Retrospective Review of 733 Clinical MEG Studies

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Objective: A retrospective review of MEG test results from patients undergoing auditory, motor, somatosensory, visual, language, and epileptic testing to determine the utility of MEG.

Introduction

Outcomes studies are necessary to determine the value of specific clinical diagnostic tests or procedures. There are a variety of methods for localizing functional brain activity. The non-invasive methods such as MEG, EEG, fMRI and PET can be compared to each other by looking at the value of the information obtained from retrospective or outcome studies. These functional imaging methods should be useful in a multitude of different applications, so that various cortical regions (e.g. auditory evoked responses) can be identified and sufficiently specific to provide a good location within the brain for presurgical evaluation.

Methods

733 MEG scans on 525 patients (Male: 1-83 years, Female: 2-72 years) between January 1999 and January 2006 were recorded by 148-channel neuromagnetometer.

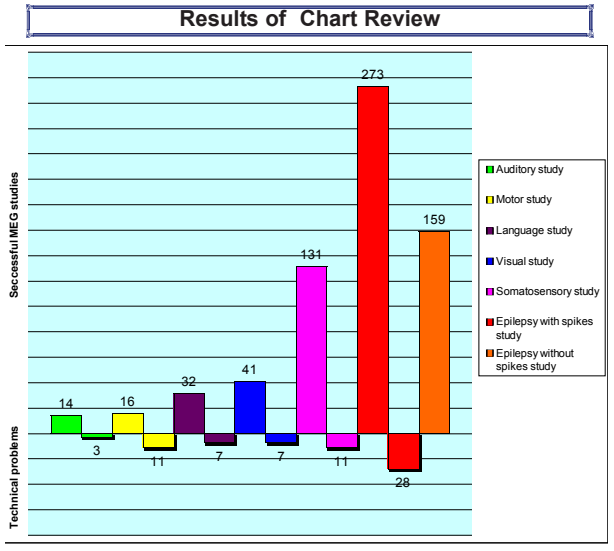
- Auditory cortices were mapped using 1000 Hz tone bursts with durations of 250 ms presented 150 times.
- Motor cortices were mapped by having subjects use their index fingers to press a button on a response pad upon a command 100 times.

Somatosensory cortices were mapped by applying 512 pressure pulses to index or middle fingers using a bladder inflated for 30 ms.

- Visual cortices were mapped using black and white checkerboard patterns reversing at 1 Hz, 200 reversal patterns were averaged together.

Averaged waveforms for Auditory, Motor, Somatosensory and Visual data were bandpass filtered 1-50 Hz with a notch at 60Hz and visually inspected for the peaks on interest (100ms peak for auditory, visual; 40ms peak for somotosensory; the 40 ms peak for motor).

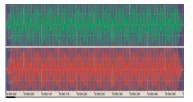
- Epilepsy studies consisted of three consecutive ten minute intervals of continuous acquisitions. Waveforms were bandpass filtered 1-100 Hz with a notch at 60Hz and visually inspected for interictal epileptic activity. Single ECD fits were performed using 38 channels to localize underlying sources for the peaks or the interictal spikes of interest [1].
- Language studies were performed using Picture Naming and Verb Generation. Approximately 80-100 epochs were averaged together. MEG data were analyzed by MR-FOCUSS [2,3], a current density imaging technique. This technique transforms random initial amplitudes of a 3000 point cortical structure, derived from the individuals MRI cortical gray matter, into a source structure corresponding to the magnetic field data utilizing an iterative algorithm. For robustness 20 solutions are used to create the final images.



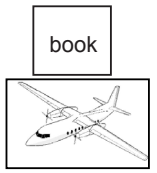
Audio presentation

Visual presentation

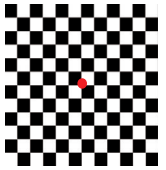
Somatosensory Stimulus



Auditory Stimulus



Language Stimuli



Visual Stimulus

Results

- Of 17 auditory studies 14 (82%) had localized responses. Two were unreadable due to artifact.
- Of 27 motor studies, 16 (59%) showed localized responses. The remaining 11 could not be read due to artifact.
- Of 142 somatosensory studies, 131 (92%) showed localized responses. The remaining 11 could not be used due to artifact.
- Of 48 visual studies, 41(85%) had localized responses; one did not have a response and 6 were unreadable due to artifact.
- Of the 39 language studies, 32 (82%) had localized responses. The remaining 7 could not be used due to artifact.
- Of 460 epileptic studies, 273 showed localized abnormal activity, 159 had no epileptic spikes, 28 could not be used due to magnetic noise or some type of artifact in the data. This indicates a 63% (273/432) success rate for detecting interictal spikes from clean data.

Conclusion:

These results show MEG is a useful technique for localizing normal and abnormal cortical activity.

References

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3. Moran JE. MR-FOCUSS. MEG_Tools user manual. Available for download from: http://www.megimaging.com

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