Surface EEG

Surface EEG can show epileptiform ripples in people with focal epilepsy, but identification is impeded by the low signal-to-noise ratio of the electrode recordings. We used beamformer-based virtual electrodes to improve ripple identification.

van Klink et al. analyzed ten minutes of interictal EEG of nine patients with refractory focal epilepsy. EEGs with more than 60 channels and 20 spikes were included. We computed ~79 virtual electrodes using a scalar beamformer and marked ripples (80-250 Hz) co-occurring with spikes in physical and virtual electrodes. Ripple numbers in physical and virtual electrodes were compared, and sensitivity and specificity of ripples for the region of interest (ROI; based on clinical information) were determined.

Five patients had ripples in the physical electrodes and eight in the virtual electrodes, with more ripples in virtual than in physical electrodes (101 vs. 57, p = .007). Ripples in virtual electrodes predicted the ROI better than physical electrodes (AUC 0.65 vs. 0.56, p = .03).

Beamforming increased ripple visibility in surface EEG. Virtual ripples predicted the ROI better than physical ripples, although sensitivity was still poor.

Beamforming can facilitate ripple identification in EEG. Ripple localization needs to be improved to enable its use for presurgical evaluation in people with epilepsy [1].

Thirty-one patients demonstrated bilateral features defined as: bilateral independent temporal or bitemporal ictal onsets on surface or intracranial EEG, or bitemporal interictal epileptiform abnormalities on surface EEG with bilateral radiographic mesial temporal sclerosis. Surgical outcomes were classified according to reduction in seizure frequency: I (100% reduction), II (≥75% reduction), III (50-74% reduction), IV (<50% reduction).

Of 31 patients, 14 (45%) improved to class I and 9 (29%) had a class II outcome at an average of 4 years after surgery. Eight (26%) patients did not exhibit good surgical outcome (class III, class IV). We found that neuropsychological and Wada memory scores were significantly correlated ($p<0.05$) with surgical outcome, and logistic regression found neuropsychological evaluation significantly predicted better surgical outcome ($p<0.05$).

When bilateral features are present on pre-operative evaluation, neuropsychological and Wada test results can provide unique data to better identify those patients more likely to achieve substantial seizure reduction [2].

1)
van Klink N, Mol A, Ferrier C, Hillebrand A, Huiskamp G, Zijlmans M. Beamforming applied to surface EEG improves ripple visibility. Clin Neurophysiol. 2017 Nov 9;129(1):101-111. doi: 10.1016/j.clinph.2017.10.026. [Epub ahead of print] PubMed PMID: 29172114.
2)
Waseem H, Osborn KE, Schoenberg MR, Kelley V, Bozorg AM, Benbadis SR, Vale FL. Predictors of surgical outcome in medically-resistant temporal lobe epilepsy with bilateral features on pre-operative evaluation. Clin Neurol Neurosurg. 2015 Oct 23;139:199-205. doi: 10.1016/j.clineuro.2015.10.016. [Epub ahead of print] PubMed PMID: 26513433.