«Impulse» Experiment

INFLUENCE OF MICROGRAVITY ON THE NERVOUS SIGNAL TRANSMISSION

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A long-term stay under the conditions of space flight leads to the pathological changes of a wide variety of neuronal systems ranging from motor to hypothalamic function. Such changes are likely to involve both functional and morphological alterations in the brain. The underlying mechanisms are still unclear.

The objective of the proposed research is to identify the alterations in synaptic transmission characteristics, which correlate with the process of adaptation to microgravity. A comparative analysis will be performed on rats exposed to micro- and hypergravity. Special attention will be paid to the two main stages of this process, namely the excitation and neurosecretion. The effect of microgravity on the potential-dependent calcium channels and process of neurosecretion in nerve terminals will be studied. The nerve terminals (synaptosomes) used in this experiment will be purified from rat brain.

Three sets of ground-based and space-based experiments are planned: 1) analysis of the presynaptic membrane calcium permeability; 2) monitoring the cytoplasmic Ca^{2+} concentration; 3) study of uptake and release of neurotransmitters.

These studies will allow recognition of neurochemical bases for the synaptic plasticity, which accompanies CNS responses to altered gravitational environment. They will provide insight into the molecular changes, which may occur in the brain during exposure to space flight, and will advance our understanding of the role of gravity in the maintenance of normal nervous signal transmission.

«Netcells» Experiment

INFLUENCE OF MICROGRAVITY ON GROWTH, STRUCTURE, AND FUNCTIONS OF NERVOUS, ENDOCRINE AND TRANSFORMED CELLS

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The purpose of the proposed experiment is to study the cellular and molecular mechanisms of changes in functioning of the nervous and endocrinal systems, induced by long-term staying in an orbital station. The latter may be important for development of prophylactic recommendations and usage of pharmacological preparations to prevent pathological changes in human health. It is planned to use a large set of methods for testing the morphological and functional changes of excitable cells under the conditions of orbital flight. It will be possible to conduct microphotoshooting of development of either normal or transformed cells under low gravity during the flight. The detailed analysis of data, as well as

comparative electrophysiological and microfluorimetric investigations of the cells, which have been exposed to space flight factors, will be conducted after space mission in a ground-based laboratory. For this ground-based experiment, the isolated cultivated cells kept under sterile conditions in a microincubator will be used, and the cells from rats, which were in the orbital station, will be tested in parallel.

The following methods will be used: cell cultivation, microphotography, computer morphometric analysis, electron microscopy, electrophysiological and electrochemical investigations.

This complex space-based and ground-based research will allow clarifying the nature of morphological and functional changes, as well as changes in development of the corresponding cells.

«Immunity» Experiment

IMMUNE RESPONSE IN MICROGRAVITY

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Space flight factors, primarily, microgravity, affect all the functional systems of an organism. One of the most sensitive is the immune system.

The experiment will study microgravity effects on the immune response of test animals. Immunological approach to analysis of cellular processes occurring under microgravity will be used. The main objective is to identify the most vulnerable elements of the immune response in microgravity.

For this purpose, in the first set of experiments, it is planned to send on board the URM several groups of mice with different degrees of immunisation, and to study their immune response to the model antigens compared to control groups. Such an approach will enable following the effect of microgravity at different stages of the immune response: antigen presentation and primary recognition, germinal centre and memory cell formation, as well as secondary immune response. In the second set of experiments, the cultivable antibody-secreting cells and hybridomas will be delivered to the space station. The rate of the antibody production, as well as the proliferation processes occurring under microgravity will be studied. In addition, the blood sera of both test animals and astronauts will be examined for the presence of natural antibodies.

The modern experimental techniques, such as immunoenzyme assays and immunoblotting will be used to determine the quantity and specificity of the antibodies produced. The expected results will help to determine the exact stages of the immune response, which are the most sensitive to the effect of space flight factors.

«Oblast» Experiment

INFLUENCE OF MICROGRAVITY ON OSTEOGENESIS

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The purpose of the experiment is to study the cytological mechanisms of gravity-dependent changes in the developing and mature bone skeleton under the space flight conditions for devising methods to correct them. The main objectives are the following:

— to study peculiarities of proliferation, differen-