EFFECT OF ADAPTATION TO HIGH-ALTITUDE HYPOXIA ON RAT BRAIN SEROTONIN LEVELS

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Animals were adapted to high-altitude hypoxia (6000 m) for 6 h daily for 40 days. Adaptation to high-altitude hypoxia increased the serotonin concentration by 18% in the cerebral cortex but lowered its concentration in the hypothalamus. It is postulated that the increase in power of the system of serotoninergic neurons and in their influence on the cortex plays an important role in the mechanism through which adaptation to hypoxia prevents audiogenic epileptiform convulsions.

Previous investigations showed that preliminary adaptation to high-altitude hypoxia increases the resistance of rats to extremal stimuli giving rise to epileptiform convulsions and, in particular, to Krushinskii's audiogenic epilepsy [1, 2]. Considering that in rabbits with genetically determined audiogenic epilepsy the serotonin concentration is lowered in the brain stem and diencephalon [7] it can be assumed that the changes in serotonin metabolism developing in the brain may play an important role in the mechanism of the antiepileptic action of adaptation.

The object of the investigation described below was to study changes in the serotonin concentration in the cerebral cortex and hypothalamus of rats under the influence of adaptation to high-altitude hypoxia.

EXPERIMENTAL METHOD

The investigation was carried out on male rats weighing 200-250 g. The animals were adapted to high-altitude hypoxia for 6 h daily for 40 days at an altitude of 6000 m, i. e., under the conditions used to prevent experimental epilepsy [1]. Intact rats of the same weight were used as the control.

The serotonin concentration was determined in the cerebral cortex and hypothalamus on the 40th day after the beginning adaptation and 18 h after removal from the pressure chamber. The experimental animals were decapitated simultaneously with the controls. Samples of tissue for testing were removed quickly and placed in liquid nitrogen. Serotonin [5] was determined with the Hitachi MPF-2 spectrofluorimeter. Serotonin creatinine-sulfate was used as the standard.

EXPERIMENTAL RESULTS AND DISCUSSION

Adaptation to high-altitude hypoxia led to appreciable changes in the serotonin concentration in the brain structures of the experimental animals compared with the control (Table 1). In the control animals the serotonin concentration in the cerebral cortex was much lower than in the hypothalamus, only 38%. In the adapted rats the serotonin concentration in the cortex was also less than in the hypothalamus but the difference was less marked (50% of the hypothalamic concentration). In rats adapted to high-altitude hypoxia the serotonin concentration in the cortex was increased significantly (by 18%) whereas in the hypothalamus the serotonin concentration showed a tendency to fall.

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TABLE 1. Effect of Adaptation to High-Altitude Hypoxia on Serotonin Concentration in the Rat Brain (M ± m)

Series of experiments	No. of animals	Serotonin concentration (in μg/g frozen tissue)	
		cerebral cortex	hypothalamus
Control	21	0,514±0,015	1,326±0,023
Hypoxia	30	0,609±0,033	1,210±0,045
Magnitude and significance of differences		+18% $P<0,01$	−8% $P<0,05$

Since a genetically determined decrease in the brain serotonin concentration is accompanied by a decrease in resistance to sound evoking epileptiform convulsions [7] and since an increase in the serotonin concentration in the brain induced by adaptation, on the other hand, is accompanied by increased resistance to this factor, it can be concluded that the increase in strength of the system of serotoninergic neurons [3, 4, 6, 8] and their influence on the cerebral cortex plays a role in the mechanism whereby adaptation to hypoxia prevents audiogenic epileptiform convulsions.

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