Microstructural network damage in mesial temporal lobe epilepsy

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Introduction

Patients with mesial temporal lobe epilepsy (mTLE) and associated hippocampal sclerosis have a network of brain abnormalities not confined to the medial temporal lobe. Structural MRI studies have revealed volume atrophy in cortical and subcortical regions within and outside the temporal lobe (1). However, neuropathological alterations of the white and grey matter, such as a loss of integrity or connectivity, are likely to be more substantial in patients with mTLE. In the present study, we used diffusion tensor imaging (DTI) and analyses of fractional anisotropy (FA) to investigate the spatial distribution of white and grey matter microstructural abnormalities in patients with unilateral mTLE and to determine whether there are any differences between patients with left and right mTLE.

Methods

We studied 22 patients with clinical evidence of mTLE and radiological evidence of unilateral hippocampal sclerosis (14 left mTLE, 8 right mTLE), and 40 neurologically healthy controls. Interictal EEG, long-term video EEG monitoring, and conventional MRI (T1-weighted, T2-weighted and FLAIR) were performed for all patients in context of pre-surgical evaluation. Diffusion weighted (DW) images were obtained using a 3T MRI scanner (Siemens Trio, Erlangen) with 60 gradient directions (scan parameters: TR 1200 ms, TE 100, 72 axial slices, voxel size 1.7x1.7 mm, matrix size 128x128, b-value 1000 s/mm2). All DTI data were spatially processed using our recently developed toolbox incorporating optimal eddy current correction and multi-contrast image registration (2). Voxel-based statistics (VBS) using SPM8 (data smoothed using 8 mm isotropic Gaussian kernel) was used. Comparisons were made between patients and controls, and results were thresholded corrected for multiple comparisons (unless otherwise indicated).

Results

Patients with left and right mTLE had significantly reduced FA relative to controls in the ipsilateral temporal lobe white matter, frontal lobe, anterior corpus callosum, thalamus and midbrain regions. Using this conservative statistical threshold, patients with left mTLE had more widespread reductions of both hemispheres, but temporal lobe FA was preferentially reduced ipsilateral to hippocampal sclerosis (Figure 1, radiological orientation, p=0.05, cor). Given that there were fewer patients with right mTLE, we relaxed thresholds to uncorrected levels, but patients with right mTLE still exhibited FA alterations preferentially ipsilaterally (Figure 2, radiological orientation, p=0.01, unc). There was no FA increase in patients relative to controls.

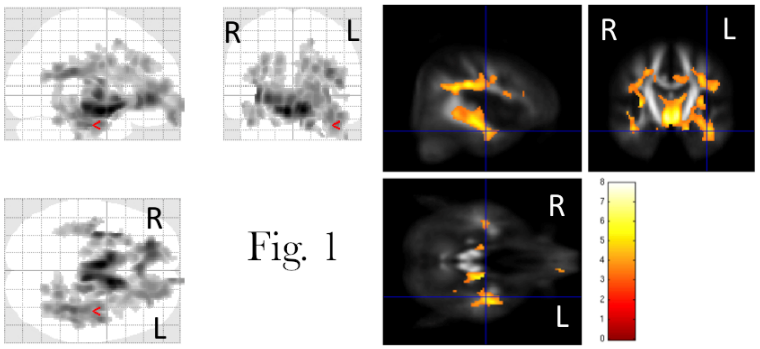

Fig. 1

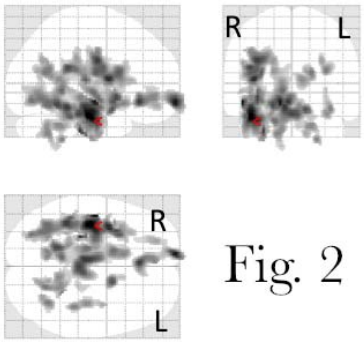

Fig. 2

Discussion

Patients with unilateral mTLE show evidence of widespread reductions of FA, primarily encompassing temporal lobe, frontal lobe, callosal, thalamic and midbrain regions, suggesting a network of microstructural damage. The localised reductions of white matter FA deviate substantially from that of controls, which indicates considerable deterioration of brain integrity in patients with mTLE. Finally, this work suggests that patients with left mTLE may have a more bilateral distribution of brain abnormalities relative to patients with right mTLE, which is consistent with some structural MRI studies (3, 4), but this effect requires further investigation in equal sized samples.

Acknowledgement

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References

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