Risk Of Visual Impairment And Intracranial Hypertension After Space Flight: Evaluation Of The Role Of Polymorphism Of Enzymes Involved In One-Carbon Metabolism

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Data from the Nutritional Status Assessment protocol provided biochemical evidence that the folate-dependent 1-carbon metabolic pathway may be altered in individuals experiencing vision-related issues during and after space flight (1). Briefly, serum concentrations of homocysteine, cystathionine, 2-methylcitric acid, and methylmalonic acid were significantly \( P < 0.001 \) higher (25-45%) in astronauts with ophthalmic changes than in those without such changes (1). These differences existed before, during, and after flight. Serum folate tended to be lower \( P = 0.06 \) in individuals with ophthalmic changes. Preflight serum concentrations of cystathionine and 2-methylcitric acid, and mean in-flight serum folate, were significantly \( P < 0.05 \) correlated with postflight changes in refraction.

Potential confounding factors, including creatinine clearance, serum vitamin B12, coffee consumption, and body composition, have not explained any of these differences between groups.

These data document that individuals with an altered 1-carbon metabolic pathway may be predisposed to anatomic and/or physiologic changes that render them susceptible to ophthalmic damage during space flight. Commonly existing enzyme polymorphisms affect this pathway. Polymorphisms could explain the differences described above, including the fact that these differences were observed before flight. They could also help explain why crewmembers on the same mission do not all have ophthalmic issues, despite the same environmental factors (e.g., weightlessness, atmosphere, exercise, diet). One-carbon polymorphisms have been associated with increased incidence of stroke, migraines, and other vascular issues.

These preliminary data led us to conduct a follow-on project to assess enzyme polymorphisms and metabolic profiles associated with the 1-carbon pathway in astronauts, and how they relate to vision impairment and other issues. Sample and data collection were completed in 2013, with analyses underway.