ON THE CAPACITY OF MINERAL RADON WATER TO RESTORE FUNCTIONING OF A FROG HEART' DISTURBED BY THE ACTION OF CORTISONE AND ACTH

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There are very few clinical works devoted to studying the mechanism of the negative action that cortisone and ACTH exert on cardiac activity, or to developing methods for its treatment, and the literature is completely devoid of experimental works revealing the biochemical changes in the cardiac muscle. Also unexplained is the question of the effect played by mineral radon waters on the disturbance in the functional state of the cardiovascular system caused by hormonotherapy.

We set out to clarify whether or not large doses of cortisone and ACTH have a negative action on heart functioning, caused by depression of the activity of the tissue sulfhydryl groups, the latter playing an important role in the contraction of cardiac muscle and in its bioelectrical activity [2-5].

EXPERIMENTAL METHOD

The experiments were performed on winter and spring frogs. The heart of the frog was isolated according to the method of Shtraub. Cardiac functioning was recorded with the aid of a mechanographic writer. We tested the action of cortisone (Cortisone roussel Acetate de 17-dehydroxy-11-dehydrocorticosterone) and domestic ACTH, in various concentrations, the action of urea in a dilution of $1 \cdot 10^{-2}$, of Pyatigorsk mineral radon water with a radon concentration of 100 Mache units, and deemanated mineral radon water from bore hole No. 4 in a dilution of 1:10, and also artificial radon water, with a radon concentration of 100 Mache units. All the test preparations, including the artificial radon water, were prepared in Ringer's solution.

EXPERIMENTAL RESULTS

In the first series of experiments, we studied the effect of cortisone and ACTH, in varying concentration, on the isolated frog heart. After preliminary testing, we established the concentrations which manifested a definite inhibitory influence on cardiac activity, namely $5 \cdot 10^{-3}$, $4 \cdot 10^{-3}$, $1 \cdot 10^{-3}$ and $0{,}5 \cdot 10^{-3}$ (109 experiments). With administration of cortisone and ACTH in concentrations of $4 \cdot 10^{-3}$ and $5 \cdot 10^{-3}$, the depression of the amplitude of cardiac contractions was quite stable, and as a rule, was not removed by washing the ventricle of the heart with Ringer's solution for a period of 3 min.

In the second series of experiments, we investigated the effect of urea on functioning of the frog heart after the preliminary action of cortisone and ACTH in a concentration of $5 \cdot 10^{-3}$. Immediately after beginning the perfusion with the cortisone or ACTH solution, the amplitdue of the cardiac contractions decreased markedly, down to cessation of cardiac functioning (44 trials). In 8 trials, the amplitude of the cardiac contractions was equal to 5-14% of the original magnitude. Subsequent washing of the ventricle of the heart with Ringer's solution for a period of 3 min did not restore normal cardiac activity. Under these conditions, the administration of urea caused an increase in the amplitude of the cardiac contractions in all cases. In 14 trials, the amplitude of the cardiac contractions exceeded the original magnitude, in 18 it was completely restored, and in 12 it was lower than the level recorded before the injection of urea by 10-28%.

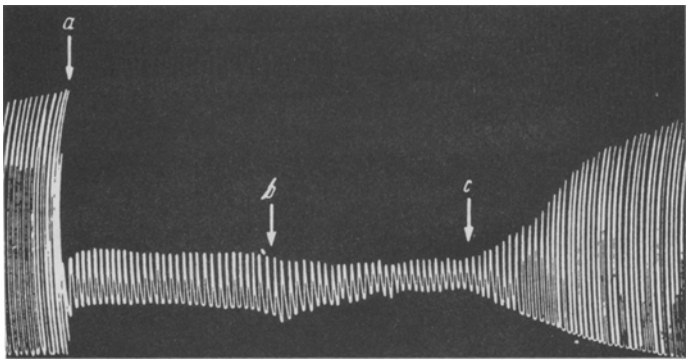

Fig. 1. The effect of mineral radon water on the contraction of an isolated frog heart after the preliminary action of cortisone. a) Action of cortisone ($5 \cdot 10^{-3}$); b) washing of the cardiac ventricle with Ringer's solution for a period of 3 min; c) action of mineral radon water (1 : 10).

