INTER-HEMISPHERIC FUNCTIONAL AND ANATOMICAL CONNECTIVITY ABNORMALITIES IN TRAFFIC ACCIDENT-INDUCED PTSD: A STUDY COMBINING FMRI AND DTI

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TARGET AUDIENCE

Radiologists and psychiatrist

PURPOSE

Aberrant brain functional and structural changes have been considered as one of the important mechanisms underlying post-traumatic stress disorder (PTSD). However it remains unclear whether inter-hemispheric connection is changed in PTSD. The current study is aimed to identify the inter-hemispheric functional and anatomical connectivity changes in patients who consequently develop PTSD. A secondary aim was to examine the ability of the factors to predict the future severity of PTSD.

METHODS

We investigated the potential factors relating to the development of PTSD using the voxel-mirrored homotopic connectivity (VMHC) analysis and diffusion tractography techniques. Resting-state functional magnetic resonance imaging (rs-fMRI) and diffusion tensor imaging (DTI) data were acquired on victims who had experienced traffic accidents within 2 days after the traumatic event. The diagnosis was made using the Clinician-Administered PTSD Scale (CAPS) at 1 or 6 months later. Fifteen trauma-exposed victims met the criteria for diagnosis of PTSD and 14 trauma-exposed victims who did not develop PTSD at 6 months after trauma were selected as the control group.

RESULTS

Compared to the victims without PTSD, the victims with PTSD exhibited an abnormal homotopic pattern with decreased VMHC in the superior/middle frontal gyrus before diagnosis. These regions showing abnormal functional connectivity were then chosen as regions of interest for an analysis of DTI tractography. Decreased fractional anisotropy values in the frontal lobe regions (corpus callosum genu) were found in the victims with PTSD. In addition, the greater WM disruptions within 2 days predicted greater symptom severity (CAPS scores) at diagnosis.

DISSCUSION

The corpus callosum (CC) is an important target for PTSD researches. It is possible that the abnormalities in CC are due to developmental/genetic factors and predispose individuals to develop PTSD after exposure to trauma[1]. Abnormalities in CC may influence inter-hemispheric connectivity. The VHMC is an informative technique that computes functional connectivity between symmetric inter-hemispheric voxels[2]. In our study, we observed decreased VMHC between the bilateral superior/middle frontal gyrus in victims with PTSD within 2 days before the diagnosis. We also found decreased FA values in corpus callosum genu that connect the bilateral prefrontal regions. We suggest that these alterations are found within 2 days of experiencing a traumatic event may be a possible pre-existing vulnerability factor for the development of PTSD following trauma exposure. The greater WM disruptions within 2 days could predict the future severity of PTSD.

CONCLUSION

Our results suggest that the functional and structural connectivity between homotopic brain regions is impaired in PTSD within 2 days, which supports the connectivity deficits of PTSD. The imaging results may be potential markers showing predisposition towards developing PTSD and this novel method of examining inter-hemispheric coordination may provide new insight into the disease-related mechanisms of PTSD

REFERENCES

1. Villarreal G, Hamilton DA, Graham DP, et al. Reduced area of the corpus callosum in posttraumatic stress disorder. Psychiatry Res. 2004;131:227-235.
2. Zuo XN, Kelly C, Di Martino A, et al. Growing together and growing apart: regional and sex differences in the lifespan developmental trajectories of functional homotopy. J Neurosci. 2010;30:15034-15043.

FIGURES

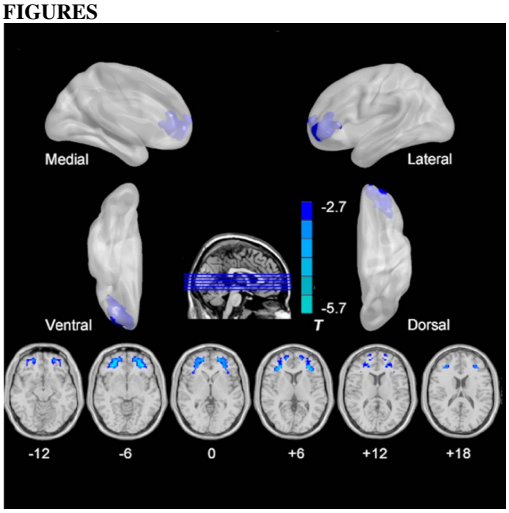

Figure 1. The brain regions with between-group difference in VMHC. Brain regions showing significant decreased (cool color) VMHC victims with PTSD. These clusters were shown in the bilateral superior frontal gyrus and middle frontal gyrus ($p < 0.05$, AlphaSim corrected). VHMC = voxel-mirrored homotopic connectivity; PTSD = posttraumatic stress disorder.

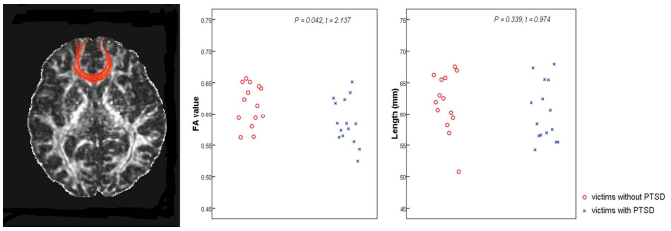

Figure 2. The left column is an example of diffusion tractography from a single control subject. The right two columns are scatter plots illustrating the between-group comparison for the fiber length and FA of commissure tracts. FA = fractional anisotropy; PTSD = posttraumatic stress disorder.