Longitudinal Study of Brain Volume and White Matter Integrity After Blast Injury

D.B. Fitzgerald (North Florida/South Georgia VA Medical Center, Neurology), A. Ford (UF, Psychology), T.H. Mareci (UF, Biochemistry), W. Tripplett (UF, Biochemistry)

Introduction

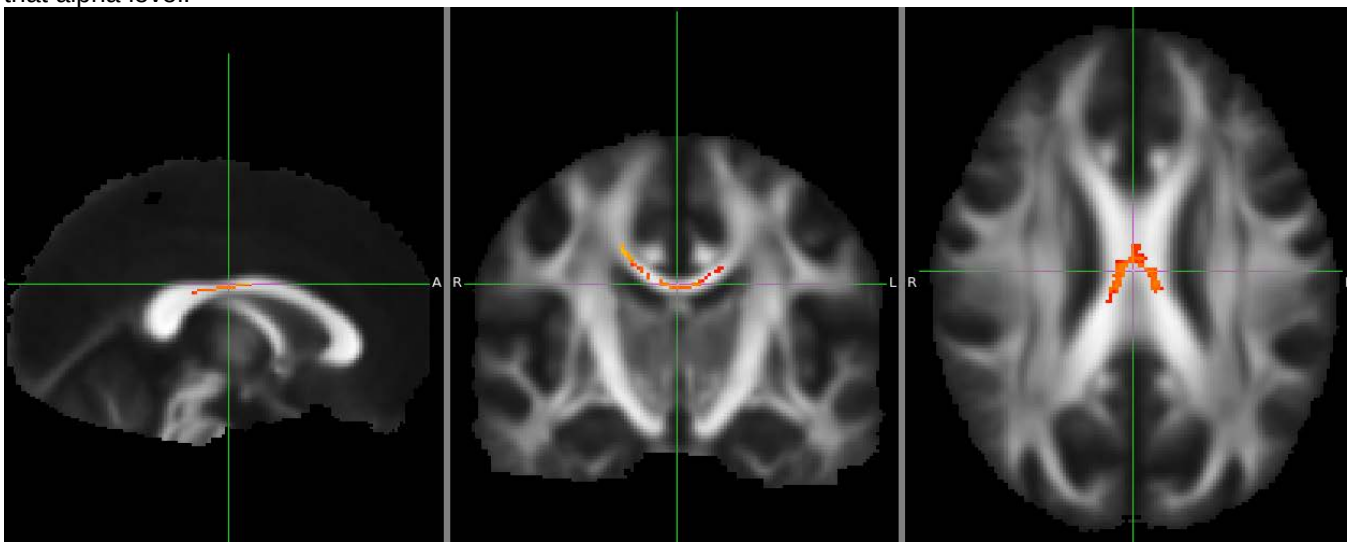
Many veterans returning from military operations in the Middle East have received mild traumatic brain injuries (mTBI) as result of exposures to blasts. Despite having clinically normal structural imaging, many patients with mTBI have persistent cognitive impairments such as decreased working memory/attention, reduced executive functions, and reduced speed of processing. This longitudinal study asks whether there may be changes in gray matter or white matter volumes, or changes in white matter integrity, which are correlated with these cognitive impairments.

Experimental

In this five year proposed study, veterans and age-mathced neurologically healthy controls will be scanned in the UF AMRIS 3T. Images to be obtained include anatomical MPRAGE (1.0 X 0.94 X 0.94 mm voxels); FLAIR spin echo (0.6 X 0.44 X 0.44 mm voxels); T2 spin echo (1 X 1 X 1 mm voxels); high angular resolution diffusion-weighted images (HARDI, 2 X 2 X 2 mm voxels) with 64 isotropically distributed directions at b = 1000 s/mm^2, a further six directions at b = 100 s/mm2, and two images at b = 0; and a susceptibility-weighted image (1 X 1 X 1 mm voxels). HARDI data will be analyzed with typical second-order tensor fits for fractional anisotropy determinations, and also with probabilistic tractography, allowing for group comparisons with tract-based spatial statistics (TBSS). Voxel based morphometry group analyses will be supported by Structural Image Evaluation, using Normalisation of Atrophy softwatre (SIENA).

Results and Discussion

This project is in progress with years remaining on the five year plan. Based on preliminary analysis of groups of 42 blast-exposed veterans and 34 healthy controls, these groups have statistically significant differences in the volumes of white matter ($p < 0.01$), peripheral gray matter ($p < 0.01$), and subcortical gray matter ($p < 0.05$). Preliminary TBSS analysis of the veterans group results are shown in **Figure 1**. This figure shows the correlation between processing speed on the WAIS III neuropsychological test and fractional anisotropy (FA) values for veterans. The display threshold is set at $p < 0.05$, thus all red voxels have statistically significant correlations for that alpha level.



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