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Human Physiology in Space (2) (3)

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FURTHER DEVELOPMENT OF THE INFLIGHT EXPERIMENT CARDIOVECTOR

Abstract

Introduction. Investigations of cardiac function in weightlessness begun in 1977 when the first ballistic cardiogram (BCG) was recorded on orbital station Salyut-6. Since that time, the BCG has been used repeatedly during inflight experiments. The first three dimensional BCG experiment aiming to assess the spatial BCG in three planes was carried out during the 6-th expedition on orbital station Mir in 1990. A short 3D-BCG recording over 146 seconds was obtained during the Spacelab D2 mission in 1993. About 20 years later in 2014 3D-BCG studies were continued with the flight experiment "Cardiovector" at the ISS. Methods. Spatial ballistic cardiogram along three linear and three angular axes will be recorded in flight experiment "Cardiovector". Spatial distribution and temporal changes of mechanical forces in different planes may depend on the interaction between the right and left ventricle of the heart, which is one of the aims of our investigations. The study of spatial orientation and location of force vector loops at various stages of respiration will be combined with the changes in blood flow velocity in the aorta and pulmonary artery. The location of the center of mass may change during the flight. Consequently, the rotational BCG, which depends on the location of the center of mass of the body, will add important information to the 3D-BCG. Results. 6D-BCG was carried out once per month during long-term expeditions ISS-41, 42 and 43. The maximum mechanical force of the heart beat at rest before the flight ranged between 6-9 Newton. During the initial stage of adaptation to microgravity the maximum force tended to increase and decreased slightly later in flight. The report presents examples of recordings, samples of vector loops together with the maximum forces. The data characterize dynamic individual changes of the mechanical forces of the heart at different phases of flight. Attempts are made to connect linear 3D-BCG with the parameters of rotational BCG along three axes with the stages of adaptation to weightlessness. Prospects. These first data from space allowed us to evaluate the criteria of vector loops orientation more carefully. Our results demonstrate the feasibility of 6D-BCG to obtain specific individual changes. Further development of the experiment and the equipment "Cardiovector" is planned as a part of the scheduled space experiment 3D Ballisto by ESA. The long-term aim is to develop an approach, which could be used in cardiac patients on earth to detect clinical relevant individual changes.