Background

The Spaceflight Associated Neuro-ocular Syndrome (SANS) is characterized by the development of optic disc edema, choroidal folds, cotton-wool spots, globe flattening, and/or refractive error changes ≥0.75D during long-duration spaceflight to the International Space Station (ISS). The number of astronauts with each finding is shown in Figure 1.

It is hypothesized that these findings result from the headward fluid shift that occurs due to weightlessness.

We can induce a headward fluid shift on Earth using positional changes and on ISS due to weightlessness.

Lower-body negative pressure (LBPN) is used to reverse the headward fluid shift by drawing fluid into the lower body and can be used on Earth and on ISS.

Methodology

The purpose of this study was to characterize how the headward fluid shift during spaceflight affects choroid thickness (CT) and intraocular pressure (IOP) and to determine if use of LBPN could reverse the effects of the headward fluid shift on these variables.

Methods

Nine astronauts were studied before, during, and after long-duration spaceflight on the ISS (Figure 2).

Heidelberg Spectralis OCT was used to obtain a single B-scan through the macula and optic disc on Earth and on ISS (Figures 2 and 3).

During spaceflight, data collection occurred in weightlessness (Spaceflight, SF) and during activation of LBPN (SF + LBPN).

IOP was measured usingicare Pro (on Earth) and TonoPen Avia (ISS).

Mixed-effects linear regression modeling was used to derive means and 95% confidence intervals (Stata/IC 14.2).

Results

Acute posture changes on Earth do not cause a significant change in subfoveal choroid thickness.

Prolonged exposure to weightlessness during spaceflight causes an increase in subfoveal choroid thickness that is not reversed by use of LBPN.

Following return to Earth (R+10 and R+45), choroid thickness is similar to preflight values.

IOP increases during HDT on Earth, but IOP during spaceflight is similar to values measured while supine on Earth. This suggests the known increase in IOP during the first few days of spaceflight resolves and is maintained throughout long-duration flight.

These data suggest the increase in choroid thickness during spaceflight does not lead to an increase in IOP.

Whether changes in choroid thickness during spaceflight contribute to, or result from, SANS symptoms such as optic disc edema requires further investigation.

Discussion

Footnotes


References


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