

Evaluation of white matter integrity, cortical thickness and volume of subcortical structures in patients with typical absence epilepsy

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Introduction:

Typical absence epilepsy is a transient impairment of consciousness, with sudden onset and interruption of ongoing activities lasting from a few seconds to half a minute. It affects 10-15% of children with epilepsy and can significantly impair quality of life. In most patients with absence seizures, conventional MRI is normal. In previous studies voxel-based morphometry (VBM) analyses have shown: grey matter decrease in both thalami; white matter decrease in the basal forebrain and in the extranuclear subcortical area.

Objective:

Our study intends to evaluate white matter integrity, cortical thickness and the volume of subcortical structures in patients with typical absence epilepsy through the use of three-dimensional maps based on conventional high-resolution MRI.

Materials and Methods:

In this cross-sectional cohort study 19 patients (11 females and 8 males, mean age 24.9) and 19 healthy subjects (matched by gender and age) underwent MRI at 1.5 Tesla (Avanto, Siemens, Germany). The acquisition protocol included structural sagittal T1-MPRAGE and axial FLAIR sequences and axial isotropic DTI with 30 direction. The image volumes were transferred to a workstation where cortical and volumetric segmentations were performed with the FreeSurfer image analysis suite (Fischl 2002). Statistical analysis was performed on the morphometry with QDEC, a tool within FreeSurfer, to identify differences between the patient and control group. The Evaluation of white matter integrity was performed using tract based spatial statistics (TBSS) on diffusion tensor imaging data within FSL (Smith, 2006). Voxel-wise cross-subject statistics were performed by using permutation-based inference (5000 permutations) corrected for multiple comparisons with a threshold-free cluster enhancement (TFCE) and significance level of $P < 0.05$. Corrected TFCE p-maps were computed to enable the identification of differences in the FA areas between patients and healthy control subjects.

Results:

Morphometric analysis: patients with absence epilepsy exhibited reduction of grey matter volume in both thalami, with significant reduction in the left thalamus ($p=0.035$) and not significant reduction in the right thalamus ($p=0.08$). Several regions were found in which typical absence epilepsy patients had thinner cortices compared to controls. Significant reductions in cortical thickness of the precentral gyrus ($p=0.002$) and precuneus ($p=0.001$) of the right hemisphere were observed. Significant reduction of grey matter in the: transverse temporal gyrus ($p=0.028$) of the left hemisphere was observed. We also observed increase of the grey matter within the rostralmiddle frontal gyrus in the left hemisphere ($p=0.027$). TBSS: Patients with absence epilepsy showed a significant reduction in fractional anisotropy in the white matter, underlying the following regions: right frontal lobe ($p<0,05$) and Knee of the corpus callosum ($p<0.05$).

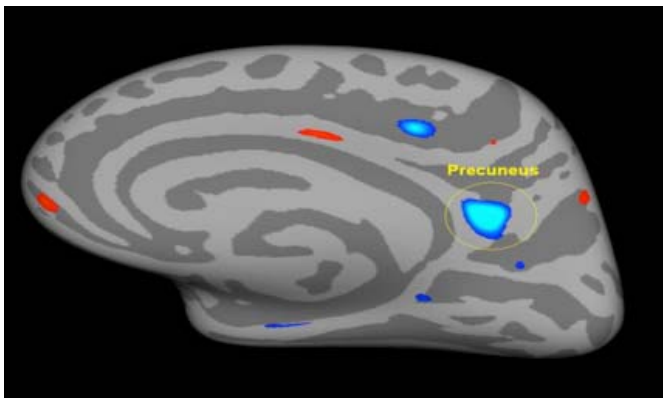


Figure 1: FreeSurfer- in blue the area where a significant reduction of cortical thickness in the patients were observed

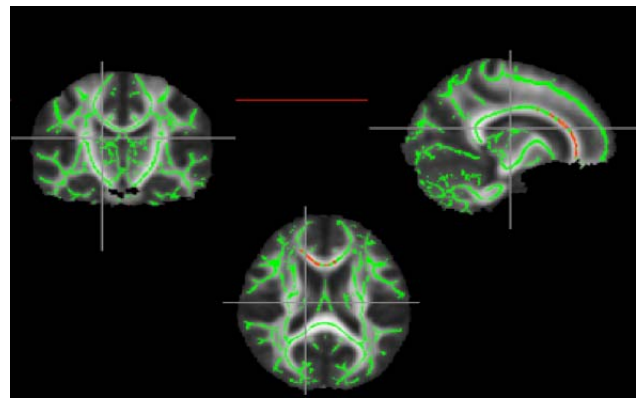


Figure 2: TBSS – the red areas (knee of the corpus callosum) of the skeleton (green) where statistical analysis were done show reduction of FA in patients with

Conclusion:

Abnormalities in the cortical thickness and white matter integrity were demonstrated in patients with absence epilepsy, even when conventional MRI studies were normal. These results corroborate the hypotheses that abnormalities can be demonstrated not only in the subcortical regions, but also in the cortex. The further investigation of these image abnormalities can provide better understanding of the patho-physiology of typical absence epilepsies and thereby changes in treatment strategies.

References:

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