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EFFECTS OF PROLONGED EXPOSURE TO A SPACE ANALOG ENVIRONMENT ON CARDIOVASCULAR VARIABILITY AND CARDIO-POSTURAL INTERACTIONS: A JOINT MBRSC AND IBMP RAS PROJECT.

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Abstract

Physiological and psychosocial adaptation to long-term isolation and confinement in extreme environments is a major concern for the international astronautics community. Understanding the development and interactions of these processes is critical for effective mission planning, especially extensive deep space missions. Cardiovascular and posture control research has evolved from a focus on the individual systems to an integrative multiple system approach; however, to date very little attempt has been made to integrate cardiovascular and posture control. Although it has been known for a long time that leg movement, while upright, helps maintain blood pressure, only as of late research has been conducted to investigate the control relationship between the postural skeletal-muscle, autonomic nervous and cardiovascular systems. The aim of this research project is to examine the interaction between postural and cardiovascular control centres in response to prolonged isolation.We will determine the interaction characteristics between the components of cardiovascular and posture control: cardiovascular posture sensory input, sensory-motor output, skeletal muscle pump and cardiac output in relation to isolation stress. Sit-to-stand test with ballistocardiography (BCG), seat force plate and standing force plate. The test protocol will be used to distinguish between posture and blood pressure related skeletal muscle activation with the sit-to-stand test. Participants will undergo a 15-minute sit-to-stand test with a ten minutes sit and a five minutes stand phase under eyes closed conditions. For the stand portion of the test the participants will be required to stand quietly with their hands by their sides. The feet will be placed in a parallel formation with both heels 10 cm apart. The sudden change in posture from the sit-to-stand condition will induce an orthostatic challenge to the cardiovascular system. In response to orthostatic stressor there shall be changes in the peripheral vasculature and muscle activation, which will further contribute to the postural sway. The primary motive of the test is to understand the interaction between the two systems during the transition phase and the afterwards recovery period. The experiment will be done in eyes closed condition to remove visual feedback which may be used as a posture control input to reduce the body sway. Cardio-postural sit-to-stand data will be collected during identical pre- and post-Analog sessions as described above. Pre-Analog tests will be conducted within 5 days of isolation. Post-Analog tests will be conducted immediately after the end of the Analog period and 3 months later.