The elucidation of the propagation of epileptic activity between bilateral hemispheres analyzed by synthetic aperture magnetometry (SAM)

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Introduction: The propagation of epileptic activity to the contralateral hemisphere takes great part in complex partial seizure. So, we aimed to detect the propagation from the magnetoencephalography (MEG) with a spatial filter. Synthetic aperture magnetometry virtual sensor (SAM-VS) analysis: This spatial filter, called SAM, is based on the Frost's adaptive beamformer theory for signal analysis. SAM-VS analysis expresses the statistically epileptogenic area in the brain spatially and the electrical activity as the currentdendisitography of each sensor temporally.

Subjects and Methods: We analyzed the representative raw MEG data including strong epileptic activity of two cases; right medial temporal lobe epilepsy (MTLE) and right frontal lobe epilepsy (FLE). SAM-VSs were set at 0.5cm interval in the brain. We searched for the epileptic activity detected on the virtual sensor of affected side initially and detected on the contralateral side succeedingly. Then, we measured electrical conduction time.

Results: We succeeded in detecting the propagating epileptic activity in both cases. In case of MTLE, 14 propagations were detected. The sensor set at the right hippocampal region showed initial epileptic activity in all spikes. The conduction time (CT) between the bilateral hippocampi ranged from 0 msec to 24 msec. The average time delay was 8.9 msec. In case of FLE, five propagations were detected. The range of CT was 7.2-60msec and the average was 32 msec.

Conclusion: SAM-VS analysis enables to detect the epileptic propagation and will provide the electrical evidence leading to the elucidation of CPS.

Antiepileptic effect of unilateral suppression of the subthalamic nucleus for focal neocortical seizures

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It has been reported that chemical or electrical suppression of bilateral subthalamic nucleus (STN) inhibit epileptic seizures in animals, but the unilateral procedures are not effective. We examined antiepileptic effect of unilateral STN suppression in focal neocortical seizures.

Wistar male rats were implanted bipolar electrodes for electrical stimulation in bilateral STN or a cannula for muscimol infusion in the left STN. All animals implanted another cannula into the left motor cortex. Seven days later, 2.0 mg/ML of kainic acid was injected into the left motor cortex to induce focal motor seizures, and EEG was recorded from bilateral motor cortices. During seizure status, electrical stimulation of unilateral (left) or bilateral STN was performed intermittently in seven animals. The stimulation parameters were; frequency was 130Hz, pulse width was 0.1 ms, intensity was 60-70 % of motor-symptom threshold. In other three animals, 200 ng/ML of muscimol was infused in left STN. Seizure frequency was compared between in stimulation and resting periods, pre- and post-infusion of muscimol.

Some animals were removed from this study when the electrode or cannula was located incorrectly in STN histopathologically. Not only bilateral but also unilateral stimulation of STN inhibited focal seizures. Unilateral infusion of muscimol also immediately suppressed seizures, but transient abnormal behavior was observed.

If suppression of STN inhibits seizures, the unilateral procedure must inhibit ipsilateral neocortical seizures because the neuronal circuit from STN affects the ipsilateral motor function. The results indicated that both electrical and chemical suppression of unilateral STN inhibited focal neocortical seizures.