Comparison of Structural and Functional Ocular Outcomes Between 14- and 70-day 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.

PURPOSE

- To compare structural and functional ocular outcomes between 14- and 70-day HDTBR in healthy human subjects.
- Hypothesis: the amount of ocular changes induced by HDTBR is affected by the time spent in the HDTBR position.

METHODS

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

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-hour 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)

70 days HDTBR Duration

14 days

OCULAR EXAMS:

YES 2 office visits

YES Weekly (FARU)

YES 2 office visits

RESULTS

- Mixed-effects linear models compared pre- and post-HDTBR observations between 14- and 70-day HDTBR in:
  - Near best-corrected visual acuity
  - Spherical equivalent
  - Goldmann and iCare (iCare Finland Oy, Espoo, Finland) intraocular pressure (IOP)
  - Spectralis OCT (Heidelberg Engineering, Heidelberg, Germany) average retinal nerve fiber layer thickness (RNFLT), peripapillary retinal thickness and macular thicknesses.

- Statistical analyses were conducted using Stata (StataCorp LP, College Station, TX; software version 14.0).

- In the superior, nasal and inferior peripapillary sectors, the magnitude of retinal thinning post-HDTBR was greater after 70-day HDTBR (p < 0.01).

- Overall, average RNFL thickness increased (p = 0.002), while macular thickness decreased from baseline (p < 0.01).

CONCLUSIONS

- 70-day HDTBR induced greater peripapillary retinal thinning than 14-day HDTBR, suggesting that the time spent in the 6G HDTBR position may affect the amount of optic disc swelling.
- There was a slight RNFL thinning post-HDTBR, without signs of optic disc edema. Such changes may have resulted from HDTBR-induced cephalad fluid shifts.
- HDTBR induced a small non-progressive increase in IOP, which subsided post-HDTBR.
- HDTBR duration may be critical for replicating ophthalmological changes observed in astronauts on x6-month spaceflights.
- Further research is necessary to elucidate the interaction of HDTBR duration and the angle of tilt to study microgravity-related ophthalmological changes.

SUPPORT

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DISCLOSURE

All Authors, None
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