Advanced dynamic statistical parametric mapping

Advanced dynamic statistical parametric mapping (AdSPM) with magnetoencephalography (MEG) was used to identify MRI-negative epileptogenic lesions in a report. A 15-year-old girl had MRI-negative and pharmacology-resistant focal-onset epilepsy. She experienced two types of seizures. Type I consisted of her arousal from sleep, staring, and a forced head-turning movement to the left, followed by secondary generalization. Type II began with an aura of dizziness followed by staring and postictal headache with fatigue. Scalp video-electroencephalography (EEG) captured two type I seizures originating from the right frontocentral region. MEG showed scattered dipoles over the right frontal region. AdSPM identified the spike source at the bottom of the right inferior frontal sulcus. Intracranial video-EEG captured one type I seizure, which originated from the depth electrode at the bottom of the sulcus and correlated with the AdSPM spike source. Accordingly, the patient underwent resection of the middle and inferior frontal gyri, including the AdSPM-identified spike source. Histopathological examination revealed that the patient had focal cortical dysplasia type II B. To date, the patient has been seizure free for 2 years while receiving topiramate treatment. This is the first preliminary report to identify MRI-negative epilepsy using AdSPM. Further investigation of AdSPM would be valuable for cases of MRI-negative focal epilepsy [1].

Nakajima et al. analyzed 15 children with diagnosis of FCDB in surgical specimen and 3 T MRI by using MEG. Using AdSPM, they analyzed a ±50 ms epoch relative to each single moving dipole (SMD) and applied summation technique to estimate the source activity. The most active area in AdSPM was defined as the location of AdSPM spike source. We compared spatial congruence between MRI-visible FCDB and (1) dipole cluster in SMD method; and (2) AdSPM spike source.

AdSPM localized FCDB in 12 (80%) of 15 children whereas dipole cluster localized six (40%). AdSPM spike source was concordant within seizure onset zone in nine (82%) of 11 children with intracranial video EEG. Eleven children with resective surgery achieved seizure freedom with follow-up period of 1.9 ± 1.5 years. Ten (91%) of them had an AdSPM spike source in the resection area.

AdSPM can noninvasively and neurophysiologically localize epileptogenic FCDB, whether it overlaps with the dipole cluster or not.

This is the first study to localize epileptogenic FCDB using MEG [2].

1)
Chang WS, Nakajima M, Ochi A, Widjaja E, Rutka JT, Yau I, Baba S, Otsubo H. Detection of epileptogenic focus using advanced dynamic statistical parametric mapping with magnetoencephalography in a patient with MRI-negative focal cortical dysplasia type IIB. J Neurosurg Pediatr. 2019 Oct 11:1-5. doi: 10.3171/2019.7.PEDS1948. [Epub ahead of print] PubMed PMID: 31604322.
2)
Nakajima M, Wong S, Widjaja E, Baba S, Okanishi T, Takada L, Sato Y, Iwata H, Sogabe M, Morooka H, Whitney R, Ueda Y, Ito T, Yagyu K, Ochi A, Carter Snead O 3rd, Rutka JT, Drake JM, Doesburg S, Takeuchi F, Shiraishi H, Otsubo H. Advanced dynamic statistical parametric mapping with MEG in localizing epileptogenicity of the bottom of sulcus dysplasia. Clin Neurophysiol. 2018 Jun;129(6):1182-1191. doi: 10.1016/j.clinph.2018.03.007. Epub 2018 Mar 30. PubMed PMID:

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