Semantic and lexical language deficits in left temporal lobe epilepsy patients using BOLD

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Introduction: Medically intractable epilepsy is a common chronic neurological disorder affecting an estimated 50 million people worldwide[1]. Temporal lobe epilepsy (TLE) due to hippocampal sclerosis (HS) is a common cause of medically intractable seizures, and has a good outcome following anterior temporal lobe resection (ATLR). TLE may be associated with disrupted lateralisation and localisation of language function[2]. Language lateralization by fMRI provides results comparable to that of intracarotid amobarbital testing (WADA) and memory lateralization also shows promise[3]. We evaluated the semantic, lexical and comprehension lexical processing of language (in mother tongue, i.e., Hindi) in left temporal lobe epilepsy (LTLE) patients to quantify the deficit using BOLD technique.

Materials and Methods: After obtaining the institute ethics approval, 8 healthy controls (7M,1F,Mean age: 34.62years) and 7 consecutive patients with left temporal lobe epilepsy diagnosed with left MTS and LTLE (4M,3F, Mean age: 23.85years), all right handed, were recruited for the study. Standard diagnostic and exclusion criteria were followed. The fMRI sessions were carried out using 1.5T MR scanner (Avanto, Siemens, Germany) using head coil. The language task consisted of words (60 s), noun pairs (108 s), sentences (60 s), jumbled sentences (155s) with increasing complexity during active phase in four blocks and black screen during baseline phase. The stimuli were presented using a MR compatible audio visual stimulus system with binocular goggles (NordicNeuroLab, Norway). Single-shot echo planar imaging (EPI) sequence was used for the BOLD studies (number of slices: 29, slice thickness 4.5 mm; TR: 2000 ms, TE: 24 ms, FOV: 100 mm, resolution: 64x64 and total number of measurements: 256).

Results: BOLD activation was observed in Wernicke's area (BA 21,22) in left hemisphere, Broca's area (BA 43,44) in right hemisphere in control subjects with respect to LTLE patients (one way ANOVA, contrast 1,-1: controls-LTLE), along with fusiform gyrus and frontal gyrus (BA 6,47) during simple semantic task. Broca's area (BA 43,44) and Wernicke's area (BA 21,22) were activated in the controls in left hemisphere, which means that there was deactivation in these areas in LTLE subjects. Broca's area was activated along with cingulate gyrus and medial frontal gyrus (BA 18,24,6) in left hemisphere in LTLE patients group during increasing complexity of sentences (in comparison to controls).

Discussion: In subjects with temporal lobe epilepsy have observed BOLD activation during language tasks has been observed in frontal region (BA 43,44, 47, 6) and temporal region (BA 21,22, 39) during word generation and lexical task (Powel et al 2007, Detre et al 2004). Hippocampal sclerosis in TLE patients might cause deficits in language network (Powel et al 2007, Detre et al 2004). Phonetic, lexical and comprehension lexical tasks in healthy brain has caused activation in frontal region in (BA 45,46, BA 6,8,9) and temporal region (BA 21,22,BA37,39) (Gernsbacher and Kaschak 2003). In our study, we found BOLD clusters in cortical language areas in control group during simple semantic, lexical task, whereas the LTLE patients group were showing absence of Broca's and wernicke's area during simple semantic task and recruited Broca's area activation in lexical and comprehension lexical task only. Absence of temporal lobe activation suggest deficits in these patients, as they have left temporal lobe abnormality due to intractable seizure discharges and pathological disturbances. Surprisingly increasing language complexity invoked activation in left temporal cortex indicating that Wernicke's area may still be intact for higher language functions, and hence a need to preserve the temporal lobe during surgery. This may suggest the need for postoperative follow up of these patients to determine language reorganization.
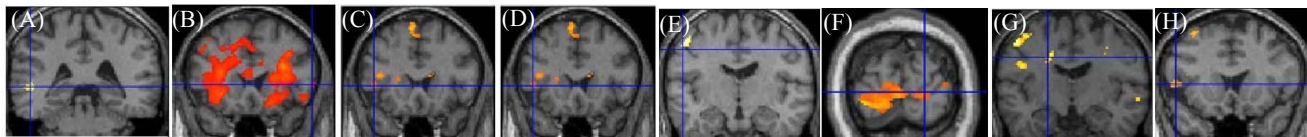

Figure 1. BOLD activation estimated using group analysis in controls (A,B,C,D) and LTLE patients (E,F,G,H) overlaid on anatomical coronal images for semantic (A,E), semantic decision task (B,F), lexical task (C, G) and lexical comprehension task (D,H).

References:

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