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| Fiscal Year: | FY 2010 | Task Last Updated: | FY 01/27/2011 |
| PI Name: | Platts, Steven H. Ph.D. | | |
| Project Title: | Gender Differences in Bedrest: Autonomic and Neuroendocrine Changes and Vascular Responses in Lower and Upper Extremities | | |
| Division Name: | Human Research | | |
| Program/Discipline: | HUMAN RESEARCH | | |
| Program/Discipline--Element/Subdiscipline: | HUMAN RESEARCH--Physiology | | |
| Joint Agency Name: | | TechPort: | No |
| Human Research Program Elements: | (1) HHC: Human Health Countermeasures | | |
| Human Research Program Risks: | (1) OI: Risk of Orthostatic Intolerance during Re-Exposure to Gravity | | |
| Space Biology Element: | None | | |
| Space Biology Cross-Element Discipline: | None | | |
| Space Biology Special Category: | None | | |
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| Organization Name: | NASA Johnson Space Center | | |
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| City: | Houston | State: | TX |
| Zip Code: | 77058 | Congressional District: | 36 |
| Comments: | | | |
| Project Type: | GROUND | Solicitation / Funding Source: | 2003 Biomedical Research & Countermeasures 03-OBPR-04 |
| Start Date: | 12/01/2006 | End Date: | 06/30/2010 |
| No. of Post Docs: | 0 | No. of PhD Degrees: | |
| No. of PhD Candidates: | 1 | No. of Master' Degrees: | |
| No. of Master's Candidates: | 0 | No. of Bachelor's Degrees: | |
| No. of Bachelor's Candidates: | 0 | Monitoring Center: | NASA JSC |
| Contact Monitor: | Norsk, Peter | Contact Phone: | |
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| Flight Program: | | | |
| Flight Assignment: | NOTE: Changed end date to 6/30/2010 per PI information (jvp 8/19/10) NOTE: Changed end date to 6/1/2010 due to PI information on hurricane delays in project; end date may change later (jvp 7/10/09) | | |
| Key Personnel Changes/Previous PI: | PI Steven Platts became PI 12/2006; see J. Meck for previous years' information on this project. | | |
| COI Name (Institution): | | | |
| Grant/Contract No.: | | | |
| Performance Goal No.: | | | |
| Performance Goal Text: | | | |

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| Task Description: | <p>Women astronauts are more susceptible to postflight orthostatic hypotension and presyncope than are men. The reasons are not defined. Most bedrest studies that seek mechanisms of cardiovascular changes in response to microgravity have not included women. As a result, many conclusions about the effects of simulated microgravity on humans are flawed, in that they fail to describe mechanisms in the very people who have the most serious problems. We propose to determine how differences in strategies of arterial pressure control in men and women affect orthostatic tolerance both before and after bedrest. We will study endothelium-dependent, endothelium-independent and adrenergic receptor responses in both arteries and veins, before and after bedrest. In addition, we will measure plasma volumes, and hemodynamic and neuroendocrine responses to arterial and cardiopulmonary baroreceptor inputs, in women versus men, before and after bedrest. We also intend to pursue in humans the recent animal data which shows that different vascular beds respond differently to simulated microgravity. Hindlimb-suspended rats show hypertrophic remodeling of the vessels in their forelimbs and atrophic remodeling in the vessels of their hindlimbs. This is thought to occur because changes in transmural pressures and shear forces with hindlimb suspension occur in opposite directions in the upper and lower extremities. These studies have not been repeated in female rats, and nothing like this has been performed in humans of either gender. Since humans are bipedal, bedrest would greatly reduce transmural pressures and shear forces in the legs but not the arms. If vessel remodeling follows the patterns in humans as in the rats, large changes could occur which might contribute to orthostatic hypotension after bedrest. Accordingly, we plan to repeat the vascular measurements mentioned above in both upper and lower extremities before and after bed rest and relate the findings to the occurrence of orthostatic hypotension.</p> |
| Rationale for HRP Directed Research: | |
