Evaluation of magnetic spontaneous brain activity using magnetoencephalography frequency topography

Akira Hashizume, Kaoru Kurisu, Kazunori Arita, Ryosuke Hanaya

Department of Neurosurgery, Graduate School of Biomedical Sciences, Hiroshima University, Hiroshima, Japan

Magnetoencephalography (MEG) is one of the useful non-invasive tools for detection of epileptic foci. Most MEG users tend to evaluate only the electric equivalent current dipoles (ECDs), which mean no more than the center of electric activity. During ECDs estimation with high reliability, numerous spatial data of MEG are discarded. The information of ECDs doesn't include the spatial range of the epileptic activity. Therefore, we developed MEG frequency topography to clarify the spatial range of epileptic activity. Our magnetometer is Neuromag SystemTM (Neuromag Ltd, Finland). Fortunately the magnetometer has planer gradiometers whose gradiometers have the property that the maximum magnetic flux is detected just above the electric source. Obtained raw data of spontaneous magnetic brain activities are processed through fast Fourier transformation using the signal processor GraphTM, and interpolated to make topography. The MEG frequency topography could reveal the dynamic changes of the brain activities. The MEG frequency topography shows low activities to high activities as the latent epileptic discharges appear and spreads over the brain, while it shows high activities to low activities as epileptic discharges disappear. In MEG frequency topography of six patients suffering from epilepsy, 4-8 Hz band activity tends to precede epileptic discharges. As compared to the conventional electroencephalography frequency topography, MEG frequency topography has a great advantage in respect of the spatial resolution, this may attribute to invalidation of electric volume conductivity.

Detection of a small hippocampal lesion by 3 tesla MRI in a patient with 1.5 tesla MRI-negative temporal lobe epilepsy

Tamami Yano¹, Makoto Sasaki ², Yukio Sawaishi ¹, Aya Hirayama¹, Jinzo Akabane ³, Goro Takada ¹

¹Department of Pediatrics, Akita University School of Medicine, Japan ²Department of Radiology, Iwate University School of Medicine, Japan ³Department of Pediatrics, Nakadori General Hospital, Japan

Purpose: We have investigated whether 3 tesla (T) MRI can reveal a small lesion in the hippocampus responsible for complex partial seizure (CPS), which cannot be found by 1.5 T MRI. Case report: A female patient with a history of normal delivery and development had an onset of CPS at 3 years of age. Interictal EEG showed right mid-temporal spikes both in sleep and awake. Despite treatments with some anticonvulsants, she suffered from frequent episodes of CPS and was referred to our hospital at age 4. Ictal video-EEG monitoring showed the seizure originating at the right temporal region and interictal SPECT demonstrated hypoperfusion over the right temporal lobe. However, 1.5 T MRI showed no abnormality in the suspected right temporal lobe. Thus, 3 T MRI was performed and demonstrated a small T2-high lesion in the right hippocampus possibly responsible for the seizures. The recurrent CPSs were finally controlled by the combined administration of valproic acid, zonisamide, and nitrazepam. Discussion: Reviewing English literature, this is possibly the first report to show a clinical application of 3 T MRI for detecting a 1.5-tesla negative small lesion in the hippocampus. Because approximately 20% of patients with temporal lobe epilepsy have been estimated to remain MRI negative after extensive qualitative and quantitative investigation, 3-tesla MRI may pave the way for definite neuroimaging assessments of such patients.