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EFFECT OF SUPERHIGH-FREQUENCY ELECTROMAGNETIC RADIATION AND OF SOME HORMONES ON OSMOTIC RESISTANCE OF MOUSE ERYTHROCYTES

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Some hormones increase the resistance of animals to superhigh-frequency electromagnetic (or microwave) irradiation [4, 6, 12, 13] which, inter alia, affects the osmotic resistance of erythrocytes (ORE) [2, 3, 7, 9-11]. Changes in ORE in animals exposed to microwave (MW) irradiation in response to injection of hormones have received little study.

The aim of this investigation was to study the effect of adrenal hormones (hydrocortisone and adrenalin) and a pituitary hormone (ACTH) on ORE in mice during repeated MW irradiation.

EXPERIMENTAL METHOD

Experiments were carried out on 594 noninbred albino mice of both sexes (80% males), weighing 22-26 g, in spring.

In the experiments of series I 168 mice of one group received intraperitoneal injections of adrenalin (1 mg/kg), hydrocortisone (1 mg/kg), or ACTH (15 U/kg) on alternate days for 12 days (each hormone was given to 56 mice), in the form of solutions in isotonic NaCl solution, in a volume of 1 ml/100 g body weight (control), whereas mice of another group (42 animals) received injections of the corresponding volume of solvent (healthy animals) according to the same scheme. In the experiments of series II the mice were irradiated with MW by the method described previously [5] for 8 min daily for 12 days, with an intensity of 62 ± 5 mW/cm^2 (frequency 2374 MHz). After the first session of irradiation and subsequently every other day, the mice of one group (342 animals) were injected with the above-mentioned hormones (114 mice received each hormone — experiment), whereas the mice of another group (42 animals) received an injection of 0.9% NaCl solution (irradiated control) in the doses given above.

ORE of all mice was determined on the 2nd, 4th, 6th, 8th, 10th, 12th, and 17th days after the beginning of the experiments, 30 min after MW irradiation or injection of the sub-

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TABLE 1. Survival (in %) of Mice Exposed to Repeated MW Irradiation and Receiving Isotonic NaCl Solution (irradiated control) and Hormones

Experimental conditions	Number of sessions of irradiation					
	2	4	6	8	10	12
Irradiated control	100	83±7,4	79±9,4	58±8,2	44±5,7	40±6,8
Hydrocortisone	100	100	87±6,2	87±6,2*	87±6,2*	80±6,6*
ACTH	100	100	94±6,2	75±6,0*	69±5,8*	60±5,0*
Adrenalin	100	90±6,1	80±6,0	70±6,2	60±5,8*	50±5,0

Legend. *Significant at the P < 0.05 level.

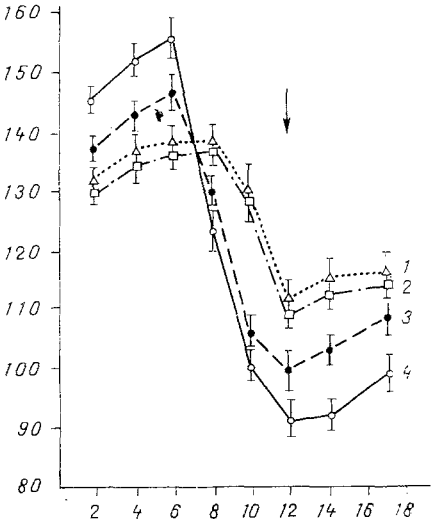

Fig. 1. T_{50} of mice exposed to repeated MW irradiation and receiving hydrocortisone (1), ACTH (2), adrenalin (3), and isotonic NaCl solution (4) at different times. Abscissa, time of determination of T_{50} (in days); ordinate, T_{50} (in sec). Arrow indicates time of stopping irradiation.

stances, by the acid erythrogram technique [1] in the writers' modification: 0.1 M HCl solution was added as hemolytic to a 4% suspension of erythrocytes made up in isotonic NaCl solution and phosphate buffer (pH 7.2) in the cuvette of a type FÉK-M photoelectric colorimeter. Changes in optical density of the erythrocyte suspension during hemolysis were recorded on an EPP-09 potentiometer connected to the FÉK-M instrument. The time of 50% hemolysis of erythrocytes (T_{50}), corresponding to the point of inflection of the hemolysis curve, was determined on the erythrograms thus recorded. The survival rate of the irradiated mice also was determined as the ratio of the number of mice alive 24 h after a routine session of irradiation to the number of animals before the beginning of irradiation in the corresponding group. The experimental results were subjected to statistical analysis by the small sample method [8].

EXPERIMENTAL RESULTS

No significant differences were observed between ORE in the healthy and control mice (P > 0.05). The hormones tested had no significant effect on ORE in the unirradiated mice.

In mice exposed to MW and receiving isotonic NaCl solution T_{50} rose during the first 6 days of irradiation by 1.25-1.30 times (P < 0.05) compared with its value in unirradiated mice. Later, as the number of sessions of MW irradiation increased, T_{50} fell sharply, evidence of reduction of ORE. After the end of irradiation a tendency was observed for this

parameter to return to normal (Fig. 1). In the experimental mice receiving hydrocortisone and ACTH in addition to MW irradiation the changes in ORE were less abrupt: T_{50} rose by not more than 1.15-1.17 times ($P < 0.05$) compared with the control on the 8th day of irradiation, and the subsequent fall in T_{50} was less marked than in the irradiated control. Hydrocortisone and ACTH thus prevent both the increase in ORE in mice in the initial period of MW irradiation (before the 6th-8th day) and its subsequent fall (on the 8th-12th day). Adrenalin also had about the same effect as ACTH, although a little weaker, on the changes in T_{50} of the erythrocytes of the experimental mice.

Simultaneously with the fall in ORE, starting with the 6th-8th day of irradiation the survival rate of the irradiated mice until the end of irradiation was observed to fall. However, the decrease in the survival rate in the group of experimental mice receiving hydrocortisone during irradiation was 50% less, in those receiving ACTH it was 33% less, and in those receiving adrenalin 20% less than the irradiated control (Table 1). Preventing the fall in ORE by administration of hormones evidently has a favorable effect on the animals' resistance to the harmful action of intensive MW irradiation.

Adrenal and pituitary hormones thus reduce the severity of changes in ORE caused by repeated MW irradiation and increase the survival rate of irradiated mice.

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