SPACE LIFE SCIENCES SYMPOSIUM (A1)
Radiation Fields, Effects and Risks in Human Space Missions (4)

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PROBLEMS OF STUDYING THE EFFECTS OF EXPLORATION MISSIONS FACTORS ON FUNCTIONING OF THE CENTRAL NERVOUS SYSTEM IN MODEL EXPERIMENTS WITH ANIMALS

Abstract

One of the limiting factors for distant space expeditions beyond the boundaries of Earth's magnetosphere is radiation which, together with other spaceflight factors, can affect the central nervous system functions crucial for space operator's activities. In its turn, impairment of the CNS functioning will endanger seriously accomplishment of the mission and even crew lives during expedition. The dire threat comes from galactic cosmic rays (GCR). To protect crew from these high-energy radiations inside space vehicle is a great challenge. Long duration and autonomy of expedition as well as the isolated life of a small group bring about psychological tension that, in addition to the combined effects of the spaceflight factors is responsible for high probability of the risk of CNS asthenization fraught with serious performance disturbance. Experimental evidence from chronic exposure to low doses of ionizing radiation on the CNS functioning is still very scarce. There are only some disembodied data about heavy ions effects and no evidence exists as regards the combined effects of heavy ions and non-radiation factors in space flight. In context of the foregoing, we may line up the following agenda of the researches into the CNS effects of distant space missions: 1. Studies with chronic exposure to ionizing radiation modeling the temporary conditions of space flight. These model investigations can be fulfilled using gamma-sources for chronic, quasi-chronic or, possibly, fractionated prolonged irradiation. 2. Studies into specifics of disorders resulting from exposure to heavy charged particles modeling the GCR effects in experiments on accelerators. 3. Model studies of the influence of the non-radiation factors including accelerations, altered gaseous environment, hyperthermia, microgravity and others. 4. Investigation into the combined effects of the variety of spaceflight factors (on the background of the radiation factor primarily) and evaluation of their mutual interference. 5. Development of methods for simulating some space operator's tasks in experiments with animals. 6. Elicitation of mechanisms underlying the CNS disorders on all levels of functional reactions, i.e. neurochemical, neurophysiological and integrative (animal behavior). From our standpoint, the optimal way to acquire adequate evidence of the spaceflight effects in ground-based model experiments with animals and subsequent extrapolation on humans is a combination of experiments with small laboratory animals to ensure representative statistical sampling and primates to simulate space operator's tasks. The algorithm of experimental data collection and analysis as well as methods and procedures were devised; key criteria for planning these experiments were established.