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Can transorbital ultrasound scan of optic nerve sheath diameter (ONSD) detect ONSD increase in healthy young subjects after a 12-degree head down tilt maintained for 4 hours compared to baseline ONSD?

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Background: Increased volume and thus pressure may contribute to the structural and functional neuro-ophthalmic changes observed in spaceflight-associated neuro-ocular syndrome (SANS). ONSD was shown to increase with a 12-degree head-down tilt. Methods: The design of the study was a balanced crossover design with 2 test conditions with 14 days interval between test conditions. Test conditions were: head down tilt 0 degrees (supine) and head down tilt 12 degrees maintained for 4 hours (Table 1). The technique employed was a transorbital B mode scan of the optic nerve sheath. Results: the highest value of ONSD was measured in most instances at a 150-minute time point with 12 degree head-down tilt and at 60 minutes time point with a 0-degree head-down tilt. A paired-samples t-test was used to determine whether there was a statistically significant mean difference between the change in optic nerve sheath diameter when participants were put in 12 degrees head-down tilt position as opposed to a supine position. Head down tilt of 12 degrees produces a statistically significant increase of optic nerve sheath diameter change of 0.565 (95% CI, 0.491 to 0.639) mm as compared to the supine position (head down tilt 0 degrees), $t(7) = 17.996$, $p < .001$. A two-way repeated-measures ANOVA was used to understand the effects of the degree of head-down tilt (0 or 12 degrees) and time spent in each test condition (time) on optic nerve sheath diameter changes. Significant two-way interaction between time spent in specific test conditions and test condition, $F(8,24) = 32.93$, $p < .001$. Conclusion: In planning head-down tilt studies with 12 degrees HDT, the desired sample size to reach statistical significance would be around 12,7 to 18 subjects. Extending measuring time beyond 180 minutes does not seem to be reasonable; the maximal changes of ONSD should be detected by then. The 4-hour protocol envisioned at the conception of the pilot study can be shortened with further studies.