Diagnostics

Deficits in Visual System Functional Connectivity after Blast-Related mTBI are Associated with Injury Severity and Executive Dysfunction

Many Service Members returning from Afghanistan and Iraq sustain mTBI. A majority of these incidents are caused or associated with explosive blast. Visual and cognitive deficits are common complaints after TBI, but to date little research has explored how these symptoms may be related neurologically. In this study, investigators at the DVBIC, Minneapolis; the Minneapolis VA Medical Center; the University of Minnesota; and the University of Iowa collaborated to study the relationship between cognitive and visual processing dysfunction after blast-related TBI. The study administered resting-state functional MRI scans to 131 Veterans of OEF/OIF. All participants completed the Minnesota Blast Exposure Screening Tool. The resting-state data were processed and analyzed to determine the functional connectivity of four seeds in the brain's visual system: lateral geniculate nucleus, primary visual cortex, lateral occipital gyrus, and the fusiform gyrus. First, multiple regression analysis produced individual functional connectivity maps depicting each seed's correlation with every other voxel. Group-level analyses then regressed scores from the Minnesota Blast Exposure Screening Tool onto data from the functional connectivity maps. This analysis yielded F-statistic maps that identified brain areas where FC variance is related to blast severity. A Monte-Carlo-based thresholding procedure controlled for multiple comparisons. Data from voxel clusters that survived the procedure were correlated with cognitive (Stroop Color-Word, Trail-Making B) and visual test scores. The behavioral data available for this final analysis included 95 participants. The results demonstrate a negative correlation for blast severity and functional connectivity between the lateral geniculate nucleus seed and the medial frontal gyrus, lingual gyrus, and right thalamus; between the primary visual cortex seed and precuneus; between the lateral occipital gyrus seed and the middle frontal gyrus; and between the fusiform gyrus seed and the superior frontal gyrus, medial frontal gyrus, and left middle frontal gyrus. In addition, higher functional connectivity values between the seeds and fronto-cortical regions were correlated with better performance on Stroop and Trail-Making tests. This study demonstrates a deficit in connectivity between visual and frontal brain regions, which also negatively correlate with cognitive performance. An understanding of brain connectivity may be critical foundational information in diagnosing and treating TBI in the Service Member.