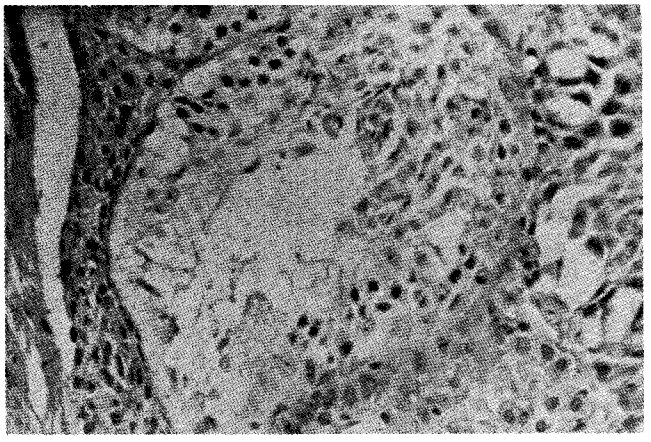

Fig. 1
Damaged Semeniferous Tubule

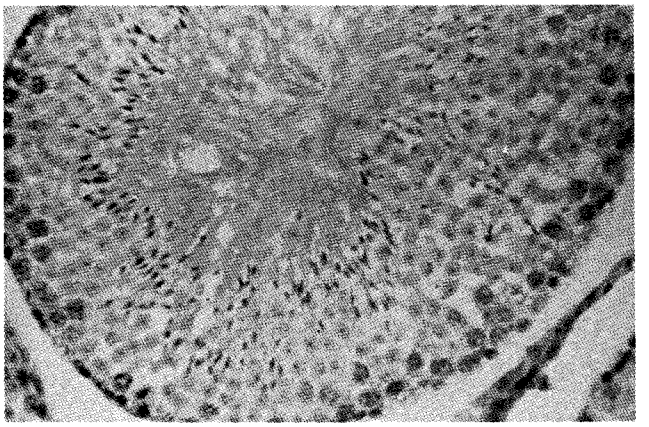

Fig. 2
Normal Semeniferous Tubule