REACTION OF THE ENTEROCHROMAFFIN SYSTEM OF RATS TO COOLING

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Activity of the enterochromaffin system (serotonin concentration in the blood stream and stomach wall) was investigated during acute (30, 60, 180 min) and chronic (1, 3, 7, 14, 21, 30 days) action of moderate cold (5°C). During the first 60 min of cooling, activation of the function of the enterochromaffin system was observed. After 3 h and during the first 7 days of chronic cooling a decrease in the serotonin concentration in the blood and stomach wall was recorded. The 5-hydroxytryptamine concentration in the rate of both groups was subsequently (on the 14th, 21st, and 30th days) about equal.

The serotonin concentration in the blood and stomach wall was studied as an index of the functional activity of the enterochromaffin system during acute and chronic exposure to moderate cold.

EXPERIMENTAL METHOD

Noninbred male rats weighing 200-220 g were used. In the experiments with short-term cooling the animals were fixed in special cases and kept in a chamber for 30, 60, and 180 min. Air at a fixed temperature of 5 ± 1°C was passed through the chamber continously. In the experiments with prolonged cooling the rats were kept separately in cages in which the air temperature was 5 ± 1°C for 1, 3, 7, 14, 21, and 30 days. Control animals were kept under the same conditions but at 21 ± 1°C. The animals were first adapted to the cages daily for 3-4 days. At the end of the experiment the rats were decapitated, blood was collected in heparinized tubes, and the stomach was removed. The stomach wall was washed to remove content, weighed, and homogenized. The serotonin concentration in the stomach tissue extract and in whole blood was determined by a fluorometric method by the ninhydrin reaction [1]. Fluorescence was measured on a "Bian-130" fluorimeter at wavelengths of 360 nm (excitation) and 530 nm (fluorescence).

EXPERIMENTAL RESULTS

The thermoregulatory reaction was investigated with respect to physiological indices of gas exchange and temperature measurement during acute (30, 60, 180 min) and chronic (1, 3, 7, 14, 21, 30 days) exposure to the action of moderate cold (5°C). The experiments showed that during short-term cooling, even though the level of gas exchange (oxygen consumption and carbon dioxide elimination) was approximately doubled, the rats developed a mild degree of hypothermia. During long-term exposure to cooling the heat formation was increased by only 15-20%, but this level was sufficient to ensure a high resistance to the hypothermic effect [2].

During short-term cooling the blood serotonin concentration changed variously (Fig. 1). During the first 60 min a marked increase in the concentration of serotonin was observed, but after 180 min its blood level in the cooled rats was distinctly lower than in the control group of animals. Changes in the serotonin concentration in the stomach wall were approximately similar (Fig. 1).

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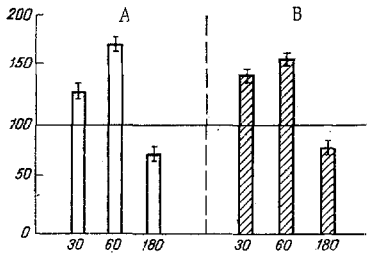

Fig. 1

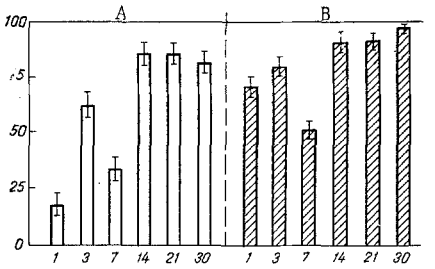

Fig. 2

Fig. 1. Serotonin concentration in blood (A) and stomach wall (B) of rats during short-term cooling. Ordinate, serotonin concentration (in percent of control); abscissa, time of cooling (in min). The normal serotonin concentration in the blood is 32-37 $\mu g\%$, and in the stomach wall 3.6-4.3 $\mu g/g$.

Fig. 2. Serotonin concentration in blood (A) and stomach wall (B) of rats during chronic exposure to cooling. Abscissa, time of cooling in days. Remainder of legend as in Fig. 1.

Investigation of the serotonin concentration in the blood and stomach wall during 30 days of exposure to moderate cold showed that in the first 7 days its concentration in these tissues is lower than in the control rats (Fig. 2). At all the other times of cooling when tests were carried out (14th, 21, and 30 days) the serotonin concentration in the blood and stomach wall was not significantly changed.

The results described above show that during both short-term and long-term cooling changes in the serotonin concentration follow a parallel course in the blood and stomach wall. This fact shows that the main source of the circulating serotonin is evidently the enterochromaffin cells of the gastro-intestinal tract, which perform an endocrine function [3]. Changes in the serotonin concentration in the blood and stomach wall during short- and long-term cooling can be explained in two ways. The most probable explanation is that during the first 50 min of action of cold there is activation of the function of the enterochromaffin system. Increase synthesis of serotinin and its secretion into the blood stream are observed under these circumstances. Starting from the 3rd h and during the first 7 days of cooling the synthesizing capacity of the chromaffin tissue becomes exhausted, as is shown by a decrease in the serotonin concentration in the stomach wall and in the blood stream. At later periods of the investigation of chronic exposure to cold (14, 21, and 30 days) adaptation of the function of the enterochromaffin system to the increased liberation of heat evidently takes place, and for this reason the serotonin level in the blood and stomach wall tissues returns to its initial value. On the other hand, the decrease in the serotonin concentration in the blood and stomach wall could be explained by its increased elimination from the blood stream.

LITERATURE CITED

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