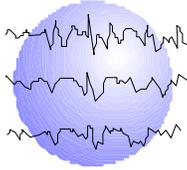


MSI ACTIVATION OF THE MESIAL TEMPORAL LOBE: RELATIONSHIP TO IAP MEMORY PERFORMANCE

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REVISED ABSTRACT

RATIONALE: Magnetic Source Imaging is now an accepted noninvasive method of identifying hemispheric language dominance in patients undergoing surgical resection for epilepsy or brain tumor. While a reliable paradigm for localization of memory function has not yet been described, more than 75% of clinical cases may demonstrate some mesial temporal activation during language testing with a word recognition paradigm. The current study reports a possible relationship between specific MSI activity sites in the hippocampus or amygdala during an auditory word recognition task, and recognition memory performance on the intracarotid amobarbital procedure (IAP).

METHODS: The subjects were 31 candidates for resective surgery to treat epilepsy or brain tumor. All patients had undergone the IAP and were classified with left language dominance (n=24) or bilateral language with greater involvement of the left hemisphere (n=7). IAP memory was assessed with a maximum of 16 items and only items presented prior to first motor return were included in the analysis. A passing score was defined as correct recognition of at least 60% of items following full recovery from the drug. An IAP memory asymmetry index was calculated for each patient. The MEG unit consisted of a 148-channel Magnes 2500 WH system (4-D Neuroimaging, San Diego, CA) housed in a magnetically shielded room. Single equivalent current dipole (ECD) model across each whole hemisphere was used in the analysis. MSI language mapping was performed with an auditory word recognition task which has been shown to reliably activate temporal lobe language specific cortex. Activation of the mesial temporal (MT) region was rated as present or absent for each hemisphere based on activity sites specifically within the hippocampus or amygdala and a MT asymmetry index was calculated based on the total number of MT dipoles in each hemisphere. MT activation in relation to IAP memory performance in each hemisphere was compared using a Pearson correlation coefficient and t-tests for independent samples.

RESULTS: The presence of MT activation was noted in 74% of the total sample with 18 patients showing MT activation in the left hemisphere and 12 patients showing activation in the right hemisphere. Seven patients showed bilateral MT activation. Sixty-eight percent of patients passed the IAP memory test with the left hemisphere, while 48% passed with the right hemisphere. Twelve patients (31%) passed the memory test with both hemispheres. There was a significant correlation between the IAP memory asymmetry and MT asymmetry index scores ($p < .05$). T-tests comparing IAP memory scores in patients with relatively more vs. fewer MT dipoles in a given hemisphere were in the expected direction, but did not reach statistical significance with the current n.

CONCLUSION: MSI activation of the mesial temporal lobe in response to an auditory recognition task appears to be related to IAP memory performance, with a trend toward higher IAP memory scores when more MT dipoles are present. The potential clinical utility of this finding for surgical decision-making, including prediction of post operative memory outcome deserves further investigation.

INTRODUCTION:

Magnetoencephalography/Magnetic Source Imaging is now a widely recognized noninvasive clinical technique for establishing hemispheric language dominance in patients undergoing surgical resection for epilepsy or brain tumor. Several language paradigms have been described with highly reliable outcomes reported using an auditory word recognition task for identification of receptive language cortex (1) in the temporal lobe. While a reliable paradigm for localization of memory function has not yet been reported, we have observed that about 75% of our clinical cases demonstrate some mesial temporal activation during language testing using this task. The purpose of the present study was to investigate the relationship between this mesial temporal activation on MSI and unilateral memory performance during the intracarotid amobarbital procedure (IAP).

METHODS:

The subjects were 31 patients who were candidates for resective surgery at Minnesota Epilepsy Group for the treatment of intractable epilepsy or brain tumor between 2004 and 2007. All patients had undergone the IAP with injections of both hemispheres and were classified with left language dominance (n=24) or bilateral language with greater involvement of the left hemisphere (n=7). Additional demographic information is presented in Table 1. Memory was assessed during the IAP using a maximum of 16 items consisting of colored pictures, words and designs. Consistent with our IAP protocol, only items presented prior to first motor return for a given injection were included in the analysis. A passing memory score for each injection was defined as correct recognition of at least 60% of items following full recovery from the drug. An IAP memory asymmetry index was calculated for each patient based on the total memory score using the formula $(R-L)/R+L$. The percent of patients passing the IAP memory test with each injection was calculated.

The MEG unit consisted of a 148-channel Magnes 2500 WH system (4-D Neuroimaging, San Diego, CA) housed in a magnetically shielded room. Single equivalent current dipole (ECD) model across each whole hemisphere was used in the analysis. MSI receptive language mapping was performed with the auditory word recognition task noted above². In this procedure, the patient first listens to a list of 30 words and then attempts to identify the target words in six successive stimulus blocks, with each block consisting of the 30 target words, presented in random order with a different set of 10 distractor or foil items. Activation of the mesial temporal (MT) region was rated as present or absent for each hemisphere based on activity sites specifically within the hippocampus or amygdala. A MT asymmetry index was calculated based on the total number of MT dipoles in each hemisphere again using the formula $(R-L)/R+L$. The percent of patients with activation in either or both mesial temporal regions was calculated. MT activation in relation to IAP memory performance in each hemisphere was compared using the Pearson correlation coefficient and t-tests for independent samples.

