Fiscal Year:	FY 2016	**Task Last Updated:**	FY 11/04/2016
PI Name:	Vizzeri, Gianmarco M.D.		
Project Title:	Effects of Short-Term Hypercapnia During Head-Down Bed Rest on Ocular Structures and Cerebral Blood Flow in Healthy Human Subjects		
Division Name:	Human Research		
Program/Discipline:			
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) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) **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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PI Organization Type:	UNIVERSITY	**Phone:**	409-747-5426
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City:	Galveston	**State:**	TX
Zip Code:	77550-5552	**Congressional District:**	14
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2013 HERO NNJ13ZSA002N-Crew Health OMNIBUS
Start Date:	01/12/2015	**End Date:**	03/10/2016
No. of Post Docs:	1	**No. of PhD Degrees:**	
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:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: Extended to 3/10/2016 (original end date was 10/1/2015) per R. Brady/JSC HRP (Ed., 2/22/16)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Stenger, Michael Ph.D. (Wyle Laboratories, Inc.) Zanello, Susana Ph.D. (Universities Space Research Association) Ploutz-Snyder, Robert Ph.D. (Universities Space Research Association) Laurie, Steven Ph.D. (Wyle Laboratories, Inc.)		
Grant/Contract No.:	T72618 (subcontract)		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	This proposal applies short-term hypercapnia to a head-down bed rest (HDBR) analog to more closely replicate the conditions characterizing a space exploration environment. The purpose of the study is to evaluate ocular structural and cerebral blood flow changes in healthy human subjects exposed to such environment. Commercially available sleeping cubicle provided with carbon dioxide (CO2) injection system will be used to produce hypercapnia (1% CO2). Intraocular pressure will be measured to evaluate the changes in response to a hypercarbic environment applied to HDBR. In addition, Spectral-domain optical coherence tomography (OCT) scans of the retina and the optic disc will be performed and compared to baseline conditions. Cerebral blood flow responses will be assessed using transcranial Doppler (TCD) ultrasonography. Noninvasive blood pressure waveforms and electrocardiogram will be obtained and correlated with TCD and ocular measures; in addition, they will be used with TCD to indirectly estimate the intracranial pressure by employing a novel algorithm (Non-invasive IntraCranial pressure Framework, or NICF). In conclusion, it is anticipated that this study will be able to assess a priority risk in the Human Research Program Roadmap and accelerate the understanding of the pathophysiology of the Visual Impairment and Intracranial Pressure syndrome.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	Many astronauts experience ocular structural and functional changes including choroidal folds, optic disc edema, globe flattening, optic nerve sheath diameter (ONSD) distension, retinal nerve fiber layer thickening, and decreased visual acuity during long-duration spaceflight. The leading hypothesis suggests that weightlessness-induced cephalad fluid shifts may increase intracranial pressure (ICP) and contribute to these findings. An additional hypothesis implicates elevated ambient CO2 levels on the International Space Station. To investigate possible mechanisms for ocular changes we used the spaceflight analog of 6° head-down tilt (HDT) and studied eight male subjects during three 1-hour conditions: Seated, HDT, and HDT with 1% inspired CO2 (HDT+CO2). Non-invasive intracranial pressure (ICP), intraocular pressure (IOP; rebound tonometry), translaminar pressure difference (TLPD=IOP-ICP), ocular ultrasound, and optical coherence tomography (OCT) scans of the macula and the optic disc were obtained. Analysis of one-carbon pathway genetics were conducted to identify possible genetic risk factors. IOP and ICP increased and TLPD decreased during HDT, compared to Seated. Exposure to 1% CO2 during HDT+CO2 further increased IOP and decreased ICP compared to HDT, but there was no difference in TLPD between the HDT conditions. Compared to Seated, ONSD and subfoveal choroidal thickness increased during HDT, but there was no difference between HDT and HDT+CO2. There were no significant changes across conditions in visual acuity or ocular structures assessed with OCT imaging. ONSD and end-tidal PCO2 differed based on genetic polymorphisms. In conclusion, compared to Seated, acute HDT induced mild ocular changes, but acute mild-hypercapnia during HDT does not exacerbate these changes. A manuscript (Laurie SS, Feiveson AH, Ferguson CR, Hu X, Lee SMC, May-Phillips T, Ploutz-Snyder R, Smith SM, Stenger MB, Taibbi G, Zwart SR, Vizzeri G. Effects of Short-Term Mild Hypercapnia during Head-Down Tilt on Ocular Structures, Visual Function, and Intracranial Pressure in Healthy Human Subjects) will soon be submitted to Journal of Applied Physiology.
Bibliography Type:	Description: (Last Updated: 04/24/2019)
Articles in Peer-reviewed Journals	Laurie SS, Vizzeri G, Taibbi G, Ferguson CR, Hu X, Lee SMC, Ploutz-Snyder R, Smith SM, Zwart SR, Stenger MB. "Effects of short-term mild hypercapnia during head-down tilt on intracranial pressure and ocular structures in healthy human subjects." Physiol Rep. 2017 Jun;5(11):e13302. https://doi.org/10.14814/phy2.13302 ; PubMed PMID: 28611153; PubMed Central PMCID: PMC5471441 , Jun-2017