[4903]

Evaluation of Ocular Outcomes in two 14-day Bed Rest Studies

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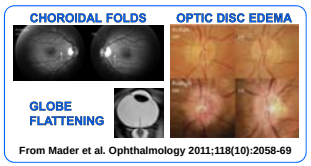
BACKGROUND

- Ophthalmological changes have been recently reported in some astronauts involved in long-duration space missions:



- Head-down tilt Bed Rest (BR): ground-based analog to simulate the effects of microgravity on the human body

PURPOSE

- To evaluate ophthalmological changes in two 14-day BR studies

METHODS

- Two integrated, multidisciplinary 14-day BR studies at NASA Flight Analogs Research Unit (FARU): 0° (supine) and -6° head-down tilt
- NASA standard screening procedures for BR studies

NASA bed rest studies STANDARDIZED CONDITIONS

- ✓ Subject to rest in bed **at all times**
- ✓ Monitoring by a subject monitor and an in room camera **24 hours a day**
- ✓ Daily measurement of vital signs, body weight, fluid intake and fluid output
- ✓ No napping permitted between 6:00 am and 10:00 pm
- ✓ Standardized diet

NASA Flight Analogs Research Unit (FARU)

0°	BR Angle	-6°
14 days	BR Duration	**14 days**
YES integrated resistance and aerobic training: 6 days/wk	Exercise During BR	**NO**

OCULAR EXAMS:

YES 1 Baseline (Office; BR -9)	Pre-BR	**YES** 2 Baselines (Office; BR -10,-3)
NO	During BR	**YES** Weekly (FARU; BR 4,11)
YES 1 (Office; BR +4)	Post-BR	**YES** 1 (Office; BR +2)

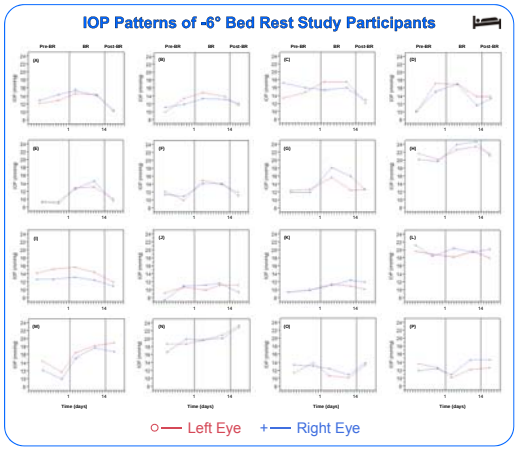
METHODS

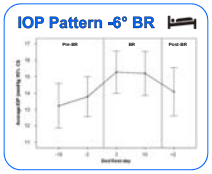
- Ophthalmoscopic evaluation of the retina and the optic disc (0° BR, pre- and post-BR)
- Stereophotographs of the retina and the optic disc (-6° BR, pre- and post-BR)
- Cycloplegic refraction and Best Corrected Visual Acuity (BCVA, at all time points)
- Intraocular pressure (IOP): Goldmann (pre- and post-BR); iCare (-6° BR, at all time points; IOP measured with Tonopen in 5 subjects)
- SPECTRAL-DOMAIN OCT (pre- and post-BR):
  - ✓ Cirrus HD-OCT (Carl Zeiss Meditec, Dublin, CA; vers. 5.0):
    - ➢ Optic disc parameters
    - ➢ Average Retinal Nerve Fiber Layer (RNFL) thickness
    - ➢ Macular Cube average thickness
  - ✓ Spectralis OCT (Heidelberg Engineering, GmbH, Heidelberg, Germany; vers. 5.1.3.0):
    - ➢ Average RNFL thickness and total retinal thickness (macular, peripapillary)

