

1. Project Overview

Visual impairment and intracranial pressure (VIIP) is a spaceflight-associated medical condition affecting at least a third of American astronauts who have flown International Space Station (ISS) missions. VIIP is defined primarily by visual acuity deficits and anatomical changes to eye structures. In some astronauts, eye-related changes do not revert back to the preflight state upon return to Earth. Our team will study some of the possible causes for this syndrome. This will be achieved by reviewing previous astronaut data for factors that may predispose astronauts to higher rates of developing this syndrome or greater severity of symptoms. Additionally, we will conduct 3 separate experiments that will characterize vessels in the head and neck and measure the effects of the experimental conditions on ocular structures and function.

2. Technical Summary

The primary objective of this study is to determine whether vascular compliance is altered by spaceflight and whether such adaptations are related to the incidence of the VIIP. In particular, we will measure ocular parameters and vascular compliance in vessels of the head and neck in astronauts who have no spaceflight experience (Ground), in astronauts before, during, and after spaceflight (Flight), and in bed rest subjects with conditions similar to spaceflight (Bed Rest). Additionally, we will analyze astronaut data from the Lifetime Surveillance of Astronaut Health (LSAH) archives to determine which factors might be predictive of the development of VIIP (Data Mining). The project will be conducted in four separate, but related parts.

Hypothesis

The central hypothesis of this proposal is that exposure to the spaceflight environment aboard the ISS may lead to development of the VIIP syndrome (increased intracranial pressure and impaired visual acuity) and that this may be related to alterations in venous and/or arterial compliance in the head and neck.

Specific Aims

1. To determine whether noninvasive measures of venous and arterial compliance are altered by long-duration spaceflight exposure in ISS astronauts and whether these changes are related to the development of the VIIP syndrome. (Flight)
2. To determine whether previous spaceflight experience predispose astronauts to lower venous compliance and/or the development of the VIIP syndrome. (Ground + Flight)
3. To use a 14-day, 6° head-down-tilt bed rest as a model of spaceflight, to evaluate the effect of aging on vascular compliance using a subject population similar to younger (25-35 yr) and older (45-55 yr) astronaut cohorts. (Bed Rest)
4. To determine what factors contribute to lower venous compliance and/or the development of the VIIP syndrome in astronauts. (Data Mining)

3. Earth Applications

This research may inform the mechanisms that regulate blood/fluid flow in and out of the brain in the head and neck. This information may help with understanding of the mechanisms behind idiopathic intracranial hypertension.

4. Link to NASA Taskbook Entry

Not Yet Available