Spatio-temporal imaging of focal interictal epileptiform activity using EEG-triggered functional MRI

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EEG-triggered, blood oxygen level-dependent functional MRI (BOLD-fMRI) was used in 24 patients with localization-related epilepsy and frequent interictal epileptiform discharges (spikes) to identify those brain areas involved in generating the spikes, and to study the evolution of the BOLD signal change over time. The location of the fMRI activation was compared with the scalp EEG spike focus and the structural MR abnormality. Twelve patients (50%) had an fMRI activation concordant with the EEG focus and structural brain abnormalities where present (n = 7). In 2 other patients, the fMRI activation was non-concordant with electroclinical findings. The remaining 10 patients (41.7%) showed no significant fMRI activation. These patients had significantly lower mean spike amplitudes compared to those with positive fMRI results (p = 0.03). The time course of the BOLD response was studied in 3 patients and this revealed a maximum signal change 1.5 to 7.5 sec after the spike. In conclusion, EEG-triggered fMRI can directly identify the generators of interictal epileptiform activity, with high spatial resolution, in selected patients with frequent spikes. The superior spatial resolution obtainable through EEG-triggered fMRI may provide an additional non-invasive tool in the presurgical evaluation of patients with intractable focal seizures.