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Functional and cerebral metabolites evaluation of single episode mTBI with MRS and DTI

Background: Traumatic brain injuries (TBI) are widespread and well documented. However, impact of a single episode mTBI has been under-diagnosed with symptoms and underlying microscopic injuries being ignored. Studies with functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI) and reconstruction software are becoming more popular in mTBI diagnoses. These methods have proven problematic and their use as a diagnostic tool for mTBI has been called into question.

Methods: Retrospective study on 250 mTBI patients was conducted in TBI clinic over last four years. 160 patients were given WMS-IV standardized test after scoring <26 on MoCA cognitive screening. Functional magnetic resonance imaging (fMRI)/diffusion tensor imaging (DTI) tests were performed within average of 22 months after initial mTBI. 31 patients were further tested with fMRI, Swan, Flair and DTI with fractional anisotropy (FA) on white matter (WM), and the cortical thickness was measured in grey matter (GM) with color representation. Magnetic resonance spectroscopy (MRS) was done on bilateral frontal lobe and posterior cingulate consistently in all patients, if decreased cortical thickness was observed with neuronal loss. We identified subject-specific regions of abnormally high and low FA, axial diffusivity (AD), radial diffusivity (RD) and mean diffusivity (MD) across all white matter voxels and several WM regions.

Results: The decrease cortical thickness in left frontal lobe (LFL) and RFL 89% (26/29) patients had MRS with decreased NAA, increased choline and myo-inositol were compared WM tract low FA. Corpus callosum (CC) WM DTI with decrease FA is 83.33% correlated with LFL, GM and MRS. Similarly, CC is 95% related with RFL with p value<0.05. 23/29 79% of lesions in the CC, hippocampus and SLF are well published in DTI literature as characteristic of mTBI. Immediate and delayed memory index is 36.79% related with Rt. temporal lesion. Decrease probability of attention score is 61.25% related with RLF and 64.51% with CC with P value<0.039. Executive functioning probability of low score is 100% related with LFL and 82.6% with RFL with P value<0.05.

Conclusion: There is no statistical difference between the areas tested by MRS in GM and DTI on WM, but they complement each other by detecting the lesions in the same patients in two different places. These tests can be used simultaneously to increase the predictive value. The MRS study with cerebral metabolites changes were seen at an average of 22 months, which was a longer interval than prior studies. WMS-IV findings of delayed recall and executive functioning are hallmarks of TBI and confirm disruptions in the memory circuit pathway. Functional magnetic resonance imaging (fMRI)/diffusion tensor imaging (DTI) study further support the memory loss in patients with cognitive deficits on WMS IV battery. There is a direct correlation between single-incident mTBI to underlying cerebral lesions and cognitive deficits. Strong correlations are seen secondary to patient selection, after low WMS-IV scores.

Biography

Suresh Kumar is a Triple Board Certified Brain Injury Specialist, Neurologist and Director of Headaches, TBI and Memory Research Institute in Southern USA. He completed his Residency training in Neurology from Louisiana State University and later board certification in Headaches Medicine & Traumatic Brain Injury Medicine. He is User Interface Software Architect; Neuro Scientist & Clinician operating research based clinical practice. He has helped more than 50 patients with memory impairment after TBI and mild to moderate dementia under Regain Memory 360 protocol approach. He has published and presented many abstracts and papers on diagnosis, treatment of mild traumatic brain injury and cognitive deficit.

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