EXPERIMENTAL INJURY TO THE EYE WITH ULTRA-HIGH-FREQUENCY ELECTROMAGNETIC FIELDS

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The high power of generators of ultra-high frequency electromagnetic fields (UHF-field) necessitate investigating its biological action on an organism as a whole and on various organs and systems in order to develop measures to protect and prevent the adverse effect of the UHF-field on the organism.

There are many indications in the literature that the organ of vision whose thermoregulation is imperfect, is theoretically one of the most vulnerable organs with respect to the effect of an UHF-field, which is accompanied by a rise of temperature of the irradiated tissues.

This gave grounds to a number of Soviet and foreign authors to carry out special investigations to elicit the mechanism of action of dangerous and threshold powers of the UHF-field on the organ of vision, the role of the frequency (wavelength), etc. As a result, it was shown that irradiation of animals with an UHF-field at a power flux density (PFD) within 100-1000 mW/cm^2 in the frequency range of 3000 and 10,000 Mc both under pulsed and continuous conditions of radiation leads to development of opacities of the lens of different size and intensity [4,5,8].

Individual works indicate opacification in people apparently in connection with the effect of an UHF-field [4,5,7]. Data are cited [1], according to which progressive opacification of the lens was noted in 34 out of 370 persons working under industrial conditions of irradiation with an UHF-field. At the same time, the mass inspection of personnel servicing radar stations did not elicit lens opacities which could be associated with the effect of UHF-radiation; the complaints in this case were explained by general and visual fatigue and unfavorable working conditions [2,3].

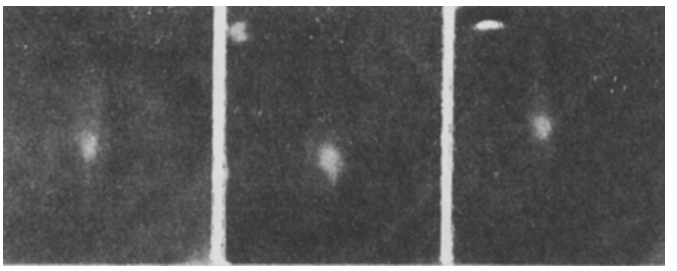
The purpose of our investigation was to study the clinical aspects of eye lesions in rabbits under the repeated threshold effects of an UHF-field.

METHODS AND RESULTS

Twenty rabbits were irradiated 69 times in a special stand which prevented movement of the animals' heads. These conditions ensured irradiation of the eye by an UHF-field of constant intensity. The eyelids of the irradiated eye were ligated and the body of the animal was shielded by a protective fabric. Before and after irradiation, the eye was examined in a slit lamp, for which purpose the pupil was preliminarily dilated, any lens opacities present were traced, measured, and photographed by means of a specially designed device with an illuminator and flat lamp mounted in it. Before and after irradiation, we measured the outside temperature of the eye by an electrothermometer, determined the width of the pupil, and investigated the condition of the external segment of the eye.

The animals were irradiated with an UHF-field (1-cm range) at PFD 120 mW/cm^2. Each exposure lasted from 20 to 50 min. During irradiation of the eye, its outside temperature increased 2-5° (depending on exposure); photophobia, hyperemia, and sometimes chemosis of the palpebral conjunctiva, eyeball, and mucosa covering the nictitating membrane (Fig. 1) developed, the cornea became lusterless as if riddled, and the pupil constricted 2-6 mm. Hyperemia and chemosis diminished 1-4 days postirradiation and the cornea became shiny. Photophobia and hyperemia lasted from 3 to 60 days; in 4 rabbits, the changes in the anterior segment of the eye were enhanced on the 11-26th day after the last irradiation and slight hyperemia and photophobia developed.

Fig. 1. Chemosis after exposure to the UHF-field.



A B C

Fig. 2. Effect of the UHF-field on lens opacities in rabbits: A) congenital opacity (before irradiation); B) extension of congenital opacity on fifth day postirradiation; C) resolution of opacity on 14th day postirradiation.

Not in a single case of the irradiated rabbits did we note the development of new lens opacities. However, the lens opacities already present (congenital) in 9 of the 20 irradiated rabbits were distinctly enhanced, which was recorded by the photographic and micrometric method. In 3 out of 9 experiments, the changes in the lenses occurred on the 5-7th day after the first irradiation and in 6 experiments after subsequent irradiation. In 7 out of 9 cases, aggravation of the opacity (Fig. 2a and 2b) occurred in those lenses in which even before irradiation there were appreciably congenital changes in the form of a posterior subcapsular cataract. In two cases, extension of the opacity which was little evidenced before irradiation (in the form of a slight induration of the posterior horizontal raphe of the lens), occurred.

Thus, as a result of irradiation, opacities were enhanced only in those lenses in which congenital changes were noted before irradiation. An extension of opacities upon irradiation was observed more frequently when there was a pronounced reaction of the external membranes of the eyeball (appreciable constriction of the pupil, hyperemia and chemosis of the conjunctiva, "riddled state" of the cornea) against a background of a somewhat higher than usual rise of eye temperature. A characteristic feature of such opacities was that, in most cases (in 7 out of 9 rabbits), the opacities resolved (Fig. 2c), which began 14-21 days after the last irradiation. The mechanism of occurrence of these opacities is not clear; its possible cause is a temporary disruption of the enzymic system of the crystalline lens.

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