Correlation between Metabolite Alterations in 1H-MR Spectroscopy in Hippocampal Sclerosis

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Rationale: The intention of our study was to assess Proton-MR Spectroscopy (^{1}H-MRS) as a non-invasive technique for grading degree of hippocampal sclerosis in patients with temporal lobe epilepsy (TLE). Quantified metabolite alterations in ^{1}H-MRS were correlated to hippocampal neuronal cell loss and degree of gliosis expressed by astroglial fibrillary acid protein (GFAP) expression.

Methods: ^{1}H-MR Spectroscopy [(Point Resolved Spectroscopy (PRESS); repetition time (TR) 3000 ms; echotime (TE) 30 ms; averages 128)] was carried out in hippocampal structures (Fig.1) of 23 unilateral TLE patients scheduled for hippocampectomy. Spectral postprocessing was carried out with LCModel (S.Provencher) (Fig.1). Neuronal cell numbers were performed with a microcomputer imaging system equipped to a BX51 microscope. Gliosis was detected by GFAP-staining. Correlation between hippocampal metabolite alterations and neuronal cell loss was calculated by Pearson Correlation Coefficient (PCC). Analysis between alterations of m-Ins and distribution of astroglial GFAP expression in the hippocampus was calculated by one-way ANOVA.

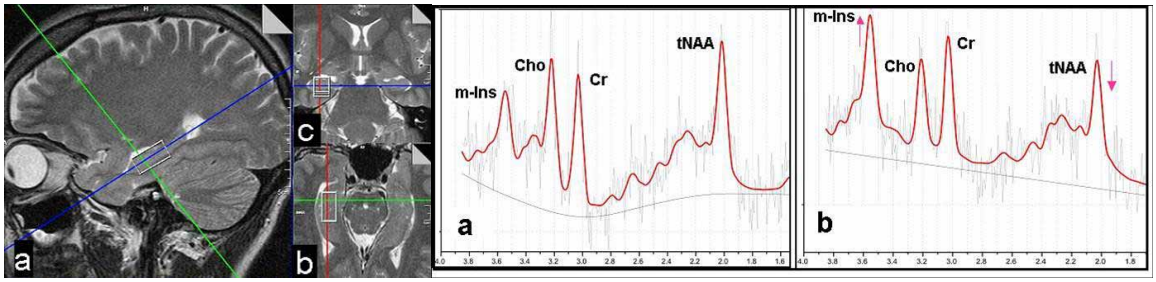

Fig 1: T2-weighted MR image illustrating Hippocampal VOI (10*20*10 mm³) selected for proton MRS (left) Absolute metabolite quantification with LCModel fit: (a) normal 1H-MRS spectrum; (b) pathological 1H-MRS spectrum of a patient with hippocampal sclerosis (decreased tNAA and increased m-Ins)

Results: Positive correlation was calculated between tNAA reduction and neuronal loss in hippocampal CA1- ($p<0,001$), CA3- ($p= 0,015$), CA4 segment ($p=0,031$) (Figure 1) and dentate gyrus ($p=0.006$). Correlation between m-Ins and astroglial GFAP expression revealed a significant increased m-Ins levels in cases of diffuse astrogliosis (m-Ins = 6.4 ± 1.1) compared to gliosis restricted to isolated sectors of the hippocampus (i.e. hilus) (m-Ins=5.3 ± 1.2) ($p=0.039$). Negative correlation was found between m-Ins and neuronal loss in the CA4 segment of the hippocampus ($p=0.012$) (Fig 2).

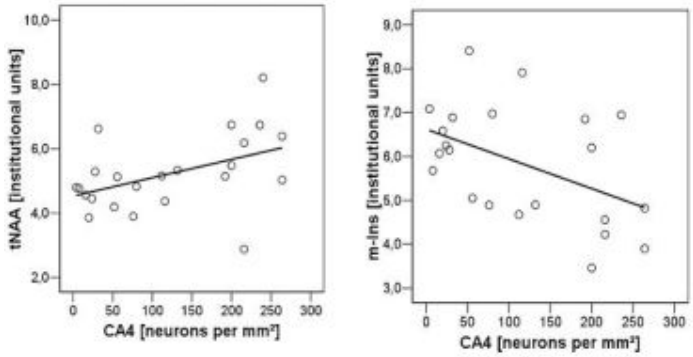

Fig.2: Correlation between tNAA and m-Ins and neurons per mm² in hippocampal CA4 segment

Conclusions: Our results support ^{1}H-MRS as a valid, non-invasive method indicating hippocampal sclerosis preoperatively in patients with TLE. Degree of tNAA reduction in ^{1}H-MRS is correlated to neuronal loss. Furthermore absolute metabolite determination of m-Ins indicates amount of hippocampal astrocytosis displayed by GFAP expression.

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