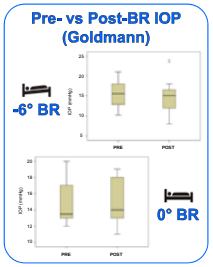
RESULTS

	0° Bed Rest			-6° Bed Rest		
	Pre-BR *	Post-BR *	P §	Pre-BR *	Post-BR *	P §
Best Corrected Visual Acuity (logMAR)	0.00 (-0.12; 0.00)	0.00 (0.00; 0.00)	0.99	-0.17 (-0.20; -0.11)	-0.20 (-0.24; -0.16)	0.16
Spherical Equivalent (Dioptres)	-0.27 (1.62)	-0.79 (1.72)	1.00	-0.07 (1.33)	-0.24 (1.36)	0.96
CIRRUS HD-OCT:						
Rim Area (mm^2)	1.34 (0.19)	1.36 (0.19)	0.83	1.37 (0.18)	1.38 (0.21)	0.96
Cup Volume (mm^3)	0.02 (0.00; 0.26)	0.02 (0.00; 0.10)	0.99	0.08 (0.03; 0.11)	0.07 (0.03; 0.12)	1.00
Average RNFL Thickness (µm)	93.56 (10.79)	92.00 (8.21)	1.00	93.41 (7.35)	93.72 (7.9)	0.96
Macular Cube Average Thickness (µm)	280.56 (15.66)	277.13 (11.40)	0.99	282.97 (11.85)	284.25 (11.99)	0.99
SPECTRALIS OCT:						
Average Macular Thickness (µm)	331.96 (18.37)	331.19 (14.93)	0.49	332.80 (12.57)	331.88 (12.39)	0.83
Average Peripapillary Retinal Thickness (µm)	364.54 (31.67)	376.34 (34.40)	0.77	350.27 (29.34)	354.41 (29.93)	0.83
Average RNFL Thickness (µm)	97.33 (9.47)	96.00 (8.45)	1.00	96.94 (8.97)	98.09 (8.77)	0.50

BR, Bed Rest; MAR, Minimum Angle of Resolution; RNFL, Retinal Nerve Fiber Layer.
•Mean (standard deviation) values for normally distributed variables; Median (first quartile, third quartile) values for non-normally distributed variables; § Kolmogorov-Smirnov test for equality of distribution functions.







RESULTS

	0° BR	-6° BR	P
n	9	16	-
Age	34.00 (8.51)	37.75 (8.78)	0.31 *
Gender (Male/Female)	8/1	12/4	0.40 §
Race:			
Caucasian/African-American	5/2	11/5	0.90 §
Others	2	-	-

BR, Bed Rest; * Unpaired *t*-test; § Chi-square test.

- Three healthy subjects who completed the 0° BR study also completed the -6° BR study (at least 3-month interval between the two studies)
- BCVA was 20/20 or better pre- and post-BR in all participants. Baseline demographic and ophthalmic characteristics were not significantly different between the two studies ($0.09 \leq P \leq 1.00$)
- Subjects remained asymptomatic throughout the duration of BR
- In both studies, no significant changes compared to baseline were detected for the ocular parameters measured (see results Table and IOP box plots)
- In -6° BR study, IOP increased on average 1.8 mmHg (+13.3%) at BR 3 and 1.7 mmHg (+12.6%) at BR 10 from baseline. At BR +2, IOP decreased on average 1.1 mmHg (-7.2%) from BR 10. A case-by-case analysis revealed different patterns of IOP changes (see, for example, panels L-P)

CONCLUSIONS

- -6° head-down tilt BR produced, in most cases, an initial increase in IOP, with subsequent stabilization and tendency to return to baseline values after BR
- More research is needed to evaluate ocular changes and to better characterize patterns of IOP changes related to long-duration BR
- Further studies will determine the validity of head-down tilt BR as a ground-based analog to study microgravity-induced ocular changes

SUPPORT

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DISCLOSURE

Taibbi, G None; **Cromwell, RL** None; **Zanello, SB** None; **Yarbough, PO** None; **Vizzeri, G** None

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