"Experimental Microwave Cataracts: *Age as Factor in Induction of Cataracts in the Rabbit"*

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IT HAS long been known that the lens in young animals, including humans, appears to be more susceptible to damage by ionizing radiation than does the older lens.[1-3] Cogan and Donaldson and others,[4,5] employing single doses of x-ray, confirmed these observations in the case of the rabbit. The younger the animal, the shorter was the latent period before development of lenticular opacities. Because single doses of microwave radiation also have been shown to cause lens opacities,[6-11] we undertook to determine whether age also is a factor in the susceptibility of the rabbit lens to damage by this type of radiation. The experiments here reported were aimed at determining whether the age of the animal affects either the latent period for opacity induction or the extent or type of the opacity.

Thirty-seven litters of New Zealand white rabbits, comprising 163 animals ranging in age from five weeks to more than a year, were used. Under pentobarbital sodium anesthesia, the right eye of each animal was positioned two inches opposite the crossover of a dipole antenna delivering 2.45 megacycles radiation (12.3 cm). In each litter, half of the animals were irradiated for eight minutes, a dose we had determined to be above the cataractogenic threshold for the power employed. The remaining animals were given threshold exposures of six minutes, except in the case of young animals five to seven weeks old, some of which received subthreshold exposures of only five minutes duration. In each animal, the nonirradiated left eye served as the control. Following irradiation, the eyes were examined regularly by ophthalmoscope and slit lamp to determine the onset and progress of any lens opacities.

The microwave power was generated by a Raytheon RK5609A magnetron tube driven by a Kepco voltage-regulated power supply having a ripple voltage of less than 3 mv RMS. The continuous wave power at 2.45 megacycles delivered to the dipole antenna (a Raytheon Microtherm Director C) was monitored by means of an inside-out coupler and a Hewlett-Packard 430C power meter. This system, shown in Fig 1, permitted correction of any fluctuations in the output of the magnetron.

Results

The results of 163 experiments are summarized in graph form in Fig 2. Opacities were located in the posterior subcapsular cortex and were similar to those described by Carpenter et al.[10] Lens responses classed as slight varied from simply a thickening of the posterior suture line to small aggregations of granules, vesicles, or fibrillar processes on the suture or in its immediate vicinity. Responses classified as opacities were initially similar but increased in extent in the course of several days to become frank circumscribed or diffuse cataracts as previously described:[11]

The circumscribed type was usually sharply delineated in the posterior cortex, was frequently axial or paraxial in position, and often appeared to consist of well-defined granules or tiny vesicles which varied in size and shape and often were arranged in radially oriented strings above and below the suture, as if they represented interfibrous or intrafibrous depositions of fluid. Often the area of the opacity was also finely fibrillar or cottony in appearance. The diffuse cataracts involved more extensive areas of the posterior cortex, penetrated more deeply in the radial lamellae of lens fibers and presented more of the cottony fibrillar appearance.

Whether the response was slight or extensive, the first change evident by slit-lamp examination of the lens was seen in the posterior cortex as a series of concentric grayish or milky bands alternating with bands of clear lens substance. Depending on their number, they were the basis for designating this condition as double or triple cortical banding (Carpenter et al[12]). Whatever the subsequent changes in the lens,

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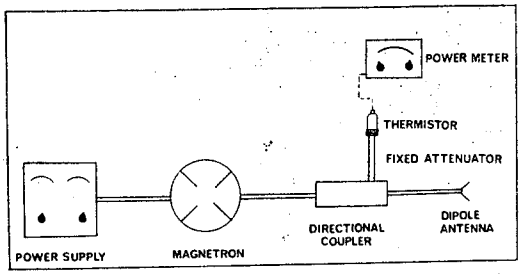

Fig 1.—System for irradiation at 2,450μ megacycles.

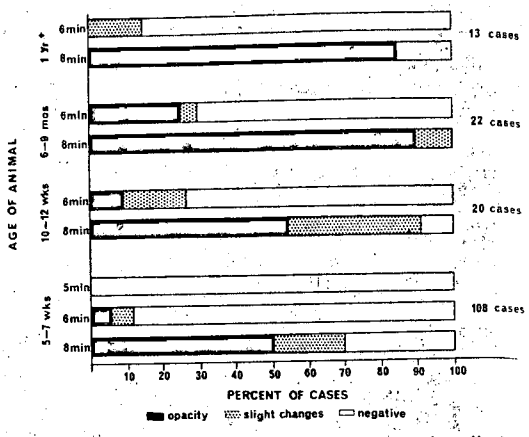

Fig 2.—Response of lens to microwave irradiation in rabbits from five weeks to over one year in age.

the banding usually disappeared within one or two weeks.

It is apparent from Fig 2 that the various age groups exhibited only minor differences in response to exposures above the cataractogenic threshold. There is perhaps a slight suggestion that the older animals, 6 months to more than a year old, were more likely to develop moderate to extensive opacities than were the animals 5 to 12 weeks old. A greater proportion of the younger animals, on the other hand, showed lens responses characterized as "slight changes."

Threshold exposures evoked some type of response in 12% of five to seven-week-old animals and in 15% of those over a year old. In animals 10 to 12 weeks and 6 to 9 months old, responses of the threshold doses occurred in 27% and 30%, respectively. We do not consider the differences to be significant.

With respect to the latent period intervening between irradiation and the first sign of lens changes, the age of the animal appeared not to be a factor. In all age groups, cortical banding was seen first on the second day following a single exposure to radiation. Slight changes developed by the third or fourth day. Circumscribed or diffuse opacities were evident in the posterior cortex on the fourth day and reached their maximal development within one or two weeks.

Conclusions

These experiments fail to demonstrate any significant relationship between the age of the animal and the susceptibility of its lens to damage by microwave radiation. Likewise, neither the latent period before appearance of an opacity nor the type of cataracts can be related to the age of the animal.

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