Simultaneous EEG-fMRI as a pre-surgical evaluation tool in focal epilepsy: a systematic review

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**Abstract**

Background: an estimated 35% of epileptic patients become refractory to antiepileptic drugs. In such cases, surgical resection of the epileptogenic locus could be considered as an alternative treatment. To precisely demarcate this locus, numerous techniques are currently under investigation including simultaneous scalp electroencephalography and functional magnetic resonance imaging (EEG-fMRI).

Aim: the combination of scalp EEG and fMRI offers the opportunity to identify the epileptogenic locus with high temporal and spatial resolutions. The aim of this systematic review is to assess the validity of this claim.

Methods: A PubMed search of the literature (2010–2015) was performed. The total number of patients for each study was extracted and divided into cohorts according to concordance between the resected area and the preoperatively elicited EEG-fMRI clusters. Comparisons were made for patient and epilepsy characteristics as well as postoperative outcomes. Post-surgical International League Against Epilepsy (ILAE) classes I, II and Engel class I were regarded as good outcomes. Concordance was noted as reported by each study.

Results: 4 studies, involving 83 patients, were included; 3 studies to assess the viability of utilising simultaneous EEG-fMRI as a pre-surgical evaluation tool and the 4th to assess the reproducibility of the technique. Concordance between the resected area and EEG-fMRI clusters was observed in 40/64 patients; 32 (80.0%) patients reported good outcomes. Conversely, discordance was noted in 24/64 patients; 9 (37.5%) patients reported good outcomes. The 4th study exhibited good reproducibility.

Conclusion: the results suggest that identification of the epileptogenic locus based on simultaneous EEG-fMRI of interictal activity is possible using the right methodological approach. In focal epilepsies, it could improve the pre-surgical evaluation and subsequently reduce surgical failures.

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