

fMRI LANGUAGE LATERALIZATION DIFFERENCES IN LATERAL TEMPORAL NEOCORTEX IN LEFT VERSUS RIGHT TEMPORAL LOBE EPILEPSY PATIENTS: A MODEL FOR BRAIN PLASTICITY?

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Introduction

Lesions acquired during childhood may cause alterations of language lateralization in epilepsy patients. This is corroborated by the observation that atypical language lateralization is more prevalent in the epilepsy population¹. As for determining language lateralization, functional magnetic resonance imaging (fMRI) has proven itself to be a reliable non-invasive alternative to the intracarotid amytal procedure (IAP) or Wada-test.

In this fMRI study we tested the hypothesis that the side of seizure focus has an effect on language distribution in lateral temporal neocortex, even in patients considered left hemispheric language dominant by the IAP.

Materials and Methods

Fifteen temporal lobe epilepsy (TLE) patients (8 left TLE (L-TLE) and 7 right TLE (R-TLE)) were examined with two fMRI language paradigms: a word generation paradigm and a reading paradigm. Imaging was performed on a 1.5 T Siemens Symphony system. Paradigm design and scanning parameters were previously described elsewhere and the paradigms have demonstrated to generate language related fMRI activation in the dominant frontal lobe (word generation) and temporal lobe (reading)². To evaluate the relative contribution of each hemisphere, lateralization indexes (LI) were calculated in different regions of interest (ROIs). For the word generation task two ROIs were created: a ROI in the frontal lobe and a ROI at around the border zone of the temporal and parietal lobe. For the reading task a ROI was created based on the observed activation regions from the group analysis of the healthy volunteers². This ROI consisted of BA 21, 22, and 38 combined with the gyrus angularis and supramarginalis.

Image post-processing and statistical analysis were performed using the software package SPM99 (<http://www.fil.ion.ucl.ac.uk>). For all contrasts the statistical results of each subject were thresholded at $p < 0.01$, uncorrected for multiple comparisons.

Results

Good correlation was found between language categorization based on frontal LI (100 %) and temporo-parietal LI (100 %) measurements and IAP using the word generation task. Using a ROI analysis in lateral temporal neocortex, less agreement (66%) in language categorization was found with the reading task (in combination with a temporal ROI) when compared to the IAP (Fig.1). A significant difference ($\Delta LI = 0.55$, $p < 0.004$) was observed between the L-TLE and R-TLE groups when using the reading task, but not for the word generation task (Fig. 1).

Discussion

The use of a word generation task and a frontal lobe analysis reliably yields the language lateralisation reliably according to the IAP. For the reading task the correlation was less reliable than for word generation, which can be explained by the notion that the IAP emphasizes more expressive than receptive language performance. Moreover we found that a seizure focus in the dominant temporal lobe caused a significant more bilateral representation of temporal language function compared to patients with seizure focus in the non-dominant temporal lobe suggesting a plasticity effect towards homologous areas in the temporal lobe of the dominant hemisphere (Fig 2).

References

1. Springer, J. A.; Binder, J. R. et al. *Brain* 1999, 122 (Pt 11), 2033-2046.
2. Deblaere, K.; Backes, W et al. *Neuroradiology* 2002, 44, 667-673.