| Research Impact/Earth Benefits: | <p>In addition to benefits for astronauts, millions of people on Earth suffer from orthostatic hypotension and may benefit from information gained from this experiment.</p> |
| Task Progress: | <p>Thirty-one (21 men, 11 women) subjects were studied during the course of this project. The purpose of this project was to examine the differences in the methods of blood pressure regulation in men and women, specifically the differences in the ways arteries, veins, and the heart work to control blood pressure. Furthermore, this study was conducted during 60 – 90 days of head down tilt bed rest, an analog for the cardiovascular deconditioning that occurs in astronauts during actual spaceflight, so differences between upper and lower body changes to bed rest were of significance.</p> <p>The general results of this study indicated that men and women have some similar and some different methods of blood pressure regulation. Before bed rest, women had lower blood pressures than men and were more prone to develop orthostatic hypotension (extremely low blood pressure when standing up). However, both men and women had similar elevations of heart rate with bed rest and similar norepinephrine responses to standing. These results were expected, and the goals of this study were to examine the physiological mechanisms that might explain why women have a higher incidence of orthostatic intolerance.</p> <p>Venous Function</p> <p>Before bed rest, women had smaller veins in the feet than did men. After bed rest, women increased the size of these veins while men decreased the size of these veins. This, along with measures of strain gauge plethysmography, indicate that women increased their venous compliance while men did not, which would make women more susceptible to fainting than men. There were no differences between men and women in the response to drugs that affect the size of veins, such as phenylephrine, isoproterenol, acetylcholine or nitroglycerin.</p> <p>Arterial Function</p> <p>There were no arterial function differences between men and women, either before or during bed rest. However, this is the first study to show that upper and lower body arteries respond differently to bed rest. Ultrasound-measured arterial diameter showed decreases in the leg with bed rest, but not in the arm. Intima-medial thickness, the layer of the blood vessel wall that contains the smooth muscle which is responsible for controlling blood vessel constriction (and therefore blood pressure), decreased in the arteries of the leg, but not in the arm. Furthermore, responses to nitroglycerine, a measure of how well the smooth muscles in the artery walls are able to constrict or dilate, were reduced in the leg after bed rest, but not in the arm.</p> <p>Baroreflex Function</p> <p>Results from systemic infusions of phenylephrine and sodium nitroprusside, two agents that cause the blood vessels to constrict and relax, respectively, were used to assess differences in baroreflex function. Women controlled their blood pressure more by utilizing changes in heart rate via the parasympathetic branch of the autonomic nervous system, while men exhibited greater sympathetic nervous system balance. Overall, baroreflex function was diminished with bed rest, but women had more of an attenuated baroreflex response than men, which may explain their predisposition to orthostatic intolerance.</p> <p>The results of this study highlighted the differences in autonomic and baroreflex control of blood pressure regulation between men and women. Furthermore, changes in arterial structure and function were no different between men and women, although women developed a larger venous compliance after bed rest, while men did not.</p> |
| Bibliography Type: | Description: (Last Updated: 03/01/2018) |
| Abstracts for Journals and Proceedings | <p>Stenger MB, Arzeno NM, Platts SH. "Baroreflex sensitivity decreases during 90-day bed rest." American College of Sports Medicine Annual Meeting, Seattle, WA, May 2009.</p> <p>Medicine & Science in Sports & Exercise 2009 May;41(5 Suppl):59. http://dx.doi.org/, May-2009</p> |
| Articles in Peer-reviewed Journals | <p>Westby CM, Martin DS, Lee SM, Stenger MB, Platts SH. "Left ventricular remodeling during and after 60 days of sedentary head-down bed rest." J Appl Physiol (1985). 2016 Apr 15;120(8):956-64. Epub 2015 Oct 22. https://pubmed.ncbi.nlm.nih.gov/26494448/; PubMed PMID: 26494448; PubMed Central PMCID: PMC4835908, Apr-2016</p> |