American Epilepsy Society

Filename: 751043

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Abstract Categories: 12C. Both

Presentation format: Either Platform or Poster

Young Investigator Travel Award: Yes

Nurse's Travel Award: No

AES member: No

Keyword 1: ECoG **Keyword 2:** Spectral analysis **Keyword 3:** Naming **Keyword 4:** Language **Keyword 5:** Cortical mapping

Title: Cortical mapping of language with subdural electrodes: a direct comparison of electrocorticographic gamma activity with electrical cortical stimulation mapping

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RATIONALE: Although electrical cortical stimulation (ECS) mapping remains the gold standard for predicting functional impairment after resection of human cortical tissue, this procedure may be complicated by pain, afterdischarges, or even seizures. Electrocorticographic (ECoG) recordings may be made through the same implanted subdural electrodes without the same complications, but ECoG indices of cortical activation must be tested against the gold standard of ECS before they can be used to guide surgery. Recent studies have shown that functional activation of human cerebral

cortex is associated with a broadband high frequency gamma (80-100 Hz) response in subdural ECoG. We therefore investigated the utility of this index of cortical activation

for mapping language cortex.
METHODS: We compared the spatial distribution of ECoG gamma during confrontation naming with the maps of naming and other language functions generated by ECS mapping in 17 subjects undergoing subdural electrode implantation for the surgical management of intractable epilepsy. Event-related ECoG gamma activity was averaged for up to 84 objects drawn from the Boston Naming Test (BNT). The sensitivity and specificity of ECoG gamma for predicting ECS impairment was calculated separately for ECS maps of (1) naming (using a subset of the same stimuli from the BNT), (2) mouth motor function (because naming involved the muscles of articulation), and (3) all language tasks--including paragraph reading, spontaneous speech, and sentence comprehension.

RESULTS: For a maximum of 10 electrode sites per subject (the average number with significant ECoG gamma) the specificity of ECoG gamma with respect to ECS was 81% for naming, 83.7% for mouth, and 81.3% for all language tasks. The equivalent sensitivities were 28.6% for naming, 41.2% for mouth, and 26.8% for all language tasks. Improved sensitivities (with no significant effect on specificities) were obtained when they were calculated within individuals and then averaged - 32.4% for naming, 47.9% for mouth, and 27.6% for all language tasks.

CONCLUSION: This study indicates that event-related ECoG gamma activity during confrontation naming predicts ECS interference with naming, mouth motor function, and other language tasks with relatively high specificity but low sensitivity. If ECoG gamma is observed during naming, it is likely that ECS at the same site will interfere with the same or related function, but if ECoG gamma is not observed at a cortical site, it is an open question whether ECS would predict that resection of this site carries a risk of functional impairment. Improvements in the sensitivity of ECoG mapping will be needed before it replaces ECS mapping; however, it may already provide a useful adjunct to ECS mapping.

Funding supported by: R01 NS40596

Disclosure: No