Fiscal Year:	FY 2013	**Task Last Updated:**	FY 10/23/2012
PI Name:	Levine, Benjamin D M.D.		
Project Title:	Effects of Microgravity on Intracranial Pressure		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Cardiovascular Alterations Team		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **VIIP**:Risk of Spaceflight-Induced Intracranial Hypertension/Vision Alterations (IRP Rev E)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	75231-5129	**Congressional District:**	5
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2011 Crew Health NNJ11ZSA002NA
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No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
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Key Personnel Changes/Previous PI:			
COI Name (Institution):	Hastings, Jeffrey (The University of Texas Southwestern Medical Center at Dallas) Whitworth, Louis (The University of Texas Southwestern Medical Center at Dallas) Zhang, Rong (The University of Texas Southwestern Medical Center at Dallas) Williams, Michael (Sinai Hospital of Baltimore, Inc.)		
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Task Description:	Lately, some astronauts have experienced visual changes that could be due to increased pressure in the brain. However the mechanism(s) underlying this problem remain unknown. The current working model is that microgravity induced fluid shifts increase intracranial pressure (ICP) and may be exacerbated by increases in the partial pressure of carbon dioxide in the ISS atmosphere or exercise. However the scientific community has been fooled before regarding expected and measured effects of microgravity on fluid compartment pressures! For example, central venous pressure (CVP) was expected to increase in space but actually fell to zero in microgravity. Also, it is hard to conceive of how the ICP in space could be greater than that which is routinely experienced on the ground in the recumbent posture. Millions of patients and thousands of research volunteers have been confined to bed for prolonged periods of time, and to our knowledge, there has never been a case of bed-rest induced blindness. Unfortunately, despite the enthusiasm for methods to measure ICP non-invasively, none are robust or reliable, and none have been validated in normal individuals without intracranial pathology. The only way to obtain this knowledge with confidence is to make direct, invasive measurements of ICP during relevant changes in hydrostatic gradients. Moreover, concomitant evaluation of inflow (arterial) and outflow (venous) pressures and flows are essential to build the science base of the effect of gravitational gradients on intracranial hemodynamics. The primary objective of this application is to make the first direct, invasive measurements of ICP and cerebral hemodynamics during changes in hydrostatic gradients induced by simulated (bedrest) and real (parabolic flight) microgravity. In order to accomplish these objectives, we propose to test the following hypotheses: Hypothesis 1: The transition from upright to supine posture increases intracranial and venous pressures that result in minimal changes in cerebral blood flow, oxygen delivery, and cerebral autoregulation. Additional gravitational loading and unloading by maneuvers result in small additional changes compared to the difference from standing to supine. Hypothesis 2: True microgravity induced by parabolic flight will produce cerebrovascular changes that are qualitatively, and quantitatively similar to those observed during bedrest. To test these hypotheses, we will accomplish the following specific aims: Specific Aim 1: Our outstanding team of clinical scientists will recruit patients whom have been cured of a cancer or brain infection and whom have had direct access to the brain obtained via an Ommaya reservoir placed to allow prophylactic brain chemotherapy. Such patients have no intracranial or cardiovascular pathology, and have easy access to direct measurement of ICP with little risk. Simultaneous measurement of jugular venous pressure (PICC line) and intra-arterial pressure (arterial line or Finapres) will be combined with echo-Doppler ultrasound of the middle cerebral artery (transcranial Doppler) carotid and jugular size, velocity, and flow, plus near infrared spectroscopy to assess oxygen delivery/utilization to allow a comprehensive assessment of cerebrovascular hemodynamics during routine gravitational transients. Measurements will be repeated with modest increases in $PaCO_2$, and during aerobic and strength exercise to determine the independent and additive effects of these baffling stimuli. Specific Aim 2: The same patients as in Aim 1 will be invited to participate in a second study involving parabolic flight to achieve true microgravity. The same instrumentation will allow contrast between real microgravity, and usual terrestrial changes in hydrostatic gradients during daily life. Similar to aim 1, measurements will be obtained at rest, during exercise, and during small increases in $PaCO_2$ (10 parabolas each).
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	0
Task Progress:	New project for FY2013.
Bibliography Type:	Description: (Last Updated: 09/27/2021)