Fiscal Year:	FY 2013	**Task Last Updated:**	FY 01/02/2013
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Project Title:	Human Cerebral Vascular Autoregulation and Venous Outflow in Response to Microgravity-Induced Cephalad Fluid Redistribution		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2011 Crew Health NNJ11ZSA002NA
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No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
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No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Alperin, Noam (University of Miami, Medical Campus) Brown, Truman (Medical University of South Carolina) Helpern, Joseph (Medical University of South Carolina) Jensen, Jen (Medical University of South Carolina) Studholme, Colin (University of Washington, Seattle) Tabesh, Ali (Medical University of South Carolina) Wagner, Mark (Medical University of South Carolina)		
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Performance Goal Text:			

Task Description:	According to the NASA Human Research Roadmap (Risk of Microgravity-Induced Visual Impairment/Intracranial Pressure; Gaps VIIP2, VIIP4, VIIP5, VIIP8) and further expounded upon in the Visual Impairment Intracranial Pressure (ICP) Summit Report (May 2011), an essential gap exists in our knowledge of intracranial pressure regulation in spaceflight. This is exemplified by the fact that there are no published studies investigating the structural and functional changes occurring as a result of long-term spaceflight and there is almost no data concerning cerebral autoregulation in astronauts following return from space. Only two published studies exist investigating cerebral autoregulation in astronauts using an indirect method for measuring CBF at the level of the major arteries of the circle of Willis. Thus, although cerebrovascular hemodynamics plays a crucial role in ICP regulation and also in the response to orthostatic stress, we have almost no knowledge of the state of cerebral autoregulatory mechanisms during spaceflight. The operational relevance of this gap according to the NASA Human Research Roadmap is that elevated ICP and likely associated vision disturbances due to microgravity exposure are serious health risks for astronauts. Furthermore, this is an even greater concern for potential longer duration missions such as to the moon or Mars where decreased vision may impact mission performance and may even require early mission termination. Permanent visual losses may result in lifetime disability issues. Almost certainly, during long-term flights, as the hydrostatic pressure gradients due to gravity are abolished with resultant large cephalad fluid shifts, an intracranial adaptive response occurs. Thus direct measurements of cerebral fluid shifts and cerebral hemodynamics as proposed in this study will allow us to more fully characterize the intracranial compartment guiding the development of preventive measures, such as specific pharmacological countermeasures, to combat the development and sequelae of increased ICP during future missions. In order to fully characterize intracranial adaptation to long-term microgravity, we will use magnetic resonance imaging (MRI) which is the terrestrial gold standard. MRI allows direct visualization and functional characterization of the intracranial contents. Indeed, MR imaging is the clinical standard of care in evaluating patients with idiopathic intracranial hypertension. We will use a suite of advanced MRI sequences to: (1.) characterize weightlessness-induced intracranial compartmental fluid volume changes at the macroscopic (brain, CSF, orbit), microscopic (brain tissue water) and vascular (arterial and venous) levels following adaptation to long-term spaceflight and (2.) assess for potential resultant hemodynamic changes (cerebral perfusion) in the brain. This proposal represents the most relevant and advanced suit of MRI techniques for the characterization of intracranial compartmental fluid and hemodynamic changes induced by long-term microgravity. The specific sequences will be carried out by the recognized experts in each area and in most cases, the developer of the specific technique. It is imperative to obtain this data in order to have an understanding of what is happening to the brain and orbits while living and working in microgravity. We are only now realizing the consequences of this lack of knowledge. This data will serve as the basis for the development of fundamental theories describing intracranial adaptation to microgravity. It may help establish a risk stratification strategy based on intracranial anatomy, dural venous sinus and jugular vessel outflow, cranial compliance, and cerebral vascular autoregulation. Importantly, it will serve as a basis for interpretation of in-flight data collected via other techniques such as ultrasound, the primary in-flight imaging modality.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	NOTE that project continues as "Human Cerebral Vascular Autoregulation and Venous Outflow in Response to Microgravity-Induced Cephalad Fluid Redistribution--NNX13AJ92G" WITH THE SAME PRINCIPAL INVESTIGATOR; PERIOD OF PERFORMANCE IS 5/16/2013-5/15/2019. SEE THAT PROJECT FOR SUBSEQUENT REPORTING. (Ed., 6/14/13) New project for FY2013 in November 2012.
Bibliography Type:	Description: (Last Updated: 01/11/2023)