Gender differences in bed rest: preliminary analysis of vascular function
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Orthostatic intolerance is a recognized consequence of spaceflight. Numerous studies have shown that women are more susceptible to orthostatic intolerance following spaceflight as well as bed rest, the most commonly used ground-based analog for spaceflight. One of the possible mechanisms proposed to account for this is a difference in vascular responsiveness between genders. We hypothesized that women and men would have differing vascular responses to 90 days of 6-degree head down tilt bed rest. Additionally, we hypothesized that vessels in the upper and lower body would respond differently, as has been shown in the animal literature. Thirteen subjects were placed in bedrest for 90 days (8 men, 5 women) at the Flight Analogs Unit, UTMB. Direct arterial and venous measurements were made with ultrasound to evaluate changes in vascular structure and function. Arterial function was assessed, in the arm and leg, during a reactive hyperemia protocol and during sublingual nitroglycerin administration to gauge the contributions of endothelial dependent and independent dilator function respectively. Venous function was assessed in dorsal hand and foot veins during the administration of pharmaceuticals to assess constrictor and dilator function. Both gender and day effects are seen in arterial dilator function to reactive hyperemia, but none are seen with nitroglycerin. There are also differences in the wall thickness in the arm vs the leg during bed rest, which return toward pre-bed rest levels by day 90. More subjects are required, especially females as there is not sufficient power to properly analyze venous function. Day 90 data are most underpowered.
Gender differences in bed rest: preliminary analysis of vascular function

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ABSTRACT

Orthostatic intolerance is a recognised consequence of spaceflight. Symptoms include orthostatic hypotension, altered cerebral perfusion, and venous return issues. While these responses have been studied extensively, the underlying mechanisms remain unclear. One possible mechanism affecting this is a difference in vascular responsiveness between men and women. Orthostatic hypotension continues to be a problem following spaceflight, especially long duration spaceflight. Females are more susceptible to orthostatic intolerance following spaceflight as well as bed rest, the most widely accepted ground-based analog of spaceflight. Twelve more females and 9 more males will be studied. We hypothesized that gender will influence the vascular responses to bed rest.

INTRODUCTION

• Orthostatic hypotension continues to be a problem following spaceflight, especially long duration spaceflight.
• Females are more susceptible to orthostatic hypotension and pancytopenia.

METHODS

• Thirteen subjects are included in this study (8 men and 5 women) from the Flight Analog Project being conducted at the pen in conjunction with NASA.
• To determine arterial function (flow-mediated dilation and direct dilation), data were collected on arterial diameters and flows at baseline, during reactive hyperemia (5 minutes in the arm, 7 minutes in the leg) and following pharmacological agents during bed rest.
• Flow-mediated dilation was performed above the carotid bifurcation in the brachial artery and was measured proximal to the carotid sinus. Baseline images were obtained with special attention paid to acquiring images that best visualised intimal-medial thickness. For measurements during reactive hyperemia, diameters were measured in response to a pharmacological agent (5% acetylcholine) to combine cross-sectional area from the brachial artery. Using a blinding technique, measurements were taken for the brachial artery. Using a blinding technique, measurements were taken for the brachial artery. Using a blinding technique, measurements were taken for the brachial artery. Using a blinding technique, measurements were taken for the brachial artery.
• To determine venous function, data were collected on venous diameters and flows at baseline, during reactive hyperemia and following pharmacological agents during bed rest.

RESULTS I: Reactive Hyperemia

- Delta % change in the anterior tibial artery between men and women.
- There were no significant differences in venous function.

RESULTS II: Sublingual Nitroglycerin

- Direct arterial dilation with nitroglycerin. These graphs show the difference between pre- and post-occlusion (delta) for each time point. There were no significant differences in the anterior tibial artery between men and women.

RESULTS III: Intimal Medial Thickness

- Delta % change in the anterior tibial artery between men and women.
- There were no significant differences in venous function.

RESULTS IV: Venous Function

- Ultrasound images of dorsal veins showing the difference between pre- and post-occlusion (delta).
- Venous return issues.

SUMMARY

There were no differences in flow-mediated dilation response in the arm at any time point. However, the flow-mediated dilation response in the leg was significantly increased at day 49. There is a trend for a gender difference over the course of bedrest in the anterior tibial artery (p = 0.07). On day 21, there is a significant difference in the anterior tibial artery between men and women.

CONCLUSIONS:

These data show that some arterial and venous measures change during bed rest, while others do not. The challenge is to elucidate which parameters may translate into functional decrements on long duration spaceflight. Flow-mediated dilation and intimal-medial thickness has been shown to be clinically relevant indicators of dysfunction in patients exhibiting disease.

We do not have sufficient statistical power to detect any changes in venous function. Twelve more females and 9 more males will be studied.

Further study is needed to determine if these measures can provide any insight into the effects of bed rest, or spaceflight, on cardiovascular performance in otherwise healthy subjects.

Limitations

A major limitation for this study is the subject number at the varying time points. This is largely due to the forced evacuation of subjects for Hurricane Rita. Those subjects, therefore, only completed 44-03 days of the designed 90 day bed rest protocol. Thus, only a subset of subjects completed the full 90 days of bed rest. Due to the relatively small number of women participating, the statistical power was limited.