Prospective Observational Study of Ocular Health In ISS Crews: Study Update

Ocular Health

- Occupational exposure study:
  - Define changes due to ISS environment occurring in:
    - Ocular
    - CNS
    - Cardiovascular
  - Mechanistic by observation & measurement
  - Limited physiologic manipulation vs FS
    - TCD measurement during tilt testing pre/post
- Recruitment: 9/12 subjects
  - Two subjects have completed preflight and inflight
  - Two additional subjects currently inflight
Ocular Health Study Aims & Rationale:

1. Increased frequency of crew VIIP testing is required to:
   a) Define the temporal sequence for the appearance of signs and symptoms.
   b) Delineate the interaction between duration of weightlessness and severity of symptoms, i.e. the dose-response.
   c) Identify whether VIIP signs and symptoms recover post-flight and determine the impact of prolonged changes on crew health.
   d) Outline the mechanism for the VIIP syndrome to aid in the development of protective countermeasures and treatments.

2. Data from this study will:
   a) Improve the understanding of VIIP incidence, signs, symptoms, susceptibilities, and timeline for development and recovery.
   b) Aid in guiding development of countermeasures and targeted treatments in for the VIIP syndrome and its complications.
**Pre-flight Exams**

- Victory Lakes
  - MRI
- Flt Med Clinic
  - Vision Testing
  - Fundoscopy
  - Refraction
  - Pupil Reflexes
  - Extra-Ocular Muscle Balance
  - IOP (Tonometry)
  - Blood pressure
- Coastal Eye Assoc
  - OCT/A-Scan
  - Biomicroscopy/Hi Res Photography
- Bldg. 261
  - Cardiac Ultrasound
  - Blood Pressure
  - Transcranial Doppler

**In-flight Exams**

- Suite of tests will occur over 2-3 days at each FD requirement.
  - Vision Testing
  - IOP (Tonometry)
  - Blood pressure
  - Fundoscopy
  - Ocular Ultrasound
  - Cardiac Ultrasound
  - Blood Pressure
  - Transcranial Doppler

**Post-flight Exams**

- Victory Lakes
  - MRI
- Flt Med Clinic
  - Ocular Ultrasound
  - Vision Testing
  - Fundoscopy
  - Refraction
  - Pupil Reflexes
  - Extra-Ocular Muscle Balance
  - IOP (Tonometry)
  - Blood pressure
- Coastal Eye Assoc
  - OCT/A-Scan
  - Biomicroscopy/Hi Res Photography
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  - Cardiac Ultrasound
  - Blood Pressure
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**Medical Activity**

- Medical Session
- Research Additional Activity

**Research Additional Session**
Ocular Health

• Data for two subjects will be presented:
  – Preflight
  – Inflight
  – Early postflight
• Both subjects are non-cases, or VIIP Class “0”
Venous Compliance

\[ C = \frac{\Delta V}{\Delta P} \]
Compliance Crewmember A & B

The diagram illustrates the means and observed vascular compliance over days since launch. The x-axis represents days since launch, ranging from -100 to 200. The y-axis shows vascular compliance, ranging from 0 to 4. The graph compares pre-flight, flight, and post-flight periods, with distinct visual representations for each phase. The data points are indicated with error bars, showing the range of compliance values across multiple repetitions within a day (pre & post only).
In Flight B-scan Ultrasound
Optic Nerve Sheath Diameter, Crewmember A & B
MRI & US

MRI ONSD (cm)

ONSD (cm)

Days Since Launch

Pre-Flight  Flight  Pre-Flight  Flight

OD  OS
Intraocular Pressure: Crewmember A & B

Mean and Individual Observations of IO

Days Since Launch

Pre-Flight  Flight  Pre-Flight  Flight

Mean IOP (range) taken across multiple repetitions within day
Sheath to OND Diameter Ratio Crewmember A & B
Globe Axial Length, Biometry & US: Crewmember A & B
**Finding:**

Instrument derived RNFL thickness is increased in inflammatory optic neuropathies and with inflammatory retinal disease. The total retinal thickness minus RNFL is not significantly different in optic neuropathies.

OCT and the Swollen Optic Nerve Head

Finding:
Optic nerve head (ONH) ‘deflection’, can be quantified using the RPE-angle. This angle is increased in papilledema associated with increased ICP.

ISS Scans – OS

RNFL B-Scan

Scan Path

TSNIT Plot

RNFL Thickness

Choroid Thickness

Global Thickness 115

Global Thickness 161
Summary

• Difference in compliance
  – Compliance changes occurred
• Optic Nerve sheath diameter
  – Increased from pre to post
• IOP increased for crew A, decreased for crew B
• Sheath to OND ratio increased for crewmember A & B
• No change in globe axial length
• OCT: choroidal thickness increased for crew A & B
  – RNFL increased for crew A & B