

LABORATORY 9

Laboratory of Neurobiology of Motor Control

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DIRECTIONS OF ACTIVITY

Laboratory of neurobiology of motor control investigates the mechanisms of control of posture and movements for more than 30 years. At present time the efforts are focused at study of system of internal representation and its role in motor control and at the investigations of reference systems used by brain for organization of motor behavior. During last years it was shown that in situations with discrepancy between real and perceived position of body segments many motor reactions such as vestibulo-motor and neck influences on leg muscles or oculomotor reactions are determined not by real body configuration but by its description in the system of the internal representation.

In the activity of laboratory the studies of neural mechanisms of locomotion traditionally took an important place. On the basis of this works our researchers develop new methods of medical rehabilitation for patients with walking disorders.

Manned spaceflights open a possibility for studying how the human central nervous system adapts to the microgravity, to what extent the gravitation is essential for processing of proprioceptive information and for motor control. A series of joint research projects with France, ESA and NASA was accomplished in this direction during 1982-2004 under conditions of real spaceflights.

MAIN RESULTS

The new data about the principles of organization of the system of internal representation in humans were obtained. It was shown that the internal representation of the length of the limbs in children is less accurate and more variable than in adults. In studies of influence of vision on the accuracy of limb perception it was demonstrated that the sensory conflict evoked by prismatic glasses produces much more difficulties in localization of characteristic points of the hand in children than in adults. Probably, the elaboration of the internal limb model in children of 6-7 years of age is not completed and during pointing tasks they are more dependent on proprioceptive and visual feedbacks.

It was shown that development of kinesthetic illusions during vibratory stimulation of muscular afferents is accompanied by greater enhancement of response on transcranial magnetic stimulation than usual TVR or voluntary muscle contraction. The results obtained suggest that the motor cortex plays an important place in genesis of

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vibratory kinesthetic illusions. Thus, these illusions must be treated as a result of complex processes of the processing of proprioceptive information, involving the mechanisms of internal representation of own body, and not as a simple effect of enhanced sensory input or as pure psychological effect.

For accomplishing sensorymotor tasks CNS needs a reference system for interpretation of sensory information and control of movements. However it is not known how the brain builds this system, to what extent it uses the gravitational vertical. The data obtained at International Space Station and in ground tests demonstrated that at the Earth CNS uses reference system elaborated on the basis of both proprioceptive and gravitational information. During prolong stay in weightlessness CNS elaborates reference system, which takes into account the absence of gravity forces. The preliminary data show the decrease of asymmetry of perception of 3D turns in weightlessness. It is concluded that if on the Earth the gravity plays an important role in elaboration of multimodal reference systems, in the weightlessness the main role is played by visual system, and when the vision is excluded, brain uses the reference system anchored to the natural axes of human body.

We developed multi-channel portable microprocessor-controlled electric stimulator that can be effectively used for rehabilitation of patients with lesions of motor and nervous systems. The device permits to perform neuromuscular stimulation timed according the phase of stepping cycle. The software and hardware are protected by patents and certificate for useful model.

In our laboratory 2 students of Moscow Physical Technical Institute are preparing there magisterial works, 2 postgraduate students of Moscow State Pedagogic University are preparing candidate thesis; Y.S. Levik reads lectures for the students of the Chair of Living Systems Physics of Moscow Physical Technical Institute.

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