AAN Summary of Practice Guideline for **Clinicians**

Practice Guideline: Use of fMRI in the Presurgical Evaluation of Patients with Epilepsy

This is a summary of the American Academy of Neurology (AAN) guideline, "Use of fMRI in the presurgical evaluation of patients with epilepsy," which was published in *Neurology*® online on January 11, 2017, and appears in the January 24, 2017, print issue.

Please refer to the full guideline at AAN.com/guidelines for more information, including the complete clinical context and definitions of the classifications of evidence and recommendations.

Is fMRI comparable with the current standard intracarotid amobarbital procedure (IAP) for measuring language lateralization?

Weak Evidence	The use of fMRI may be considered an option in lateralizing language functions in place of IAP in patients with medial temporal lobe epilepsy (MTLE) (**Level C**), temporal epilepsy in general (**Level C**), or extratemporal epilepsy (**Level C**), although patients should be carefully advised of the risks and benefits of fMRI vs IAP during discussions of modality choice in each individual case.
Insufficient Evidence	The evidence is unclear for patients with temporal neocortical epilepsy or temporal tumors (**Level U**).

Can fMRI predict postsurgical language outcomes in patients with epilepsy undergoing brain surgery?

Weak Evidence	The use of fMRI may be considered an option for predicting postsurgical language outcomes after anterior temporal lobe (ATL) resection for the control of temporal lobe epilepsy (TLE) (**Level C**).

Is fMRI comparable with the current standard (IAP) for measuring memory lateralization?

Weak Evidence	The use of fMRI may be considered as an option to lateralize memory functions in place of IAP in patients with MTLE (**Level C**).

Can fMRI predict postsurgical verbal memory outcomes in patients with epilepsy undergoing temporal lobectomy?

Moderate Evidence	Presurgical fMRI of verbal memory or of language encoding should be considered as an option to predict verbal memory outcome in patients with epilepsy who are undergoing evaluation for left medial temporal lobe (MTL) surgery (**Level B**).

Can fMRI predict postsurgical nonverbal (visuospatial) memory outcomes in patients with epilepsy undergoing temporal lobectomy?

Weak Evidence	Presurgical fMRI using nonverbal memory encoding may be considered as a means to predict visuospatial memory outcomes in patients with epilepsy who are undergoing evaluation for temporal lobe surgery (**Level C**).

Is there sufficient evidence in terms of diagnostic accuracy and outcome prediction for fMRI to replace the IAP (Wada test) in presurgical evaluation for epilepsy surgery?

Language	
Weak Evidence	Presurgical fMRI may be used instead of the IAP for language lateralization in patients with epilepsy who are undergoing evaluation for brain surgery (**Level C**). However, when fMRI is used for this purpose, task design, data analysis methods, and epilepsy type (temporal vs. extratemporal, lesional vs. nonlesional) need to be considered. Of particular importance for patients with lesional epilepsy is the fact that only small numbers of participants with variable lesion size/location were included in the previously discussed studies.
Memory	
Weak Evidence	fMRI of language and verbal memory lateralization may be an alternative to IAP memory testing for prediction of verbal memory outcome in MTLE (**Level C**). FMRI is not yet established as an alternative to the IAP for prediction of global amnesia in patients who have undergone ATL surgery.

Clinical Context

Several Class I–III studies provide support for fMRI use for language mapping, although several reservations are warranted. Much of the evidence was derived from relatively small patient samples with heterogeneous characteristics. Some studies were underpowered or susceptible to random variation. Few studies have examined the ability of fMRI to predict language outcomes. Multicenter studies are missing, and there are no data about generalizability across centers.

The available evidence leaves many critical matters unresolved. The imperfect concordance between fMRI and IAP language lateralization leaves open the question of which test is more accurate in discordant cases. Although the IAP has been considered a reference standard, it is susceptible to a number of limitations resulting from individual variation in arterial anatomy (i.e., circle of Willis), variable effects of anesthesia, rate of amobarbital or methohexital injection, variation in patient cooperation, and variation in testing methods. Evidence concerning the relative accuracy of IAP and fMRI in predicting language outcomes is limited to a single study.[e10] Another important clinical question is the extent to which the published results apply to children and adolescents, patients with varying seizure focus location or lesion types, and patients with different levels of cognitive performance or ability to cooperate with the procedure. The vast majority of the available data are from adults with TLE and minimal structural lesions. A few studies suggest less reliable results in patients with extratemporal foci and larger lesions. Several studies included adolescents and children as young as six years. Although results appear similar to those in adults, there are no Class I or II studies that solely address fMRI in comparison with IAP or outcomes in the younger age ranges. The reviewed studies varied across a number of methodologic features, including the strength of the magnetic field used, expertise in the techniques used for analysis of the raw data, thresholding method (if any), region of interest (ROI) examined, and lateralization method. The extent to which these variables affect data quality and validity is currently unknown.

The present recommendations assume that published standards are followed for conducting clinical fMRI studies. As with the IAP, cognitive fMRI is a complex diagnostic procedure that requires both advanced technical expertise in imaging and expert interaction with patients to elicit adequate levels of task performance, select a set of activation tasks appropriate to the patient's ability and the clinical aims of the study, instruct the patient on the tasks, administer the tasks during scanning, and evaluate and provide corrective feedback on task performance during the scanning session.[e11] Compliance with the activation tasks is a prerequisite for eliciting the modulation of brain activity on which fMRI depends. Clinicians need to have a thorough understanding of the cognitive processes (language and nonlanguage) elicited by the tasks and be mindful of the advantages and disadvantages of particular language and baseline or contrast tasks.

This guideline was endorsed by the American College of Radiology and the American Epilepsy Society.

References

e10. Janecek JK, Swanson SJ, Sabsevitz DS, et al. Naming outcome prediction in patients with discordant Wada and fMRI language lateralization. Epilepsy Behav 2013;27:399–403.

e11. Hart J, Jr., Rao SM, Nuwer M. Clinical functional magnetic resonance imaging. Cogn Behav Neurol 2007;20:141–144.

American Academy of Neurology, 201 Chicago Avenue, Minneapolis, MN 55415
Copies of this summary and additional companion tools are available at *AAN.com* or through AAN Member Services at (800) 879-1960.