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Voxel-Based Diffusion Tensor Imaging Analysis using Statistical Parametric Mapping between Temporal Lobe Epilepsy and Normal Controls

Rahyeong Juh^{1,3}, Lydia Su³, ChaungUk Lee², Taesuk Suh¹, and Orhan Nalcioglu³

¹ Dept. of Biomedical Engineering, Catholic University, ² Dept. of Psychiatry, Catholic University, ³ Center for Functional Onco-Imaging, University of California, Irvine

rahyeong@catholic.ac.kr

Object: Diffusion tensor imaging (DTI) can provide information regarding early pathological changes, such as neuronal cellular changes in gray matter or demyelination in white matter tracts. Voxel-based statistical analysis can be performed to compare changes in a group of patients and control. In this study we investigated whether the seizure focus in patients with temporal lobe epilepsy (TLE) can be identified compared to controls.

Method: Ten normal control (36±7y) with no history of neurological disease, and 10 TLE patients (30±10y) diagnosed with temporal lobe epilepsy were included in this study. The seizure onset age was 22±12y, seizure history was 8 ± 7y, and seizure duration 1.8±1.5 minutes. All subjects received a standard MRI scan with DTI.

The ADC and FA maps acquired from each patient was compared to the normal group data, and also the whole patient group was compared to the control group on a voxel-by-voxel basis using SPM.

Results: In this study we investigated whether the patients with temporal lobe epilepsy showed abnormality in DTI compared to normal controls. The three of ten patients, a well localized region in the temporal lobe gray matter was found to show significantly increased ADC, which might be associated with the seizure focus. In one of ten patient, no elevated ADC regions were found, but 2 areas with decreased ADC were found in the frontal lobe. As the long-term seizure may damage the tissues, the involved areas may show changes in DTI. Every patient showed a different pattern, some with a well-localized focus with increased ADC which might be associated with seizure focus. On the other hand, 2 patients did not show a significantly increased ADC, rather a decreased ADC elsewhere. Due to the disease diversity in patients, the group comparison may be dominated by some individuals. The FA maps were also analyzed, however no significant changes were found localized in the white matter, rather in the same gray matter area, suggesting that the effect was mediated from ADC changes.

Conclusions: The SPM analysis of ADC maps acquired from each individual patient compared to a normal group might provide a means of accurately identifying focal abnormalities prior to more invasive diagnostic procedures and possible epilepsy surgery. The occult epileptogenic regions may be identified using voxel-based statistical analysis of ADC.

Keywords : Diffusion Tensor imaging, Epilepsy