American Clinical Magnetoencephalography Society Clinical Practice Guideline 3: MEG–EEG Reporting*

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This guideline should be considered in the context of other American Clinical Magnetoencephalography Society (ACMEGS) guidelines that are conceptually similar to the sets of guidelines defined by the American Clinical Neurophysiology Society (http://www.acns.org/) for EEG.

MEG–EEG REPORTING

MEG–EEG reporting guidelines are not meant to represent rigid rules but general recommendations for reporting MEG–EEG results. They are intended for standard MEG–EEG recordings rather than for special procedures. When reporting on more specialized types of records, description of technical details should be more complete than in the case of standard recordings.

The MEG–EEG report should consist of the following principal parts: (1) patient identification information and clinical history; (2) MEG–EEG acquisition; (3) methods of analysis; (4) description of significant MEG and EEG findings; and (5) interpretation of findings, including impression regarding its normality or degree of abnormality and conservative correlation of the MEG–EEG findings with the clinical picture.

Patient Identification Information and Clinical History

This introductory segment of the report includes pertinent patient information and sufficient details from clinical history to clarify referral question(s) so that the clinical magnetoencephalographer can provide an optimally useful interpretation of the data. This segment of the report may be generated by an appropriately trained technologist or other ancillary personnel.

MEG–EEG Acquisition

Details regarding the technical aspects of the recording and patient preparation should be described in this section of the report. These should include type of MEG system, number of channels, types of sensors, and number and duration of individual data collection runs. Specifics of EEG electrode placement, medications used in conjunction with the study, and problems with acquisition should be included.

Additional specifics related to the acquisition of magnetic evoked fields (specifications of stimuli and their presentation, stimulation sites where appropriate, number of averages, and number of replications) should be described if used.

An institution-specific template may be used if recording techniques are standardized.

Methods of Analysis of Spontaneous Activity and Magnetic Evoked Fields

All methods used in the analysis of spontaneous MEG–EEG and of magnetic evoked fields should be clearly stated in this part of the report. Currently accepted methods of analysis of spontaneous MEG–EEG activity are detailed in ACMEGS Guideline 1, 2011, "Recording and Analysis of Spontaneous Cerebral Activity" (Bagić, Knowlton, Rose, and Ebersole, 2011), and accepted methods for evoked magnetic field analysis can be found in ACMEGS Guideline 2, 2011, "Presurgical Functional Brain Mapping Using Magnetic Evoked Fields" (Burgess et al, 2011).

Description of Significant MEG and EEG Findings

This section of the report should include a separate description of all noteworthy features of the MEG and EEG, as well as comments regarding the spatiotemporal relationship between the two. Both normal and abnormal findings from a visual examination of spontaneous activity should be described in an objective way and without judgment about their significance.

Subsequently, the results of MEG spike and/or seizure source analysis should be presented clearly and concisely, as described in ACMEGS Guideline 1, 2011. The source estimate "goodness of fit" should be described in general terms, if not quantitatively. If simultaneous EEG source analysis is performed, these findings should be similarly described and the relationship between MEG and EEG source models should be discussed. At a minimum, the correlation between MEG source analysis and EEG visual inspection should be provided.

In a similar fashion, a description of averaged magnetic evoked field data, their reliability/reproducibility, and source modeling results should be provided, if these tests are performed.

*Revisions of the document authored by the task force were made and the final version was approved unanimously by the ACMEGS Board (Anto I. Bagić, Gregory L. Barkley, Richard C. Burgess, Michael E. Funke, Robert C. Knowlton, Jeffrey D. Lewine) on December 18, 2010.

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Interpretation of MEG–EEG Findings

This part of the report is most frequently read by the referring physicians, who may have a less technical background. Accordingly, it should be phrased using clear and commonly understandable terms.

Impression Regarding Normality or Degree of Abnormality

The report should state clearly if the recording was normal or abnormal, and if the latter, the specific reasons for it is being considered abnormal. Usually, a report of a normal recording does not require further clarification.

Correlation of the MEG–EEG Findings With the Clinical Picture

The clinical correlation should be an attempt to explain how the MEG–EEG findings relate to the total clinical picture and to what degree these findings answer the referral questions. This explanation should be relayed in terms familiar to the referring physician.

For a spontaneous MEG study done as a presurgical evaluation, the use of the phrase, "clinical correlation necessary" is considered insufficient. Additional, clinically relevant information must be provided because source localizations may guide intracranial electrode placement. Interictal discharges, and when available ictal rhythms, should be described as focal, multifocal, or generalized at a minimum. Source lateralization and localization, in terms of lobar or sublobar area, should be summarized. Any propagation of interictal or ictal activity should also be described. In addition, this part of the report should state whether the MEG–EEG source localization is consistent with the presumed focus based on previous EEG findings and the patient's seizure semiology. If disparate, plausible reason(s) for the difference should be provided. Furthermore, the anatomic relationship of MEG–EEG source estimates to any MRI lesion should be described.

Similarly, for an evoked magnetic field study done as part of a presurgical evaluation, the use of the phrase, "clinical correlation necessary" is considered insufficient. MEG–EEG localizations of eloquent cortex may also influence intracranial electrode placement, and the proximity of eloquent cortex to the presumed epileptogenic focus may influence the decision of whether to proceed with further surgical evaluation or surgery. It is important to indicate any deviation from the expected physiologic location of eloquent cortex and to describe the anatomic relationship of source estimates to any MRI lesion.

For presurgical evaluations of either spontaneous MEG–EEG or evoked fields, it may be reasonable to include specific recommendations for the referring physician, if clearly supported by the data and the clinical history available to the clinical magnetoencephalographer.

CONCLUDING REMARKS

At minimum, the referring physicians should receive MEG results in the form of magnetic source images that contain dipole source localizations coregistered with the patient's brain MRI, in addition to the described narrative.

It is strongly recommended that examples of raw MEG–EEG traces and topographic field maps depicting the reported abnormalities be included. This includes both spontaneous and averaged evoked MEG–EEG data. The use of a specific symbol for each mapped modality on magnetic source images is necessary if more than one is depicted on the same image.

Because an MEG–EEG clinical report is used to guide clinical care and particularly presurgical epilepsy planning, the official report must be reviewed and signed by a clinical magnetoencephalographer (ACMEGS Guideline 4, 2011, "Qualifications of MEG-EEG Personnel" [Bagić, Barkley, Rose, and Ebersole, 2011]) to ensure clinical appropriateness and relevance in the clinical care setting.

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