Gender differences in bed rest: preliminary analysis of vascular function
Steven H. Platts, Michael B. Stenger, David S. Martin, Sondra A. Freeman-Perez, Tiffany Phillips, L.Christine Ribeiro

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

Steven H. Platts¹, Michael B. Stenger², David S. Martin², Sondra A. Freeman-Perez², Tiffany Phillips² and L. Christine Ribeiro²

¹Human Adaptation and Countermeasures Division, NASA JSC, Houston, TX 77058 and ²Wyle Laboratories

ABSTRACT

Orthostatic intolerance is a recognized consequence of spaceflight. Syndrome studies of orthostatic intolerance have been conducted during spaceflight missions. Orthostatic intolerance is also a problem in Earth-bound subjects, especially the older population. We hypothesized that functional and structural changes of the arterial system may occur during bed rest. The objective of this study was to assess functional and structural changes in the arterial system during bed rest. To test the HYPOTHESIS, we performed functional and structural assessments of the arterial system during bed rest. Those subjects, therefore, only completed 44-53 days of bed rest. Overall, we found that some functional and structural changes occur during bed rest, while others do not. The challenge is to elucidate which functional and structural changes occur during bed rest.

INTRODUCTION

Orthostatic intolerance is a problem following spaceflight, especially long duration spaceflight.

Female are more susceptible to orthostatic hypotension and pancytopenia.

Numerous citations in the literature point to a venous return issue, this may include differences in arterial or venous function.

Animal literature shows a differential remodeling of vasculature that leads to structural and functional changes. There is also bed rest evidence for increased arterial dilator function.

METHODS

• Females are more susceptible to orthostatic hypotension and pancytopenia.

• Numerous citations in the literature point to a venous return issue, this may include differences in arterial or venous function.

• Animal literature shows a differential remodeling of vasculature that leads to structural and functional changes. There is also bed rest evidence for increased arterial dilator function.

RESULTS I : Reactive Hyperemia

Ketorolac or indomethacin dilated the artery at any time point. However, the flow-mediated dilation response in the arm at any time point.

RESULTS II : Sublingual Nitroglycerin

Baseline and nitroglycerin produced an acetylcholine dose response curve, right panel, as compared to baseline pre-constriction, left panel. These graphs show the difference between pre and post nitroglycerin at each time point.

RESULTS III : Intimal Medial Thickness

Intimal medial thickness in the anterior tibial artery at day 21 (10.3%), 35 (20.6%) and 49 (24%) was determined. We were unable to detect any differences.

RESULTS IV : Venous Function

Venous function was assessed in this study of rest and sex using the Flight Analogs Protocol being conducted at UTMB in conjunction with NASA.

CONCLUSIONS:

These data show that some arterial and 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 44-53 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.