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NEWS

Disrupted Default Mode Network Functional Connectivity In Adolescents With Mild Traumatic Brain Injury

PURPOSE

Use resting-state fMRI (rs-fMRI) to determine network connectivity measures in the default mode network (DMN) of patients with mild traumatic brain injury (i.e., concussion - mTBI) with symptoms of post-concussion syndrome (PCS) and compare them to healthy controls.

METHODS AND MATERIALS

Concussion patients (n=142, 75M, 67F, mean age 18.2 yrs, range 9-60) with a history of clinically diagnosed mTBI and PCS and age and sex-matched controls (n=27, 15M, 12F, mean age 20.7 yrs, range 18-28) underwent rs-fMRI. The control group consisted of young athletes with no history of mTBI, as confirmed by a physician. A clinician extracted the number of previous concussions and time between injury and MRI from electronic medical records. Subjects were scanned anywhere between 3 days to 2 years after concussion. 3D MPRAGE sequence: TR/TE = 1200/2.29ms, voxel size = 1.0 x 1.0 x 1.0mm, matrix size = 256 x 256 x 208. Motion-corrected EPI sequence: TR/TE = 2200/30ms, voxel size = 4.0 x 4.0 x 4.0mm, matrix size 64 x 64 x 38 with 220 time points. Patients were instructed to close their eyes during rs-fMRI acquisition. Data analysis was performed using the FSL, and the pipeline and relevant modules are summarized below: 1. Data cleanup [FEAT], including brain extraction, field correction, linear motion correction, and registration to standard space [MNI atlas]. 2. Individual independent component analysis (ICA) [MELODIC], including finding the maximally independent components of the data in both space and time and classifying each as noise vs. signal. 3. Denoising data [FIX] by training a denoiser with hand-labeled components from ICA (10 controls, 20 subjects) and removing noisy components from fMRI data. 4. Group ICA [MELODIC] analysis, concatenating data from all subjects temporally. 5. Mapping group ICA components back to individual subjects [dual_regression] and performing a statistical comparison of groups [randomise].

RESULTS

3-factor ANOVA (Control [CON], 1-2 concussions [C1-2], >=3 concussions [C3]) with posthoc F-test showed significant differences in DMN functional connectivity between C1-2 and C3 as well as CON and C1-2. There was also a trend between CON and C3 groups, p_min=0.055. The disrupted regions include the post-central and supramarginal gyri.

CONCLUSIONS

DMN functional connectivity is disrupted in mTBI patients experiencing symptoms of PCS, with a significant difference in connectivity between low and high mTBI burden groups. This is congruent with previous data showing disrupted structural connectivity in the same patient group.

CLINICAL RELEVANCE/APPLICATION:

The fact that disruption of connectivity is most pronounced in chronic mTBI patients suggests that a more severe disease process occurs in subjects with greater mTBI burden.