Ocular Outcomes Comparison Between 14- and 70-day Head-down Tilt Bed Rest

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BACKGROUND

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

  - Elevated intracranial pressure resulting from µG-induced cephalad fluid shifts may be responsible for most of these findings
  - Head-down tilt bed rest (HDTBR) produces cephalad fluid shifts; used to simulate the effects of µG on the human body

METHODS

• Experimental protocols:

  - Two integrated, multidisciplinary studies conducted at NASA Flight Analogs Research Unit (FARU): 14- and 70-day 6º HDTBR
  - NASA standard HDTBR screening procedures (healthy adults)

  - Subject to rest in bed all times
  - Monitoring by a subject monitor and an in room camera 24 hrs 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

  - 14-day HDTBR
    - n = 6
    - Age: 37.75 (8.78) 39.5 (7.8)
    - Gender: Male/Female 12/4
    - Ethnicity: Caucasian/African-American 10/5
    - Near Visual Acuity, logMAR -0.05
    - Spherical Equivalent, D -0.27
    - Intraocular Pressure (Goldmann), mmHg -0.95
    - Average RNFLT, retinal nerve fiber layer thickness µm 1.16

  - 70-day HDTBR
    - n = 6
    - Age: 39.5 (7.8) 38 (5.1)
    - Gender: Male/Female 12/4
    - Ethnicity: Caucasian/African-American 10/5
    - Near Visual Acuity, logMAR -0.05
    - Spherical Equivalent, D -0.23
    - Intraocular Pressure (Goldmann), mmHg -0.20
    - Average RNFLT, retinal nerve fiber layer thickness µm 1.33

RESULTS

• Pre/post-HDTBR differences in near visual acuity, spherical equivalent, IOP and SD-OCT average RNFL thickness were compared between the two studies

  - 1 subject who completed the 14-day HDTBR study also completed the 70-day HDTBR study

  - In both studies:
    - subjects remained asymptomatic throughout the duration of HDTBR
    - distance and near visual acuity was 20/20 or better pre- and post-HDTBR in all subjects
    - modified Amsler grid, red dot test, color vision, confrontational visual field were within normal limits at all visits
    - no detectable changes on stereoscopic color fundus photography

CONCLUSIONS

• There were no significant pre/post-HDTBR differences between 14- and 70-day HDTBR for the structural and functional ophthalmological variables evaluated

  • Further HDTBR studies with different duration and/or angle of tilt and/or environmental conditions (e.g., high CO2 exposure during HDTBR) may help determine the validity of the HDTBR analog to investigate microgravity-induced ophthalmological changes

DISCLOSURE

Cromwell, RL None; Taibbi, G None; Zanello, SB None; Yarbough, PO None; Ploutz-Snyder, RJ None; Vizzeri, G None
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