1. EXPERIMENTS ON THE SATELLITES.

1.1. SLOVAK SPACE MISSION TO STATION MIR

On February 20-28.1999 a short-term space flight of the first Slovak Astronaut Ivan Bella was realized during the Russian - French - Slovak mission. The program of Slovak space mission was named M.R.Stefanik- the outstanding Slovak scientist in astronomy, political person and French general (1880-1919). The first Slovak astronaut performed research program prepared by the Institutes of the Slovak Academy of Sciences. On the station MIR four experimental projects were realized: Dozimetria (in space physics [14]), Endotest and Senso-asymetria (in space medicine) and Quail (in space biology).

The aim of the project Endotest (proposed by the ***Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava***) was an investigation of the response of neuroendocrine and physiological functions of astronaut on various types of stress load during the space flight, and the evaluation of the degree of stressogenic influence of space flight on working capacity of human subjects. Previous observations of the activity of neuroendocrine system during the space flight were performed in resting conditions and showed the changes in neuroendocrine functions of persons exposed to microgravity. However, these results did not allow to evaluate the functional reserve of endocrine system and to determine the capacity of human organism to overcome rapid and unpredictable stressogenic situation during space flight especially of long duration. Therefore, the aim of the Endotest project was to provide series of functional tests for the evaluation of the capacity of endocrine system and metabolic processes during the preflight, in-flight and postflight periods.

Four functional tests were performed in two candidates for space flight before they started physical training and special preparation for space flight. The second examination was realized at the end of preflight preparation -three weeks before the date of space flight. The third series of tests were performed in Slovak astronaut during the space flight and exposure to microgravity. The last examinations were realized between the first and third day after landing and repeated again after three weeks of recovery period.

The following functional tests were performed: 1. Physical exercise on bicycle ergometer-which informs on neuroendocrine, cardiovascular and metabolic response of the organism on physical exercise and on the changes of this response during the space flight. 2. Mental arithmetic test-which informs on the changes of response after a mental load. The results of these tests are important in relation to evaluation of preflight training and on the possibilities to overcome the increasing mental (psychical) load during activities during space flight on

station MIR. 3. Glucose tolerance test- this test can prove whether the previously observed increases in plasma levels of glucose and insulin in astronauts during the space flight are a result of metabolic changes due to decrease of gravitational load on skeletal muscles and moving activities during the space flight. 4. Insulin test-, which inform on functional reserve of neuroendocrine system and on the ability of contraregulatory mechanisms involved in the response to hypoglycemia.

For this project a new special appliance PLASMA 03 was used for collection of human blood, for its centrifugation and freezing of blood samples and for their transport to Earth for analysis of hormone levels, neurotransmitters and concentration of metabolites in plasma. The exaggerated responses of plasma catecholamine levels to work load were observed during the space flight. Further the higher increases of plasma growth hormone and prolactin levels were noted after workload during space flight as compared to preflight response. The reduced plasma epinephrine levels were noted during insulin induced hypoglycemia during space flight, plasma norepinephrine responses were not different compared to changes during the tests in preflight period. A diminution of plasma prolactin and growth hormone responses to insulin induced hypoglycemia was observed in microgravity. These data demonstrate different responses of neuroendocrine system to stressors during space flight and in the conditions of Earth gravitation (see papers 1-5).

The aim of the project Senso-asymetria (proposed by ***Institute of Normal and Pathological Physiology, SAS***) was an investigation of the effects of asymmetric activity of sensoric imputes (vestibular or proprioceptive) and an involvement of this activity in the development of kinetosis and orientation illusions in the conditions of microgravity (during space flight) and readaptation period after space flight. The results of the observations performed before, during and after space flight in Slovak astronaut showed a successful process of adaptation of vestibular system to microgravity. The disturbances of postural regulation were observed by using stabilometric measurement of posture position, galvanostabilometry and after vibratory stimulation of leg muscles on the first day of landing. However, on the fifth day after the space flight these disturbances disappeared. New original results were observed in the readaptation of vestibulo-postural part of regulation of balance function by using a galvanic stimulation of vestibular apparatus. These results are important contribution to the studies of ethiology of kinetosis.

The aim of the project Quail (proposed by ***Institute of Animal Biochemistry and Genetics, SAS***) was to assess the effects of the defined intensity of gravity on the early post-embryonic development in Japanese quail aboard the orbital station MIR with the active participation of

the Slovak astronaut. Experiment aboard the station MIR lasted 7 days and its accomplishment was of great importance for the studies of ontogenic development of birds under microgravity conditions. First of all the feasibility of hatching the birds in space from eggs transported from the Earth and underwent two thirds of embryonic development on the Earth, has been approved. Investigation of the process of incubation of the quail eggs under the microgravity conditions and the hatching clearly showed that quail chicks were hatching at the normal period of development. Accomplishment of the flight experiment addressing the questions of post-embryonic development in birds under microgravity conditions has great importance, since: 1. For the first time quails hatched in the environment of the real space flight returned to the Earth, that enabled to obtain new data concerning adaptation of birds to the microgravity conditions, 2. For the first time the birds were hatched from the eggs which underwent two thirds of embryonic development before flight on the Earth, 3. The hatchability was 64,3% and for the first time the quail chicks in the early days after hatching were subjected to diverse conditions- microgravity and artificial gravity (see presentations 6-13). Preliminary results of the experiment Dosimetry (exposure of passive track detectors with the aim to estimate Linear Energy Transfer produced by cosmic rays onboard of MIR **,** ***Institute of Experimental Physics, SAS, Košice***) are presented in [14].

Figure 1. During short-term space flight of the first Slovak astronaut Ivan Bella (Feb 22-28 1999), Russian astronaut Viktor Mikhailovic Afanasjev performed the tests of the project Endotest. Picture shows insertion of permanent cannula into the antecubital vein of the Slovak astronaut used for repeated collection of blood samples during different stress loads.

Figure 2. Slovak astronaut completes the tasks of mental arithmetic test with assistance of the Russian astronaut V. M. Afanasjev. Mental arithmetics was a model of mental stress, which was evaluated by changes in plasma hormonal levels.

Figure 3. Ivan Bella during work-load on bicycle ergometer on board of the MIR-station. Blood samples were taken via an intravenously inserted permanent cannula. ECG and blood pressure were measured continuously throughout the test and telemetrically transfered to Flight Control Centre in Korolevo.

Figure 4. New special appliance PLASMA-03 (centrifuge and freezer) was installed on board of station MIR. Devices were used for centrifugation and freezing of blood samples on board. After their transoprt to Earth, the plasma levels of hormones, neurotransmitters and metabolites were determined. Picture displayes the placement of the blood sample into the centrifuge tubeholder. The centrifuge is localized in vertical position at the left part of the picture. Under the centrifuge is seen the upper part of the freezer.

Fig.5. Japanese quail aboard the orbital station MIR with the active participation of the Slovak astronaut

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