Feasibility of Magnetoencephalography Following Endovascular Treatment for Aneurysm Rupture

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Introduction

Aneurysmal subarachnoid hemorrhage (aSAH) still carries very high morbidity despite advances in care. Even amongst patients with good outcomes, memory, language, and executive function impairments are common complaints. No objective imaging marker for diagnosis and monitoring of neurocognitive complaints is available for these patients. We explored the use of magnetoencephalography (MEG) – a neurophysiological functional imaging technique - in aSAH patients following endovascular aneurysm coiling.

Methods

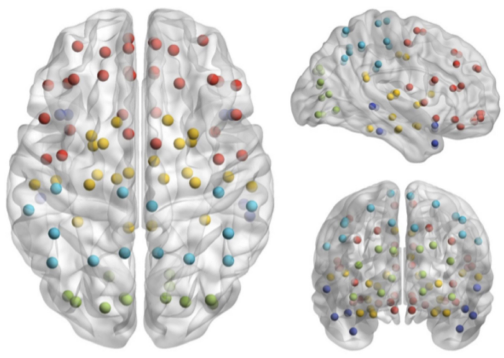
Enrollment was limited to patients with coiled ruptured aneurysms, good outcome (GOS 4 or 5) and no ischemic lesions on MRI, and matched healthy controls. Resting-state MEG data and anatomical MRI were acquired. A multi-sphere head model was constructed for each individual's brain and normalized to MNI space using SPM2. Cortical and sub-cortical voxels of interest were identified, and time series (virtual electrodes) were reconstructed using a vector beamformer. Seed locations were chosen and spectral power density estimated for each location and averaged across the brain to derive

Results

Thirteen aSAH patients and 13 controls completed MEG evaluation. Time from aSAH to testing was 18.8 months. Average test time was 80 minutes. Mean age was 57 years; the majority of aneurysms were midline (62%).

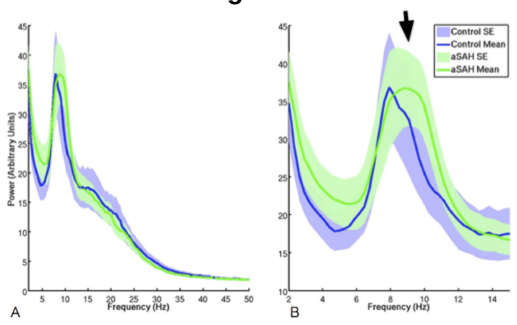
Mean signal power was similar across groups, with no significant spectral alterations among aSAH patients. Virtual-sensor data closest to the coil in aSAH patients showed comparable signal on matched locations in control participants, i.e. no artifact from the coils.

Figure 1



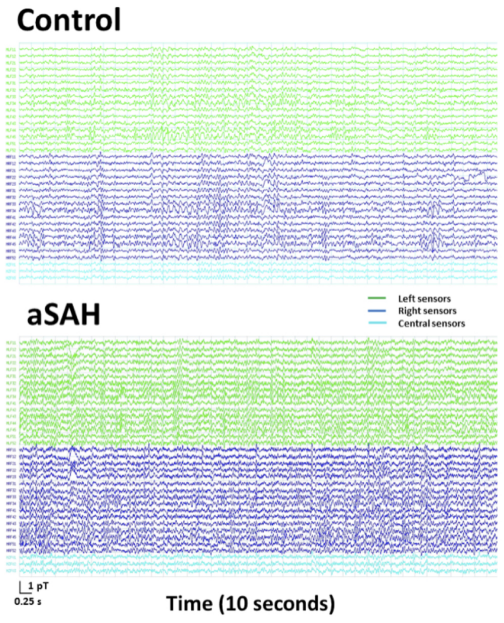
Seed locations identified by Automated Anatomical Labeling.

Figure 3.



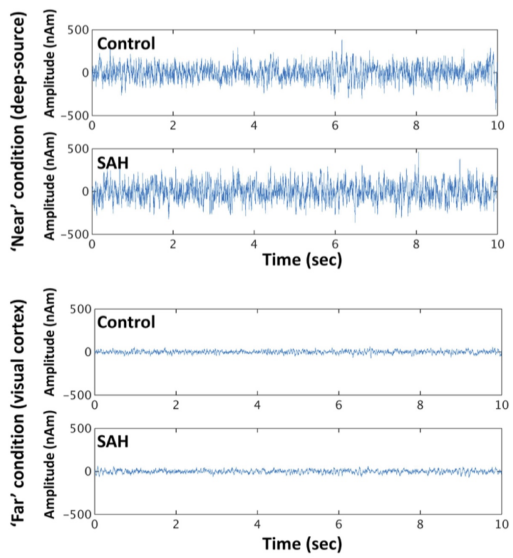
Mean and SD of MEG signal power for controls and aSAH over time (A). Note that despite the delay in activation (arrow, B) at 10Hz of frequency (alpha band) there is no detectable difference in signal strength between the groups.

Figure 2.



MEG signal recording for 10 seconds of resting state on frontal sensors, 1-150 Hz, 3rd order gradiometer, powerline notch filter in aSAH patient and healthy control.

Figure 4.



Exemplary time series from reconstructed sources in the 'near' condition, and 'far' condition, for control and SAH subjects.

Conclusions

We show the technical feasibility of MEG assessment after coiling of ruptured aneurysms. The presence of coils do not alter MEG signal quality or strength, and therefore the optimal temporal and spatial resolution of MEG holds potential for investigating the neurophysiological basis of neuro-behavioural deficits after intracranial aneurysm rupture.

Learning Objectives

Participants should be able to: 1) understand the nature of cognitive sequelae after aSAH, and 2) appreciate how robust and reliable MEG recordings are feasible in an aSAH population despite endovascular coil placement