CHANGES IN CONTENT OF CATECHOLAMINES IN THE BRAIN OF ALBINO RATS DURING STRESS PRODUCED BY RUNNING IN A REVOLVING DRUM

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The content of adrenalin and noradrenalin was investigated in the motor cortex, diencephalon, and mesencephalon of rats running in a revolving drum. No changes in the catecholamine content were observed after running for 4.5 and 70 min. After running for 13 min the noradrenalin level in the cortex was reduced. After running for 35 min the adrenalin content in the cortex and diencephalon was increased. An increase in the adrenalin content in the diencephalon was observed also after running for 97 min.

The catecholamines play an important role in adaptive and trophic functions of the animal body [9, 11]. Many investigations have shown that the effects of a stressor on the content of the biogenic amines in the animal brain are specific in character [3, 4, 13].

The objects of the present investigation were to study the content of adrenalin and noradrenalin in the brain of rats after running for various periods of time in a revolving drum.

EXPERIMENTAL METHOD

Experiments were carried out on 77 male albino rats weighing 200 ± 20 g. The animals were kept in a glass drum (covered inside with plasticine to increase friction), revolving at 44 rpm. The rats were decapitated with scissors after the lapse of the necessary time. On the day of the experiment the control animals were kept in the same room as the revolving drum. The content of noradrenalin (NA) and adrenalin (A) in the cortex, diencephalon, and mesencephalon was determined by the method of Matlina and Rakhmanova [5] in a type ÉF-3 apparatus modified by A. S. Sharov. The fraction described as "adrenalin" evidently contained a large amount of oxidation products of catecholamines which, according to some investigators, are difficult to differentiate by fluorescence analysis from adrenalin [12]. According to the literature [6], the adrenalin content in the whole rat brain varies between 0.045 and 0.047 μg/g and the noradrenalin content between 0.13 and 0.52 μg/g.

EXPERIMENTAL RESULTS

During the first 4.5 min of running in the drum, when the animals tried to escape from the apparatus, no significant changes were found in the catecholamine content in the brain tissue. During the next 13 min, when the animals ran at the same speed as the drum revolved, the noradrenalin content in the motor cortex fell from 0.205±0.053 to 0.117±0.019 μg/g fresh tissue ($P < 0.01$). After 35 min, running in the drum began to alternate with somersaulting of the animals. However, after the drum was stopped the animals immediately got up on their legs and tried to get out of the drum. This period can be regarded as the beginning of mild fatigue. At this stage the adrenalin content in the diencephalon was increased to 0.133

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± 0.022 μg/g (control 0.075 ± 0.027 μg/g; $P < 0.05$). An increase in the adrenalin content in the brain has also been observed after x-ray irradiation [2], in atherosclerosis [10], and during repeated electrical convulsions [1, 7].

When the drum was stopped after running (somersaulting) for 70 min the animals were able to stand up only after a short rest (10-20 sec). Tremor of the head and limbs was observed at this time. No significant changes were found in the catecholamine content in these parts of the brain at this stage. After somersaulting for 97 min the animals were unable to stand up and they responded only weakly to nociceptive stimulation. At this period the adrenalin content in the diencephalon was increased from 0.095 ± 0.019 μg/g in the control to 0.245 ± 0.038 μg/g in the experiment.

Hence, after running for 13 min a decrease in the noradrenalin content in the motor cortex was observed, while after 35 min the adrenalin content in the diencephalon was increased. The state of extreme fatigue occurring after running for 97 min was also characterized by an increased adrenalin level in the diencephalon. In the mesencephalon no changes in the catecholamine concentration were found throughout the period of the experiment.

Comparison of the results with those of investigation of free acetylcholine and acetylcholinesterase activity [8] show that the cholinergic components of mediator metabolism undergo more marked changes than the adrenergic components in the brain of albino rats during running in a revolving drum.

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