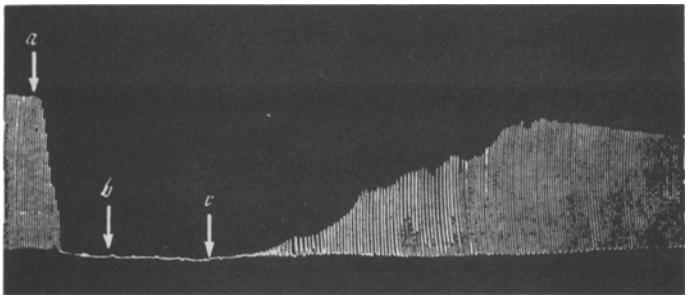

Fig. 2. The effect of artificial radon water on the contraction of an isolated frog heart after the preliminary action of cortisone. a) Action of cortisone ($5 \cdot 10^{-3}$); b) washing of the cardiac ventricle with Ringer's solution for a period of 3 min; c) action of artificial radon water.

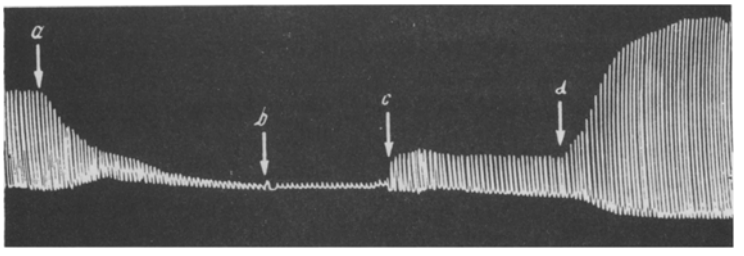

Fig. 3. The effect of deemanated mineral radon water from bore hole No. 4 on the contraction of an isolated frog heart after the preliminary action of cortisone. a) Action of cortisone ($5 \cdot 10^{-3}$); b) washing of the cardiac ventricle with Ringer's solution; c) action of deemanated mineral radon water (1 : 10); d) action of mineral radon water (1 : 10).

In the third series of experiments, we studied the effect of mineral radon water from bore hole No. 4, from artificial radon water with a radon concentration of 100 Mache units, and from deemanated mineral water, on the functioning of the frog heart, disturbed by the action of cortisone and ACTH.

In all 52 experiments, after cessation of cardiac function caused by the administration of cortisone or ACTH in a concentration of $5 \cdot 10^{-3}$, the mineral radon water from bore hole No. 4 regularly restored the normal activity of the isolated frog heart (Fig. 1).

In the experiments with artificial radon water (34 trials), the cardiac contractions were restored in 19 out of the 34 trials, which is 56% (Fig. 2). In 13 of the experiments, the amplitude of the cardiac contractions reached 15-50% of the original level.

In the experiments with the deemanated mineral radon water (20 experiments), restoration of the cardiac contractions was observed in 7 out of the 20 trials; in 6 experiments, the amplitude of the cardiac contractions averaged 50% of the original magnitude. In the remaining trials, there were still no cardiac muscle contractions. Under these conditions, the administration of mineral radon water from bore hole No. 4 completely restored cardiac functioning in all cases (Fig. 3).

The obtained experimental data justify postulating that the negative action of large doses of cortisone or ACTH on cardiac functioning may be due, to a certain degree, to depression of the activity of the tissue sulfhydryl groups. In the opinion of a number of authors [1,2,5], urea possesses the ability to loosen the protein molecule, with subsequent freeing of the tissue sulfhydryl groups.

In previous investigations [3], it was shown that when the isolated frog heart is stopped as a result of selective blockade of the sulfhydryl groups by cadmium chloride, the subsequent administration of Pyatigorsk mineral radon water from bore hole No. 4 completely restores the normal course of the biochemical processes in the cardiac muscle. Based on these data, and the results of the third series of experiments, it may be postulated that mineral radon water is capable of restoring the metabolic processes in cardiac muscle, disturbed by cortisone and ACTH.

The results of the investigations performed with artificial radon water and deemanated mineral radon water indicate that both the mineral composition of the water, and the radon and short-lived products of radon breakdown, play an important role in the mechanism of the biological action of mineral radon water on the functioning of the frog heart.

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