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EFFECTS OF EXTREME HYPOBARIC ENVIRONMENTS UPON THE BRAIN IN SPECIALIZED OPERATORS

EFFETS DES ENVIRONNEMENTS HYPOBARES EXTRÊMES SUR LE CERVEAU DANS LES OPÉRATEURS SPÉCIALISÉS

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Introduction: Repeated exposure to extreme hypobaria is associated with increased white matter hyperintensities (WMH), degradation of axonal integrity, and neurocognitive processing decrements. The goal of our research studies is to characterize the pathophysiologic response of the brain to high altitude and maximize the safety of our aircrew and special operators.

Methods: Brain MRI fluid-attenuated inversion recovery data from 41 astronauts (ASTR) were quantified for WMH volume, subcortical and periependymal. This was compared to previously reported data from 106 U-2 pilots (U2P) and to 320 health-matched control subjects (nonparametric group comparisons). 96 U.S. Air Force aircrew trainees were evaluated while undergoing initial occupational hypobaric exposure. Standard USAF procedure is a 30-minute exposure to 25,000 feet (7,620 meters). Quantitative arterial spin labeling (ASL) and proton magnetic resonance spectroscopy (MRS) data were acquired on subjects at T-24 hours, T+24 hours, and T+72 hours. Controls were 68 healthy subjects meeting the same physical and physiological criteria minus hypobaric exposure.

Results: ASTR mean WMH total volume (mL) was 0.6618 +/- 0.1289 compared to 0.8663 +/- 0.0502 for U2P and 0.2353 +/- 0.0100 for controls. Both U2P and ASTR have a significantly higher WMH volume compared to controls, with no significant difference between ASTR:U2P. Statistically significant increases in cerebral blood flow (CBF) in white matter in aircrew personnel with hypobaric exposure was observed (white matter p except glutathione, in aircrew personnel with hypobaric exposure: glutamate, choline, N-acetylaspartate, myoinositol $p<0.05$; creatine, glutamate+glutamine $p<0.01$.

Conclusion: Astronauts demonstrate similarly increased WMH burden to high-altitude pilots. There is a highly significant increased CBF response after a single exposure to hypobaria and significant differences in most neurometabolites after exposure to hypobaria. These differences may be representative of cellular level effects which are associated with changes in CBF.