CHANGES IN PROTEIN METABOLISM DURING CHRONIC EXPOSURE TO 10-cm WAVES OF LOW INTENSITY

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Studies of the protein content, the protein fractions, and the amino-acid concentration in the blood of human subjects and the content of nucleic acids in the organs of animals exposed to electromagnetic radiofrequency waves has been the subject of recent investigations [3, 7]. However, these investigations were carried out in different conditions so that their results cannot be compared and the changes taking place in protein metabolism during chronic exposure to electromagnetic radiofrequency waves cannot be defined.

The object of the present investigation was to study the effect of chronic exposure to electromagnetic waves in the 10-cm band and of low intensity on certain aspects of the protein metabolism of animals.

EXPERIMENTAL METHOD

The animals (rabbits and male rats) were exposed to whole-body irradiation with 10-cm waves with an intensity of 10 mW/cm^2, not causing any increase in body temperature (for 1 h daily for 4-8 months). Altogether, 560 investigations were carried out on 72 animals irradiated for different periods. The blood nonprotein nitrogen concentration was determined by the method of Rappaport and Eichhorn [8], and the amino acid concentration in the urine by the method of Pope and Stevens [1].

EXPERIMENTAL RESULTS

The results of the investigation showed that, depending on the duration of irradiation, 10-cm waves give rise to changes in the protein fractions occurring in two distinct phases (Fig. 1). The first phase was observed after 10-20 exposures to irradiation, and took the form of a decrease in the albumin concentration (for the irradiated animals $M_e = 3.02 \pm 0.1\%$, for the controls $M_c = 4.29 \pm 0.2\%$, $t = 5.5$), and an increase in the concentration of γ-globulins ($M_e = 2.65 \pm 0.148$, $M_c = 1.51 \pm 0.066\%$, $t = 6.9$). The second phase was observed in the later period of irradiation, after 60-190 exposures, and was characterized by a fall in the concentration of α- and γ-globulins* (α: $M_e = 0.95 \pm 0.078\%$, $M_c = 1.39 \pm 0.029\%$, $t = 5.2$; γ: $M_e = 0.91 \pm 0.047$, $M_c = 1.36 \pm 0.024\%$, $t = 8.6$) and an increase in the concentration of albumins ($M_e = 5.32 \pm 0.11$, $M_c = 4.44 \pm 0.09\%$; $t = 6.2$).

Taking into consideration suggestions which have been made regarding the pathogenesis of the changes in the serum protein fractions [2, 4-6] in animals exposed to 10-cm waves, these changes may be regarded as changes in the equilibrium between the blood and tissue proteins.

The investigation of chronic exposure to 10-cm waves on the content of nucleic acids (ribonucleic and desoxyribonucleic – RNA and DNA) caused a decrease in the RNA content in the liver ($M_e = 82 \pm 2$, $M_c = 110 \pm 2$, $t = 9.5$), the brain ($M_e = 35 \pm 0.7$, $M_c = 44 \pm 1$; $t = 7.3$), and in the spleen ($M_e = 61 \pm 4$, $M_c = 97 \pm 3$, $t = 7$).

The decrease in the RNA content in the spleen was observed much sooner, and this decrease was more marked than in the other organs (see Fig. 1).

*The content of α- and γ-globulins is given in a combined form, because often it was difficult to separate them. When they could be determined separately, the changes taking place were attributable to the α-globulins.

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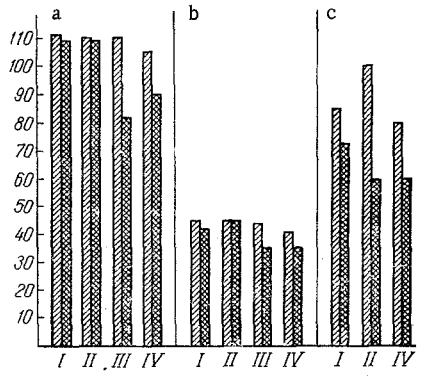

Fig. 1. Content of ribonucleic acid (in μg phosphorus) in the liver (a), brain (b), and spleen (c) of normal (left column) and irradiated (right column) rats. I) After 10-20 exposures; II) after 40-60 exposures; III) after 80 exposures; IV) after 120-140 exposures.

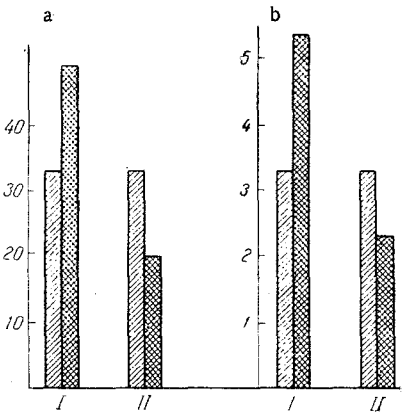

Fig. 2. Content of nonprotein nitrogen (in mg%) (a) and amino acids (in mg) (b) in the 14-h urine of normal and irradiated rats. Legend as in Fig. 1.

The character of the changes in the nucleic acid content in the organs of animals exposed to electromagnetic waves thus depends on the intensity of irradiation, while the severity and the time of appearance of the changes depend on the individual peculiarities of the organs and tissues.

Investigations of the indices of protein breakdown in the tissues – the blood nonprotein nitrogen concentration and the content of amino acids in the 24-h urine of animals irradiated with 10-cm waves – revealed fluctuating changes. The levels of the blood residual nitrogen and the urinary amino acids were sometimes raised, sometimes almost normal or diminished. Ultimately, two phases could be distinguished in the changes in the blood residual nitrogen concentration (phase I: $M_e = 49 \pm 2.1$, $M_c = 33 \pm 1.1$; $t = 6.6$; phase II: $M_e = 20 \pm 0.8$, $M_c = 33 \pm 1.1$, $t = 9$) and of the urinary amino acids (phase I: $M_e = 5.3 \pm 0.34$, $M_c = 3.34 \pm 0.15$, $t = 5.3$; phase II: $M_e = 2.3 \pm 0.09$, $M_c = 3.3 \pm 0.09$, $t = 7.7$) of the animals (Fig. 2), i.e., the changes were analogous to those in the serum protein fractions of the animals.

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