

INFLUENCE OF NOVOCAIN ON THE TOLERANCE OF HIGH ALTITUDES BY WHITE RATS

Yu. F. Udalov (Moscow)

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The dependence of the course of the vital processes in the internal organs of animals on the functional state of the nervous system has now been established. Experimental proof has also been furnished of the reverse dependence of changes in the central nervous system on the functional state and metabolism in the internal organs [5, 8]. At high altitudes the changes in certain physiological functions of the organism are also produced not only by the direct action of the factors of height (hypoxia, reduced barometric pressure) on the central nervous system and other organs, but by the interoceptor influences of the internal organs on the central nervous system and on the activity of other internal organs [1, 2, 3]. In a number of cases these interoceptor influences can exert a negative influence on the vitally important functions of the organism (blood circulation, respiration).

Earlier [7], we detected disturbance of the mechanism of tissue respiration (fall in the activity of the respiratory enzymes in the organs of white rats kept at an altitude of 11,000 meters, which served as a sound basis for presupposing that in a number of organs, interoceptor reflexes may also arise from the chemoreceptors. Interoceptor influences may exert an unfavorable influence on the organism at a high altitude; therefore, it was of interest to trace whether removal in one way or another of the unfavorable influences of the internal organs can contribute to an improved tolerance of height. The experiments were conducted on white rats weighing about 150 g.

First of all, in a baro-chamber, the practical "altitude ceiling" was determined at which the rats died. Such an "altitude" proved to be a rarification corresponding to a height of 11,000 m (169 mm Hg).

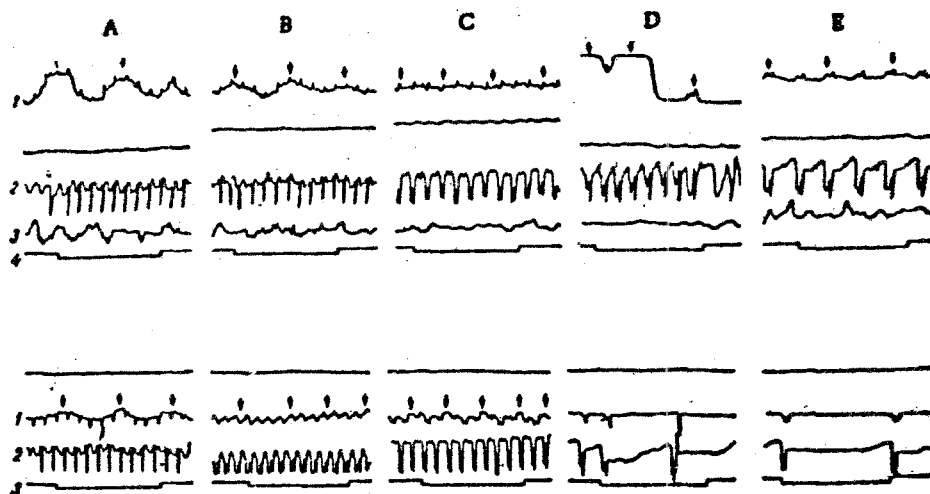
Study of a number of physiological functions in the rats showed that at this "altitude" disturbances take place in them. Figure 1 presents two typical cases out of 24 recordings of the physiological functions at various "altitudes" (7000 m, 9000 m and 11,000 m). Recording of the physiological functions was carried out with the aid of an electroencephalograph with ink tracings.

It is clear from Fig. 1 that at an "altitude" of 7000 and 9000 m, there take place in the organism of the animals basic changes: increased pulse and respiration, a change in the ECG character, increased respiratory frequency, change in the bioelectrical activity of the brain. These changes may be considered as the physiological reaction to the influence of "altitude". Changes which were observed at an altitude of 11,000 m, irrespective of whether the animal lived or died, may be considered pathological. At this altitude, we observed a disturbed rhythm and frequency of respiration, a sharp slowing-down of the pulse, disturbance of rhythm and bioelectrical activity of the heart, change in the electroencephalogram to the point of disappearance of the indices of bioelectrical activity of the brain.

Disturbance of tissue respiration in the internal organs, and the pathological character of the change in the investigated physiological functions in rats at an altitude of 11,000 m allow one to assume that in these organs, pathological nervous impulses can arise and emerge from them.

EXPERIMENTAL METHODS

One of the methods of experimental exclusion of the nervous influences of the internal organs, is transverse section of those nervous routes leading from the internal organs. It is possible to carry out this exclusion by means of the influence of novocain along the nerve routes from the organs ("novocain blockade"). The method of novocain blockade has now been widely applied in experiments.



Change of physiological functions in rats at various altitudes (read tracings from right to left).

A) Ground, B) Altitude 7,000 m, C) 9,000 m, D and E) 11,000 m. Top series of tracings - experiment, in which rats survived, lower series - rats died.

Significance of tracings: 1) respiration, 2) pulse, 3) bioelectrical activity of heart, brain, 4) indication of time (1 second). For the lower series of tracings 3 - indication of time.

We also adopted this method. For the blockade we took 0.25% novocain solution. The method of blockade was analogous to that which is routine in the laboratory of Prof. V. N. Chernigovsky [4, 6, 9]. In the region of the frontal, bilateral cervical surface, 0.5-0.7 ml of a 0.25% solution of novocain was injected in each animal. In addition, by means of a needle puncture of the abdominal wall, 2 ml of novocain solution was introduced into the abdominal cavity. The dosages of novocain were first established experimentally.

Ten minutes after introduction of novocain, the experimental animal simultaneously with the control one "was lifted" in the baro-chamber to an "altitude" of 11,000 m, at a speed of 30 m, a second and left at this "altitude" for 10 minutes. Altogether, in these investigations, 48 rats were used; 23 rats were control and 25, before being "lifted" in the baro-chamber, were subjected to the novocain blockade.

In carrying out the "lifting", we were interested in the survival rate of the animals at a height, representing a sufficiently reliable indication for clarifying the change in the sensitivity of the animal to the effect of "height".

EXPERIMENTAL RESULTS

Of 23 rats in the control group after "lifting", 17 remained alive, and of 25 animals subjected to the novocain blockade of the internal organs, altogether 2 died.

These results in a certain sense strengthen the hypothesis that the interoceptive influences of the internal organs are of a pathological character, and exert a negative influence on the animal in these conditions. Otherwise, we would not have noticed any increase in the survival upon novocain blockade of the internal organs in the rats.

It is also possible that novocain does not only "block" the interoceptors, but exercises a cholino-negative effect on the central nervous system. In the light of the latter hypothesis, of practical interest is the study of the effect in these conditions of substances similar in structure to novocain.

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* In Russian.