RESULTS

In this sample, a total of 8 patients (26%) did not demonstrate MT activation in either hemisphere and were eliminated from further analysis. Of the remaining patients, MT activation was noted in the left hemisphere of 18 patients (78%) (\bar{x} number of dipoles = 8.4), while 12 patients (52%) demonstrated MT activation in the right hemisphere (\bar{x} dipoles = 9.8). Seven patients (30%) had bilateral MT activation (\bar{x} left dipoles = 11.8; \bar{x} right dipoles = 9.8). Sixty-eight percent of patients passed the IAP memory test with the left hemisphere (\bar{x} score = 81%), while 48% passed with the right hemisphere (\bar{x} = 81%). Based on asymmetry index scores, there was a significant correlation

between MT dipoles and IAP memory performance ($p < .05$), see Figure 1. When memory performance was compared in patients with relatively greater left vs. right MT activation, the mean left IAP memory score was slightly higher in the group with more left MT activation, while mean right IAP memory was slightly higher for patients with more MT activation in the right hemisphere. This trend did not reach statistical significance based on current group size (Figure 2).

CONCLUSIONS:

- The occurrence and lateralization of MSI mesial temporal activation in response to an auditory recognition task is significantly correlated with IAP memory performance.
- There is a trend toward higher IAP memory scores in the hemisphere with relatively more MT dipoles.
- The potential clinical utility of this finding for surgical decision-making, including prediction of postoperative memory outcome, deserves further investigation.

References:

1. Lee, Dongwook; Sawrie, Stephen, Simos, Panagiotis; Killen, Jeff, and Knowlton, Robert. Reliability of language mapping with magnetic source imaging in epilepsy surgery candidates. *Epilepsy & Behavior* 8(2006) 742-749.
2. Papanicolaou AC, Simons PG, Castillo EM, et al. Magnetoencephalography: a noninvasive alternative to the Wada procedure. *J Neurosurg* 2004;100:894-76.

Table 1

Patient Demographics

N	Sex	Age	FSIQ	Diagnosis	IAP Language Dominance
31	Male 13	Mean 26	91	Epilepsy 21	Left 24
	Female 18	Range 50-60	68-119	Tumor 10	Bilateral 7

Figure 1

IAP Memory and MSI MT Activation

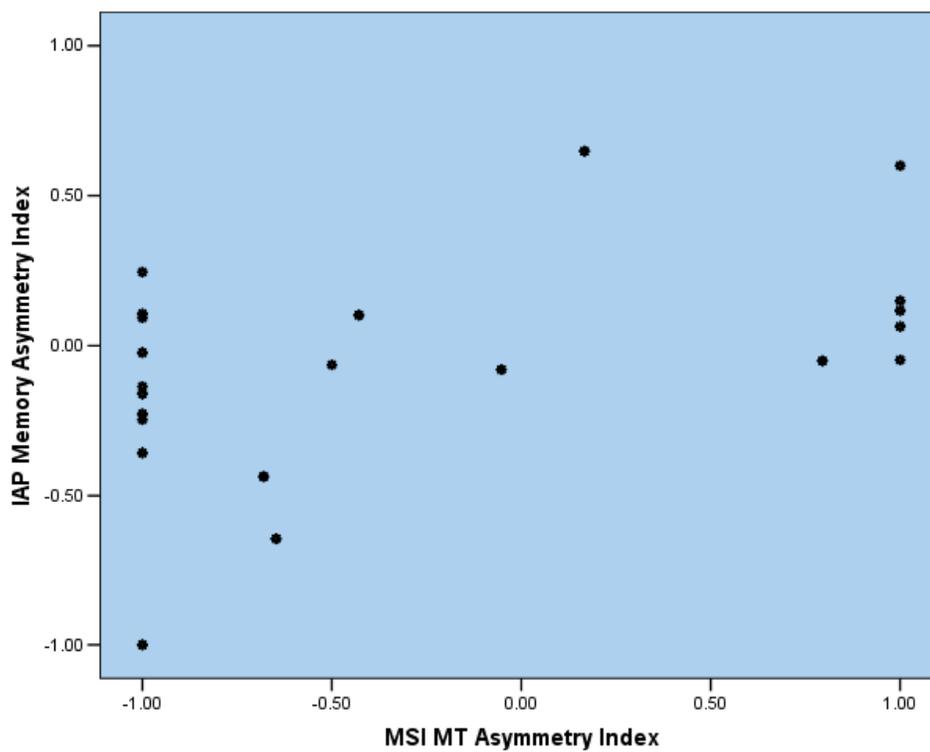


Figure 2

IAP Memory Performance and Mesial Temporal Activation on MSI

