Association Between Cardiovascular and Intraocular Pressure Changes in a 14-day 6º Head Down Tilt (HDT) Bed Rest Study: Possible Implications in Retinal Anatomy

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BACKGROUND

- History of visual impairment among astronauts with microgravity exposure.
- Numerous signs comprise the Visual Impairment/Intracranial Pressure (VIIP) syndrome. (below)

CHOROIDAL FOLDS

OPTIC DISC EDEMA

GLOBE FLATTENING

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- Lack of data and analog studies have hindered development of preventive countermeasures.
- Current theory on VIIP etiology involves interaction of increased intracranial pressure (ICP), intracranial pressure (ICP), and genetic susceptibility.

RESULTS

- Mean IOP at BR3 increased over baseline values from BR-3 (p < 0.01).
- Mean IOP at BR10 remained higher than baseline values from BR-3 (p < 0.01).
- Mean IOP approached baseline values by BR+2 and was no longer elevated at a statistically significant level (p < 0.47).
- Although mean IOP increased during the 6 HDT in-bed phase, it remained within the normal limits for subject safety.
- Analysis of RNFL Thickness with Cirrus HD-OCT showed no statistically significant changes (p < 0.48).
- Central subfield (macula) thickness decreased from an average of 260.31 μm at BR-10 to an average of 258.44 μm at BR+2 with statistical significance (p < 0.01).

PURPOSE

- Characterize HDT BR as possible VIIP syndrome model.
- Investigate association between ocular/cardiovascular parameters.

METHOD

- 14 day 6° HDT bed rest (+14 days pre-bed rest & +7 days post-bed rest).
- Nomenclature:
  - BR-13 - BR-1 Pre-bed rest phase
  - BR1 - BR14 In-bed rest phase
  - BR0 - BR6 Post-bed rest phase
- 16 subjects: normotensive, non-smoker, normal weight/EMI
- Male: 12
- Female: 4

- Statistical modeling performed using mixed effects linear regression model with random intercepts for subject and eye (L/R) to account for the within subjects experimental design (software package: Stata/IC 12.1).

OCCULAR MEASURES

Intracranial Pressure (IOP)Goldmann applanation
Retinal Nerve Fiber Layer (RNFL) Thickness
Central Subfield Thickness

CARDIOVASCULAR MEASURES

Blood Pressure (Systolic, Diastolic)
Heart Rate
Stroke Volume
Plasma Volume
Cardiac Output

Cardiovascular measures: P<0.05

NASA Flight Analogs Research Unit (FARU) Standardized Conditions

- During in-bed phase: subject reclined and monitored 24 hours/day
- Vitals, body weight, fluid intake/output measured daily
- Awake time: 6:00 am – 10:00 pm
- Standardized diet to maintain weight within 3% of initial weight

RESULTS

• Mean IOP significantly increased while at 6° HDT and returned towards pre-bed rest values upon leaving bed rest.
• While mean IOP increased during bed rest, it remained within the normal limits for subject safety.
• Diuretic shift and cardiovascular deconditioning occurs during in-bed rest, as expected.
• There was no demonstrable correlation between the largest change in IOP (pre/post) and cardiovascular measure changes (pre/post).
• Additional mixed effects linear regression modeling may reveal some subclinical physiological changes that might assist in describing the VIIP syndrome pathophysiology.

DISCLOSURE

Taibbi, G None; Cromwell, RL None; Zanello, SB None; Yarborough, PO None; Vizzieri, G None; Brewer, J None
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