

INVESTIGATION OF THE OXYGEN TENSION
IN THE BRAIN TISSUES OF ALBINO RATS
AFTER ADMINISTRATION OF RADIOPROTECTIVE SUBSTANCES

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The presence of oxygen at the moment of irradiation is known to play an important role in the development of the radiation injury [9,16]. Intravital investigations of the oxygen tension in the different systems and organs after administration of radioprotective substances can be used to carry their pharmacological analysis a stage further. During recent years, facts have accumulated as a result of the study of the pO_2 in the tissues of radiosensitive organs by the method of polarography [3,17]. Meanwhile, the information given in the literature on the influence of radioprotective substances on the oxygen concentration in the tissues of the central nervous system is scanty. It amounts to the results of experiments on only two species of animals (mice, rabbits), it is concerned mainly with the study of the thiols, and most important of all, it is contradictory [1,2].

The object of the present investigation was to study the effect of the radioprotective amine serotonin and the sulfur-containing radioprotective agent cystamine on the oxygen tension in the brain tissues of albino rats.

EXPERIMENTAL METHOD AND RESULTS

The skull of the albino rats was trephined under sodium amytal anesthesia and platinum electrodes were implanted into the parietal region of the brain to a depth of 5-6 mm at a distance of 5 mm from the sagittal line. Between 4 and 6 days after the operation, the effect of serotonin (20 mg/kg) and cystamine (100 mg/kg) on the level of pO_2 in the brain tissues was investigated by the polarographic method. As a mutual control, the action of both preparations was studied in the course of a chronic experiment in turn on the same group of animals. The interval between administration of the two preparations into the same animal was 48 h. Before administration of the radioprotective substances the oxygen tension was determined five times in the control series, and after administration it was determined every 6 min for 1 h.

The results of the investigation are given in the table.

Administration of cystamine caused a small, but statistically significant fall in the value of pO_2 in the cerebral hemispheres, whereas serotonin, in similar conditions, significantly raised the concentration of molecular oxygen in the investigated tissue. The results obtained were in good agreement with the results of investigations carried out previously by the authors in an acute experiment on mice [6,7], when it was found that sulfur-containing radioprotective preparations, with the exception of cystamine, did not lower the pO_2 in the brain tissue, while the indolylalkylamines significantly raised its value.

The fall in the value of pO_2 in the cerebral hemispheres after the administration of cystamine was not associated with its protective properties, it seems, because the active monothiol form of this preparation, β -mercapto-ethylamine, into which cystamine is converted in the body after administration [8,10], does not lower the pO_2 [11]. In contrast to the thiols, the indolylalkylamines, which possess neurotropic properties [11,14], in radioprotective doses (maximal allowable doses) cause depression of the tissue respiration of the brain, as demonstrated by an increase in the content of nonutilized oxygen in the tissue [4].

Since depression of the central nervous system involves a corresponding change in metabolism throughout the organism, while a lowering of the intensity of the metabolic processes lowers the resistance of animals to the action of radiation [18], there is reason to regard the accumulation of oxygen in the brain tissue as the result of a manifestation of one aspect of the radioprotective properties of serotonin. These arguments are in agreement with information in the literature and with experimental data obtained in the authors' laboratory in the course of an investigation

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Changes in Oxygen Content in Brain Tissue of Albino Rats after Administration of Serotonin and Cystamine in Radioprotective Doses.

Preparation	Dose of preparation (in mg/kg.)	No. of animals	pO ₂ level in control (in %)	Change in pO ₂ (as % of control level)	Δ%
Serotonin	20	10	100±1.6	115 ±0.96	+15.2
Cystamine	100	10	101±1.3	92.7±1.0	- 7.3

The negligible influence of the sulfur-containing preparations on the metabolic processes in the brain, one index of which is the oxygen consumption of the brain tissue, and also the ability of this group of protective substances, unlike the indolylalkylamines, to protect microorganisms and various cultures in vitro [12,13], confirm this suggestion.

of the functional state of the central nervous system after administration of radioprotective substances, using biochemical methods. The results of these investigations [5,15] showed that serotonin caused obvious depression of the central nervous system, whereas sulfur-containing substances had no significant influence on this system.

It may be concluded from the facts and arguments described above that the central nervous system plays a definite role in the mechanism of the protective properties of the indolylalkylamines. The mechanism of the protective action of the thiols is evidently unconnected with processes regulated by the central nervous system.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. Some or all of this periodical literature may well be available in English translation. A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.