

Fiscal Year:	FY 2016	Task Last Updated:	FY 03/10/2016
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) VIIIP :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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City:	Dallas	State:	TX
Zip Code:	75231-5129	Congressional District:	5
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2011 Crew Health NNJ11ZSA002NA
Start Date:	10/01/2012	End Date:	10/31/2015
No. of Post Docs:	1	No. of PhD Degrees:	0
No. of PhD Candidates:	1	No. of Master' Degrees:	0
No. of Master's Candidates:	2	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NSBRI
Contact Monitor:	Contact Phone:		
Contact Email:			
Flight Program:			
Flight Assignment:	NOTE: End date changed to 10/31/2015 per NSBRI (Ed., 9/25/15)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Hastings, Jeffrey (The University of Texas Southwestern Medical Center) Whitworth, Louis (The University of Texas Southwestern Medical Center) Williams, Michael (University of Washington) Zhang, Rong (The University of Texas Southwestern Medical Center)		
Grant/Contract No.:	NCC 9-58-CA02801		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Humans have been travelling in space for more than 40 years without clear evidence of visual impairment in astronauts. However very recently, it has been identified that some astronauts on the International Space Station (ISS) seem to be at risk for visual changes that may be due to elevated pressure inside the head (intracranial pressure (ICP)). It is well known that there is a relative shift in fluid towards the head in humans during space flight (microgravity) and therefore these changes may increase intracranial pressure to a greater degree than previously appreciated. Intracranial pressure may also be exacerbated or transiently elevated by small increases in the partial pressure of carbon dioxide in the International Space Station atmosphere and during strength training exercise that is employed to try and maintain astronaut's muscle mass. Therefore, the primary aim of this project will be to provide novel data about the impact of microgravity induced central fluid shifts on directly measured intracranial pressure, and the associated inflow and outflow of blood to the brain, accompanied by simultaneous assessment of structural changes in the eye. Furthermore, we will examine the above factors during small changes in atmospheric carbon dioxide and during strength training exercise in simulated microgravity. This information is entirely unknown and absolutely essential to establishing the pathophysiology of the recently identified visual impairments in some long duration astronauts, so as to develop appropriate countermeasures.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The project has implications for public health by providing a better understanding of the regulation of intracranial pressure in normal healthy individuals and thus will offer an improved knowledge base to provide effective treatments for a wide range of intracranial disorders. We have clarified the key component of the physiology of the intracranial space in microgravity, which will go a long way to eliminating the Vision Impairment and Intracranial Pressure (VIIP) syndrome. We have developed a collaboration with Under Armour, Inc., to develop a wearable garment to deliver lower body negative pressure (LBNP) and reduce ICP not only in space, but also on Earth. For example, a major Earth-based benefit to society will be the application of LBNP in a clinical environment. Alongside pharmacological interventions, placing patients with intracranial hypertension in the semi-recumbent position is standard practice to lower ICP. This slight hydrostatic gradient reduces ICP, whilst maintaining arterial blood pressure and thus cerebral perfusion pressure. LBNP may provide a more controlled and robust intervention within a hospital and field-based environment. Indeed, pathological pressure waves are often observed during sleep when patients are in the supine position. Nocturnal LBNP may provide a novel method to lower mean ICP and improve intracranial stability during this critical period. Given our robust observation that simply placing the head on a pillow lowers ICP, the combination of low level LBNP and head elevation may prove optimal. If a practical and comfortable device is developed, LBNP could also be used to reduce the incidence of chronic headache in patients with pseudotumor cerebri (raised ICP), as well as patients with traumatic brain injury.
Task Progress:	Overall Task Progress: All objectives were met and all aims were accomplished for this study. This past year was notable for our second parabolic flight campaign during which we were able to recruit 3 women to create our final cohort of 8 subjects (5 men; 3 women).
Bibliography Type:	Description: (Last Updated: 09/27/2021)
Articles in Peer-reviewed Journals	Lawley JS, Levine BD, Williams MA, Malm J, Eklund A, Polaner DM, Subudhi AW, Hackett PH, Roach RC. "Cerebral spinal fluid dynamics: Effect of hypoxia and implications for high-altitude illness." J Appl Physiol (1985). 2016 Jan 15;120(2):251-62. Review. Epub 2015 Oct 22. http://dx.doi.org/ ; PubMed PMID: 26494441 , Jan-2016
Awards	Levine BD. (Benjamin D. Levine) "Fellow, American Heart Association, February 2015." Feb-2015
Awards	Levine BD. "NASA, Most Compelling Results from the 2013 International Space Station, May 2014." May-2014
Significant Media Coverage	Frisinger C. "Online News Article, 'Cancer Patients Helping UT Southwestern Scientists and NASA Study Pressure Inside the Brain During Zero Gravity.'" UT Southwestern Medical Center News Center online, August 19, 2015. http://www.newswise.com/ , Aug-2015
Significant Media Coverage	Wheeler J. "Online News Article, 'Dallas Cancer Survivor Helps Astronauts Facing Vision Loss.'" WFAA ABC online news, August 26, 2015. http://www.wfaa.com/ , Aug-2015
Significant Media Coverage	Silverman L. "Online News Article, 'Dallas Cancer Patient Takes A Trip in Zero Gravity For Research.'" KERA News Blog, September 1, 2015. http://breakthroughs.kera.org/ , Sep-2015
Significant Media Coverage	Brown L. "Online News Article, 'N. TX Cancer Survivor Helping in Study of Astronauts, Vision Loss.'" Fox 4 online news, July 20, 2015. http://www.fox4news.com/ , Jul-2015
Significant Media Coverage	Young ME. "Online News Article, 'Cancer Survivors Volunteer for Tests that May Save Astronauts' Vision.'" Dallas Morning News online, August 25, 2015. http://www.dallasnews.com/ , Aug-2015
Significant Media Coverage	Allen S. "Online News Article, 'Pauls Valley Cancer Patient Participates in NASA Study in Zero-Gravity Environment.'" The Oklahoman online news, August 24, 2015. http://newsok.com/ , Aug-2015
Significant Media Coverage	Avril T. "Online News Article, 'Cancer survivor helps solve astronaut eye problems.'" Philadelphia Inquirer, Philly.com online news, September 7, 2015. http://www.philly.com/ , Sep-2015