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CHALLENGES OF STUDYING THE COMBINED EFFECTS OF SPACEFLIGHT FACTORS ON THE CENTRAL NERVOUS SYSTEM FUNCTIONAL REACTIONS

Abstract

Combined effects of a variety of physical factors on the central nervous system (CNS) functioning are a formidable issue still far from resolution. The most circumstantial reviews contain mere individual facts about the neurochemical, neurophysiological and behavioral effects of the spaceflight factors (SFFs). Few experimental data from animals also evidence how difficult it is to evaluate the SFFs effects on HNA which do not necessarily boil down to additivity or synergy. For instance, exposure to vibration simultaneously with irradiation by 0.5 Gy had a weaker effect on the latency of rat's conditioned reflexes as compared with exposure to vibration alone. Our experiments with rats exposed to gamma-radiation combined with tail-suspension (TS) of varying duration showed that severity of CR disorders due to suspension or other forms of motor deprivation is dependent on stage of the general adaptation syndrome, whereas ensuing irradiation aggravates these disorders. Results of the first-in-the world evaluation of rats' discriminant learning and turnover of monoamines and their metabolites in brain structures of tail-suspended, gamma-irradiated animals or exposed simultaneously to fractionated gamma-radiation (6 daily irradiation sessions during a month, summary dose 3 Gy) and TS over 30 days as a ground-based model of the spaceflight factors showed a minor cognitive effect which agrees well with feebly marked changes in monoamines in the brain structures that control cognitive and emotional/motivational behaviors.

Studies of the combined effect of 30-d TS and subsequent 8 g on the discriminant learning and monoamines in mice revealed a somewhat speeded maturation of stereotyped motor behaviors in the course of food-reward learning. This could have been due to negative feelings produced by the prefrontal-cortex serotonergic system with involvement of neural networks in the striatum and cerebellum. Besides, unlike TS that inhibited the motor activity drastically, the combined exposure had only a moderate effect. TS alone and in combination with acceleration equally impaired the ability to reestablish skills and to continue learning. On the whole, recovery of previous stereotyped spatial-motor behaviors and learning after the ground modeling of some spaceflight factors was largely successful, that is reestablished skills did not differ much from what had been seen before the experiment. It has been shown that these experimental exposures do not affect monoamine concentrations (N, D, ST); however, they do modify their metabolism but these changes have a marginal effect on animals' behavior.