

THALAMIC AND HIPPOCAMPAL DYSFUNCTION IN TLE MEASURED BY MRS

H. P. Hetherington¹, R. I. Kuzniecky², K. Vives³, D. D. Spencer³, J. W. Pan⁴

¹Radiology, Albert Einstein College of Medicine, Bronx, NY, United States, ²Neurology, New York University, New York, NY, United States, ³Neurosurgery, Yale University, New Haven, CT, United States, ⁴Neurology, Albert Einstein College of Medicine, Bronx, NY, United States

Introduction: Recent work by Pan with ³¹P spectroscopic imaging has demonstrated that there are significant declines in energetics (PCr/ATP) in the contralateral hippocampus, thalami and basal ganglia of patients with temporal lobe epilepsy. This finding supports the role of an anatomical network of involved structures in the pathophysiology of temporal lobe epilepsy. Previously, Kuzniecky reported that decrements in NAA in the contralateral hippocampus were associated with seizure recurrence following temporal lobectomy. Thus the goals of this work were to evaluate if NAA decreases in the network are: 1) anatomically correlated and 2) can they be used to lateralize the focus and predict surgical outcome.

Methods: ¹H spectroscopic images of the hippocampi and thalami of 18 patients with temporal lobe epilepsy and 20 controls were acquired with a modified LASER sequence at 4T and a volume TEM head coil. The SI data were acquired with a slice thickness of 10mm from a FOV of 19.2x19.2 cm² using 24x24-encoding steps (0.64cc nominal volume). For the hippocampus, the plane was angulated along the temporal pole. For the thalamus the plane was angulated parallel to the AC-PC line. Data were reconstructed and selected using an automated voxel shifting method based on anatomical landmarks (Fig. 1,2), providing 4 and 6 loci for the hippocampus and thalamus respectively. A discriminant analysis was used to evaluate the predictive power for localization (correct or incorrect) and outcome. The 16 patients with 1-year follow-up were grouped according to the Engel scale, Ia, Ib and II-IV (II-IV have recurrent seizures). To minimize the number of input variables, the four-hippocampal locations were averaged. Due to pronounced differences in the anterior and posterior thalamus (Table 1), the thalamic data were grouped into posterior (loci 1-3) and anterior (4-6) measures.

Results: Displayed in Fig. 1 and Fig. 2 are the hippocampal and thalamic loci and reconstructed spectra. NAA/Cr in loci 2,3,4 and 6 of the ipsilateral thalamus and 3 and 6 of the contralateral thalamus were reduced significantly in comparison to controls (p<0.05) (Table 1). Average NAA/Cr in the ipsilateral hippocampus was significantly correlated with the ipsilateral (R=0.72,p=8x10⁻⁴) and contralateral (R=0.59,p=0.01) anterior thalami (Fig 3). The contralateral hippocampus was correlated with the contralateral anterior thalamus (R=0.47,p=0.05). The posterior thalami were not correlated with either hippocampi. Using a discriminant analysis, 16 of 18 patients were correctly lateralized using only thalamic measures. Notably 4 of 18 were MRI negative or ambiguous. Adding the contralateral hippocampus to the anterior thalamic data enabled 15 of the 16 patients to be correctly categorized, with a single class Ia patient miscategorized as Ib.

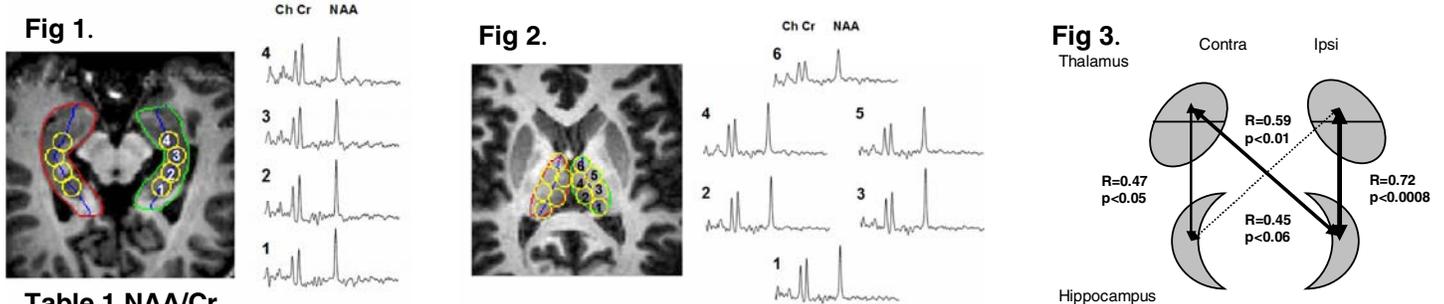


Table 1 NAA/Cr

| Thalamus | | 1 | 2 | 3 | 4 | 5 | 6 |
|------------------|----------|-------|-------|-------|-------|-------|-------|
| Controls | Mean | 1.30 | 1.29 | 1.61 | 1.43 | 1.72 | 1.63 |
| | SD | 0.15 | 0.13 | 0.18 | 0.21 | 0.26 | 0.30 |
| Patients, ipsi | Mean | 1.232 | 1.17 | 1.465 | 1.284 | 1.582 | 1.391 |
| | SD | 0.162 | 0.148 | 0.2 | 0.177 | 0.192 | 0.15 |
| | % change | -5% | -9% | -9% | -10% | -8% | -15% |
| | p-value | 0.166 | 0.004 | 0.009 | 0.011 | 0.054 | 0.001 |
| Patients, contra | Mean | 1.317 | 1.246 | 1.496 | 1.311 | 1.617 | 1.388 |
| | SD | 0.248 | 0.165 | 0.195 | 0.165 | 0.133 | 0.262 |
| | % change | 1% | -4% | -7% | -8% | -6% | -15% |
| | p-value | 0.718 | 0.351 | 0.026 | 0.068 | 0.250 | 0.004 |

Conclusions: Spectroscopic imaging measurements of patients with temporal lobe epilepsy identify significant reductions in NAA/Cr from both the ipsilateral and contralateral thalamus, with greater reductions in the anterior loci. Using only the thalamic data, 89% of the patients were correctly lateralized. When data from the contralateral hippocampus was included with the anterior thalami, the outcome in 15 of the 16 patients was correctly predicted by a discriminant analysis. The data supports the role of the thalamus as a participating in a network of involved structures, and that the severity and pattern of penetration of NAA/Cr declines is predictive of surgical outcome.