

# Full brain functional connectivity of the hippocampus in temporal lobe epilepsy compared to controls

V. L. Morgan<sup>1</sup>, B. P. Rogers<sup>1</sup>, J. C. Gore<sup>1</sup>, and B. Abou-Khalil<sup>2</sup>

<sup>1</sup>Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, <sup>2</sup>Neurology, Vanderbilt University, Nashville, TN, United States

## Introduction

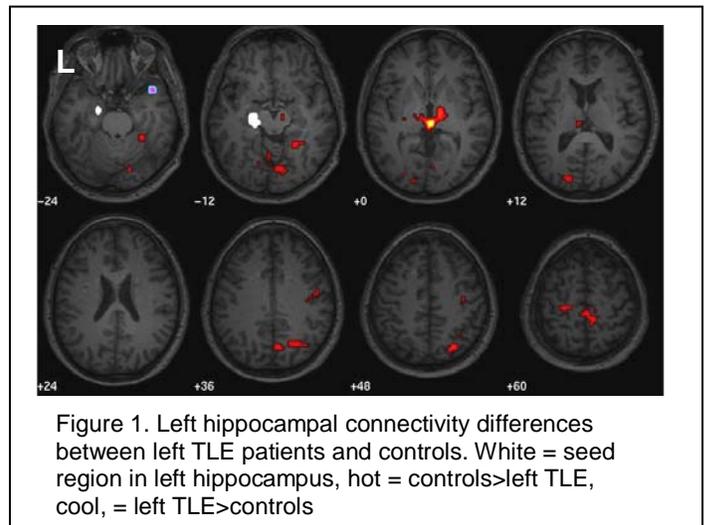
Temporal lobe epilepsy (TLE) typically is associated with seizures generated from the anterior hippocampus which may be structurally abnormal. Functional connectivity assessed with resting state BOLD signals allows examination of the networks involving the epileptogenic hippocampus in these patients. Previous abstracts have reported reduced bilateral hippocampal connectivity [1] and hippocampus to precuneus connectivity [2] in TLE compared to controls. While these previous studies focused on connectivity between specific regions, the objective of this investigation is to provide a full brain comparison of left temporal hippocampus connectivity between left TLE patients and controls.

## Methods

Five left TLE patients with left hippocampal structural abnormalities who were part of a larger investigation [3] were reanalyzed for this study. All underwent left selective amygdalohippocampectomy and became free of disabling epileptic seizures. Ten healthy controls were also included. All subjects were imaged on a 3.0T MRI scanner including structural and fMRI scans at rest with eyes closed (64x64, FOV=240 mm, TE/TR=35/2000 ms, 200 volumes, 6:40 scan time). A temporal clustering analysis (2dTCA) [3] was performed on the epilepsy group to detect transient MRI signal spiking within the left hippocampus. The average time course of this region was low pass filtered at a cutoff of 0.1Hz and used as the regressor of interest in a general linear model with the global time course and motion used as confounds. The connectivity of the individual subjects (beta weights of regressor of interest) were entered into a two-sample t-test to determine statistically significant differences between connectivity to left hippocampus between left TLE patients and controls.

## Results

The 2dTCA analysis revealed clear left anterior hippocampal activation (Figure 1, white) which was then used as the seed in the fMRI connectivity analysis. The two-sample t-test showed that controls had the strongest connectivity ( $p < 0.005$  unc, cluster 20) between the left hippocampus and the left and right thalamus. Increased connectivity was also found in other regions including the right inferior parietal cortex, visual cortex and supplementary motor regions (Figure 1, hot). The patients had slightly increased connectivity between the left hippocampus and the right temporal tip ( $p < 0.01$  unc, cluster 5) (Figure 1, cool).



## Discussion and Conclusions

In this study of connectivity to the left hippocampus, no differences between TLE patients and controls were found in the precuneus or the right hippocampus as reported earlier [1-2], but most significant decreases in TLE patients were found in the thalamus. These results are supported by findings of reduced gray matter measured by voxel based morphometry [4] and reduced resting regional cerebral glucose metabolism measured by positron emission tomography (PET) [5] of the ipsilateral hippocampus and the thalamus in TLE. These findings may provide insight into network alterations which may be related to the structural and functional changes and cognitive impairment in TLE [6].

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[1] Butler T, et al. *Epilepsia* 2007;48(s6):152. [2] Rodionov R, et al. *Epilepsia* 2007 ;48(s6) :253. [3] Morgan VL, et al., *Epilepsy Research* 2007;76:22. [4] McMillan AB, et al. *NeuroImage* 2004 ;23 :167-174. [5] Arnold S, et al. *Neurology* 1996;46 :1422-1430. [6] Seidenberg M, et al. *J International Neuropsychol. Soc.* 2008;14:384-393