Magnetoencephalography (MEG)

MEG measures the magnetic fields produced by neural activity. It provides high temporal resolution and is used to study the timing and location of brain activity.

Functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using very sensitive magnetometers. Arrays of SQUIDs (superconducting quantum interference devices) are currently the most common magnetometer, while the SERF (spin exchange relaxation-free) magnetometer is being investigated for future machines. Applications of MEG include basic research into perceptual and cognitive brain processes, localizing regions affected by pathology before surgical removal, determining the function of various parts of the brain, and neurofeedback. This can be applied in a clinical setting to find locations of abnormalities as well as in an experimental setting to simply measure brain activity.

Indications

Magnetoencephalography indications.

Case series

An observational cohort study was performed and 19 MRI-negative patients who underwent stereoelectroencephalography guided radiofrequency thermocoagulation (SEEG-guided RF-TC) in an epilepsy center. In addition, 16 MRI-positive patients were included as a reference group. Semiology, electrophysiology, and imaging information were collected. To evaluate the value of locating the MEG cluster, the proportion of the RF-TC contacts located in the MEG cluster out of all contacts used to perform RF-TC in each patient was calculated. All patients underwent the standard SEEG-guided RF-TC procedure and were followed up after the treatment.

Nineteen MRI-negative patients were divided into two groups based on the existence of MEG clusters; 10 patients with MEG clusters were in group I and nine patients without any MEG cluster were in group II. No significant difference was observed in terms of age, sex, type of seizures, or a number of SEEG electrodes implanted. The median of the proportion of contacts in the MEG cluster was 77.0 % (IQR 57.7-100.0 %). The follow-up results showed that the probability of being seizure-free at one year after RFTC in MRI-negative patients with a MEG cluster was 30.0 % (95 % CI 11.6-77.3 %), significantly ($p = 0.014$) higher than that in patients without a MEG cluster; there was no significant difference when compared with MRI-positive patients.

This is the first study to evaluate the value of MEG in SEEG-guided RF-TC in MRI-negative epilepsies. MEG is a useful supplement for patients with MRI-negative epilepsy. MEG can be applied in minimally invasive treatment. MEG clusters can help identify better candidates and provide a valuable target for SEEG-guided RF-TC, which leads to better outcomes. [1)].

1)

Gao R, Yu T, Xu C, Zhang X, Yan X, Ni D, Zhang X, Ma K, Qiao L, Zhu J, Wang X, Ren Z, Zhang X, Zhang

G, Li Y. The value of magnetoencephalography for stereo-EEG-guided radiofrequency thermocoagulation in MRI-negative epilepsy. Epilepsy Res. 2020 Mar 20;163:106322. doi: 10.1016/j.eplepsyres.2020.106322. [Epub ahead of print] PubMed PMID: 32278277.