Brain MRI Findings of Altitude Chamber Technicians: An Investigational Update

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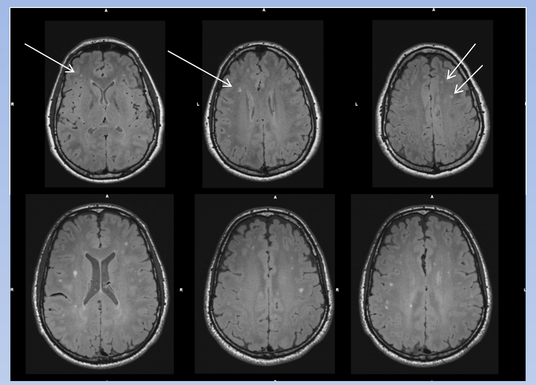
Introduction

The use of hypobaric chambers to train military aviators in recognition of signs and symptoms of hypoxia is a well-established practice. A recent study of 50 U-2 pilots, who are regularly exposed to cabin altitude pressures of 29,500 ft, revealed a significant increase in the prevalence of white matter hyperintensities (WMH) on fluid attenuated inversion recovery (FLAIR) MRI studies. Individuals who train military aviators in hypobaric conditions are also regularly exposed to very low atmospheric pressures. The intent of this investigation is to compare physiology trainers to control subjects to determine if there is any increase in prevalence of WMH in other individuals regularly exposed to hypobaric conditions. These data are offered as an update of the ongoing Normative Decompression Sickness (NDCS) study currently underway.

Methods

All participants underwent MRI. We compared 61 physiology personnel with at least 50 exposures to altitudes above 20,000 ft to 102 age-matched, healthy, active duty Air Force officers without history of exposures. 3D FLAIR MRI high-resolution (isotropic 800-µm) data acquired on a 3T Siemens scanner were analyzed for WMH. Quantitative measurement of WMH was performed as previously described. Data were analyzed using the nonparametric Mann-Whitney test. We considered a $p \leq 0.05$ significant.

Representative Images



Imaging from two hypobaric physiology technicians demonstrating numerous sub-cortical white matter hyperintensities.

Results

Item	Hypobaric Physiologists (n=61)	Air Force Officers (n=102)	p-value (2-tailed Mann-Whitney)
Subcortical WMH volume	0.148 cm^3±0.465	0.036 cm^3±0.063	p=0.021
Subcortical WMH count	7.1±12.4	2.8±3.8	p=0.017

Conclusions

The use of new, high-resolution MRI technology allows us to investigate the effects of hypobaric exposure on the brain to a level not previously available. The data collected thus far in this investigation indicate a trend towards increased volume and number of subcortical WMH in physiology technicians occupationally exposed to high altitudes vs. our control cohort. Correlation between the incidence of WMH to the number of hyperbaric exposures is not completed. Literature states that up to two-thirds of subjects exposed to an altitude of 29,500 ft will demonstrate venous bubble formation and that venous gas emboli formation is a poor predictor of neurological DCS. Based on the distribution of these hyperintensities, we postulate an underlying microembolic phenomenon as cause for these WMH. The etiology of these microemboli, however, still remains elusive. Further investigation into the mechanism of such findings is warranted.

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