CURRENT LITERATURE

UTILITY OF MEG IN PRESURGICAL LOCALIZATION

Does Magnetoencephalography Add to Scalp Video-EEG as a Diagnostic Tool in Epilepsy Surgery?

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OBJECTIVE: The authors evaluated the sensitivity and selectivity of interictal magnetoencephalography (MEG) versus prolonged ictal and interictal scalp video-electroencephalography (V-EEG) to identify patient groups that would benefit from preoperative MEG testing.

METHODS: The authors evaluated 113 consecutive patients with medically refractory epilepsy who underwent surgery. The epileptogenic region predicted by interictal and ictal V-EEG and MEG was defined in relation to the resected area as perfectly overlapping with the resected area, partially overlapping, or nonoverlapping.

RESULTS: The sensitivity of a 30-min interictal MEG study for detecting clinically significant epileptiform activity was 79.2%. With MEG, we were able to localize the resected region in a greater proportion of patients (72.3%) than with noninvasive V-EEG (40%). MEG contributed to the localization of the resected region in 58.8% of the patients with a nonlocalizing V-EEG study and 72.8% of the patients for whom V-EEG only partially identified the resected zone. Overall, MEG and V-EEG results were equivalent in 32.3% of the cases, and additional localization information was obtained by using MEG in 40% of the patients.

CONCLUSIONS: MEG is most useful for presurgical planning in patients who have either partially or nonlocalizing V-EEG results.

COMMENTARY

Resective surgical treatment of pharmacoresistant epilepsy is predicated on the ability to identify accurately the area of the brain responsible for the generation of seizures. The art and science of presurgical localization of the epileptogenic region has evolved considerably over the past several decades. One of the most profound changes has been the development of various techniques that allow identification of the seizure focus with less invasiveness than previously had been required.

Magnetoencephalography (MEG)—the recording of the miniscule magnet fields generated by the electrical activity of the brain—can detect and localize epileptiform disturbances of cerebral activity with excellent temporal and spatial resolution. By using an MRI scan coregistered to the patient's head during MEG acquisition, the MEG dipole sources can be displayed in three-dimensional space on the MRI images of the brain. Although its use is somewhat limited by the requirement for specialized equipment and facilities and although it most commonly only provides localizing information pertaining to interictal activity, MEG has been used by some centers in the evaluation of epilepsy patients for surgery. The value of this technique in presurgical localization and the circumstances in which MEG is most useful have not been fully defined. The goal of the present report by Pataraia et al. was to do just that.

The present study seeks to determine the value of MEG, as a localizing tool, in patients being evaluated for surgical treatment. The authors prospectively included a 30-min interictal MEG study in the presurgical evaluation of 113 consecutive patients who also underwent video-EEG monitoring and then, ultimately, surgical resection. MEG findings, however, were not used in the clinical decision making. The strategy for surgical resection was arrived at by consensus, which was based on consideration of ictal recordings (mostly surface but also including invasive recordings in some patients), interictal EEG abnormalities, imaging findings, and the other typical factors weighed in the presurgical planning process. The investigators then compared the suggested localization of the epileptogenic zone by MEG and EEG with the extent of brain actually included in the surgical resection.

Complete data sets, available for 82 patients, showed that during the 30-min session, MEG detected at least five epileptiform spikes in about 80% of the subjects. In those patients with MEG findings, MEG localization demonstrated perfect overlap in 72% of the patients, partial overlap in 18%, and no overlap in 9%, compared with the brain region eventually resected. MEG corroborated localization in 48% and provided additional localizing information in 40% of patients, compared

with the localization provided by noninvasive EEG. MEG information by itself would have been misleading in 12% of cases. For 73% of patients with inconsistently or partially localizing EEG and for 59% of subjects with nonlocalizing EEG, MEG provided helpful localizing information. The authors conclude that MEG is, therefore, particularly useful for patients in these categories.

There is a deficiency in the present study. Because only about half of the patients were rendered completely seizure free at the 1-year postoperative follow-up, presumably the remaining half had insufficient surgical resection. Thus for the patients who did not derive the best outcome, using the volume of brain area resected as the benchmark by which MEG and EEG were judged is problematic. Although the extent of resection arising from best clinical consensus is certainly practical and reasonable, it does not represent a "gold standard" criterion with which to make comparisons and draw final conclusions for those in whom resection did not abolish seizures.

Caution must be exercised in viewing MEG information in isolation, as the information provided by MEG is almost always interictal in its occurrence, and its correlation with the epileptogenic zone can be imperfect. Another role for MEG, not specifically addressed in the present study, is in identifying the location of probable epileptogenic foci within and adjacent to structural brain lesions—invaluable in guiding the boundaries of surgical resection.

The availability of structural and functional imaging modalities, coupled with enhancements in digital EEG recording techniques, often allows noninvasive localization of the epileptogenic region. MEG is yet another noninvasive tool that, when used in conjunction with other elements of the presurgical evaluation, can allow clinicians increased confidence in establishing an accurate localization and may reduce the need for invasive intracranial monitoring.

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