

The 3 language paradigms demonstrated the same result in only 5 of 17 studies (30%). In 8 of 17 (47%), LF and VG produced the same patterns of activations. In 12 cases, the addition of a third task produced activations not seen using 2 paradigms alone. For example, in 3 cases in which LF and VG failed to demonstrate temporal lobe activations, AD produced temporal lobe activations.

All tasks identified atypical language patterns; LF demonstrated atypical language patterns in 11 children, VG in 9 children and AD in 10 children.

Conclusions: In 70% of this cohort of children with epilepsy, 3 fMRI language paradigms were necessary to completely demonstrate frontal and temporal lobe language areas. Functional MRI acquisition may be challenging in children, particularly those with epilepsy and comorbid cognitive and developmental issues. Despite this, all efforts should be made to acquire sufficient data to fully characterize language patterns for presurgical mapping in children with epilepsy.

3.254

PEDIATRIC FUNCTIONAL IMAGING CONSORTIUM: SUB-PATTERNS OF LANGUAGE DOMINANCE IN PEDIATRIC LOCALIZATION RELATED EPILEPSY IDENTIFIED BY DATA DRIVEN SEPARATION ANALYSIS

W. D. Gaillard^{4,9}, X. You¹, B. Bernal², M. R. Guillen¹, M. Ayala¹, P. Jayakar², A. Barreto¹, N. Rishe¹, J. Sullivan³, D. Dlugos³, M. M. Berl⁴, J. VanMeter⁵, D. Morris⁶, E. Donner⁶, B. Bjornson⁸, M. Smith^{6,7} and M. Adjouadi¹

¹College of Engineering and Computing, Florida International University, Miami, FL; ²Miami Children's Hospital, Miami, FL; ³Children's Hospital of Philadelphia, Philadelphia, PA;

⁴Department of Neurosciences, Children's National Medical Center, George Washington University, Washington, DC;

⁵Department of Neurology, Georgetown University, Washington, DC; ⁶Hospital for Sick Children, Toronto, ON, Canada; ⁷Department of Psychology, University of Toronto, Toronto, ON, Canada; ⁸BC Children's Hospital, Vancouver, BC, Canada and ⁹Clinical Epilepsy Section, National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD

Rationale: Identification of variant patterns of language dominance requires large populations because of patient heterogeneity. We established a consortium of imaging centers to collect functional imaging data using common paradigms and similar acquisition parameters. We aimed to establish similarity of findings across sites, and establish data driven methods to identify sub-patterns of language processing from pooled data. We also aimed to develop data driven means for data segmentation independent of a priori notions and bias inherent in region of interest and visual analysis.

Methods: 122 children, (64 normal control; 58 with localization related epilepsy (LRE). Mean age 11.1 yrs; range 4-19 yrs) across five sites using EPI BOLD fMRI and a word definition decision task adjusted for age (reverse speech control) at 1.5 and 3T. Data were placed in an image data repository for central standardized processing; clinical measures were entered in a study Web site repository. Data were processed using FSL. After normalization to the MNI atlas data were segregated using an eigenvector parsing followed by cluster and partial component analysis. Group activation maps form subgroups were generated ($p < 0.05$). Data were examined for evidence subject differences across groups, scanner effect (both Fisher Exact Test) or site effect (Good Fit Test).

Results: There were no scanner ($p=0.7$) or site effects ($p=0.58$). Three patterns of activation were identified: 1) the typical distributed network expected for task in left inferior frontal gyrus (Broca's) and along left superior temporal gyrus (Wernicke's) (60 controls, 35 patients); 2) a variant left dominant pattern with greater activation in IFG, mesial left

frontal lobe, right cerebellum (3 controls, 15 patients); and 3) Activation in the right homologues of the first pattern in Broca's and Wernicke's territories (1 control, 8 patients). Normal controls were predominantly in group 1; Patients fell into the three groups but distribution was different than controls, and were over represented in groups 2 and 3 ($P < 0.0004$).

Conclusions: Collaborative efforts to collect common measures using advanced imaging are feasible and practicable. In addition to the expected atypical right dominant activation pattern, a subset activation pattern was identified that involved different weighting within the distributed left hemisphere language processing network favoring frontal regions. This pattern, also seen in a minority of controls, may represent an alternative, less mature, or less efficient cognitive strategy for task primarily utilized by the LRE group.

3.255

NONINVASIVE CORTICAL IMAGING OF EPILEPTIFORM ACTIVITY FROM INTERICTAL SPIKES IN PEDIATRIC PATIENTS

Bin He¹, Y. Lai¹, X. Zhang¹, W. van Drongeelen² and M. Kohrman²

¹Department of Biomedical Engineering, University of Minnesota, Minneapolis, MN and ²Department of Pediatrics, University of Chicago, Chicago, IL

Rationale: Localization of the epileptogenic focus from noninvasive measurements would greatly aid in the presurgical planning in patients with partial seizure disorders. In the absence of lesions visible on neuroimaging studies, identification of the epileptogenic cortex is made through the analysis of electrophysiological data obtained during ictal activity from prolonged intracranial recordings. The development of a noninvasive means to identify the seizure onset zone (SOZ) would thus play an important role in patients with extra-temporal lobe epilepsy. In the present study, we have developed a noninvasive cortical imaging method to estimate cortical potentials from the scalp-recorded EEG, and have examined its applicability to image epileptiform activity in patients with medically intractable epilepsy.

Methods: Ten pediatric patients (3M/7F, ages 4-16) with intractable partial epilepsy were studied using a protocol approved by the Institute Review Boards of the University of Minnesota and the University of Chicago. Each patient had multiple (6 to 14) interictal spikes (IIS) subjected to the cortical potential imaging (CPI) analysis. Realistic geometry inhomogeneous boundary element head models were built using each individual's MRI. CPI analysis was performed on the IIS, and extrema in the estimated CPI images were compared with SOZ as determined from the ictal ECoG recordings.

Results: In the group of patients studied, the CPI results identified the epileptogenic foci which were confirmed by neurosurgical resection. Among the ten patients studied, five were seizure free and five had substantial reduction in seizure. Ictal ECoG recordings revealed that 8 patients exhibited a single epileptogenic focus while 2 patients had two foci. In each patient, the CPI results revealed an area of activity overlapping with the SOZ as identified by ictal ECoG. The distance from the extreme of the CPI images at the peak of IIS to the nearest intracranial electrode associated with the onset of the ictal activity was evaluated for each patient and this averaged distance was 4.6 mm.

Conclusions: In the present study, we have developed and validated a novel CPI technique in a group of 10 pediatric epilepsy patients. The CPI analysis was successfully performed in a number of interictal spikes in patients whose ictal ECoG recordings revealed epileptogenic foci in the temporal, frontal and parietal lobes. The quantitative comparison of the foci as estimated from the scalp EEG with the SOZ determined from ictal ECoG showed a high degree of consistency between the CPI results and ictal ECoG results. These promising results demonstrate the potential for noninvasive localization of the epileptogenic focus from interictal scalp EEG recordings. The present results may have a significant impact on the