NASA HRP	DEFINING THE RELATIONSHIP BETWEEN BIOMARKERS OF OXIDATIVE AND INFLAMMATORY STRESS AND THE RISK FOR ATHEROSCLEROSIS IN ASTRONAUTS DURING AND AFTER LONG-DURATION SPACEFLIGHT	CARDIO OX

Principal Investigator

Steven H. Platts, Ph.D.

Description

Future human space travel will primarily consist of long-duration missions onboard the International Space Station (ISS) or exploration class missions to Mars, its moons, or nearby asteroids. These types of missions will put astronauts at risk of increased oxidative and inflammatory damage primarily from radiation, but also from psychological stress, reduced physical activity, diminished nutritional standards and, in the case of extravehicular activity, hyperoxic exposure. There is evidence that increased oxidative damage and inflammation can accelerate the development of atherosclerosis. The purpose of this experiment is to identify biomarkers of oxidative and inflammatory stress and to correlate them to indices of atherosclerosis risk before, during, and after long-duration spaceflight. The team will measure a number of blood and urine biomarkers, some of which have previously shown to be elevated with spaceflight. Furthermore, arterial structure and function via ultrasound measures of carotid intima-media thickness, arterial stiffness, and brachial artery flow-mediated dilation will be measured before, during, and after flight. Carotid intima-medial thickness has been shown to be an indicator for prediction of atherosclerosis. Measures of both pulse wave velocity and artery longitudinal displacement are established echocardiographic indices of vascular stiffness. Brachial artery flow-mediated dilation is an index of endothelium-dependent vasodilatation, which is a sensitive predictor of atherosclerotic risk. The investigators hypothesize that these biomarkers of oxidative and inflammatory stress will be increased with spaceflight and will correlate with decreased flow-mediated dilation, increased carotid intima-medial thickness, and increased vascular stiffness. Furthermore, they hypothesize that measures of oxidative stress will return to baseline after flight, but that biomarkers of inflammatory stress and vascular indices of atherosclerosis risk will remain elevated. This is the first study to propose assessing atherosclerotic risk using biochemical, structural and functional measures during, immediately after, and for up to five years after landing.

Objectives

Objective 1. To determine the effects of long-duration spaceflight on measures of inflammatory and oxidative stress.

Objective 2. To determine the effects of long-duration spaceflight on measures of arterial structure and function through R+3.

Objective 3. To determine how alterations in vascular function and structure correlate with changes in circulating biomarkers of oxidative and inflammatory stress.

Objective 4: To monitor oxidative, inflammatory, and vascular status of astronauts for up to five years after the completion of their long-duration space flight mission (surveillance).

Relevance

Taken as a whole, the data should provide insight into the role of oxidative stress and inflammation, changes in vascular structure and function, and the risk of atherosclerosis following long duration spaceflight aboard the International Space Station and for astronauts participating in extended duration exploration missions.

BDC Summary

Ultrasound scans of carotid and brachial arteries with ECG recording will be performed on L-180, L-45, R+3 days, R+1 year, R+3 years and R+5 years. Each scan includes baseline carotid and brachial measures, measures of flow-mediated (endothelium-dependent) dilation (reactive hyperemia), and assessment of endothelium-independent (sublingual nitroglycerine-induced) dilation (0.4 mg tablet of nitroglycerine will be administered sublingually). Blood pressure and stroke volume (ultrasound) also will be measured. Urine collections (48-hr void-by-void) and fasting blood draw will be performed on L-180, L-45, R+3 days.

In-flight Operations Summary

Ultrasound scans (carotid/brachial) with ECG recording will be performed on flight days (FDs) 15, 60 and R-15 using real-time remote guidance. Each ultrasound session will be preceded or followed by a blood draw and 24-hr void-by-void urine collection. Data sharing is requested for complementary data sets obtained as medical (MRID) and occupational health requirements.

Subject Selection/Participation Criteria