Spectroscopic imaging reveals reduced NAA/Cr ratios in epilepsy patients with secondary generalized seizures

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Introduction

A significant percentage of the patients with partial epilepsy frequently experiences secondary generalized seizures (SGS). Neuropsychological research has revealed that the frequent occurrence of SGS is associated with cognitive deterioration [1]. This cognitive decline is likely to be related to the total number of SGS experienced in lifetime, but may also be related to etiology, age of onset or other epilepsy factors. As the metabolite NAA is a (surrogate) marker for neuronal cell loss or dysfunction, magnetic resonance spectroscopic imaging was used to investigate metabolic changes in combination with neuropsychological assessment of intelligence.

Methods

Eleven healthy subjects (aged 23–57 years, median 26) and eleven partial epilepsy patients with SGS (primary focus: frontal left 2, frontal right 2, temporal left 5, temporal right 2, aged 23–55 years, median 40) were included. The patients with SGS were divided into three categories, with 1-5 (n=5), 5-25 (n=3), and 25-125 seizures (n=3), respectively. All patients were neuropsychologically assessed with the Wechsler-Adult-Intelligence-Score (WAIS) test. Imaging was performed on a 1.5 T MRI system (Philips Intera, Philips Medical Systems), using a standard quadrupolar head receiver coil. The protocol included turbo spectroscopic imaging (turbo factor 3, 2 slices, 24×24 voxels per slice, FOV = 230×230 mm^2, slice thickness = 20 mm, TR = 2.5 s, TE = 272 ms, a nominal voxel size of 1.84 ml). Localization and water suppression was achieved with PRESS and CHESS, respectively. Mean metabolite ratios NAA/Cr, and Cho/Cr, obtained through integration, were evaluated for the following regions: left (LFL) and right (RFL) frontal lobe, and left (LTL) and right (RTL) temporal lobe. Statistical analyses were performed using SPSS 12.01. Linear regression analysis was applied to examine the effect of the number of SGS and age on metabolite ratios and the relationship between the WAIS neuropsychological test score and metabolite ratios. Statistical significance was inferred when $p<0.05$.

Results

Linear regression analysis revealed that there was an overall significant negative linear relation between NAA/Cr ratios and age in the LFL and RTL for the healthy volunteer group (Figure 1). Therefore, all subsequent analyses were performed with age as a covariate. Between group comparisons of the metabolite ratios showed that the NAA/Cr ratio in the LFL, LTL, and RTL was significantly lower in the complete patient group than in the control group (25.5 %, Figure 1). Linear regression analysis between the NAA/Cr ratio and the three patient categories yielded a decrease of this ratio with increasing number of SGS for all regions, although this did not reach significance. Regression analysis between WAIS and number of SGS also yielded a negative relationship, which was however not significant.

Conclusion

The results suggest that the NAA/Cr ratio was decreased in the LFL, LTL, and RTL in epilepsy patients with SGS. Furthermore, the reduction of the NAA/Cr and the scores of the WAIS IQ test seem to be related to the number of SGS. Whether the observed decrease in NAA/Cr is due to the SGS or the primairy seizures cannot be resolved. This study shows that spectroscopic imaging may be a useful addition for the assessment of cognitive decline in epilepsy patients. Future, possibly longitudinal, studies with larger patient groups and an epilepsy control group without SGS are required to determine whether metabolite ratios are correlated with measures of cognitive decline, and whether spectroscopic imaging can be used for the early identification of patients with epilepsy at risk for cognitive problems.

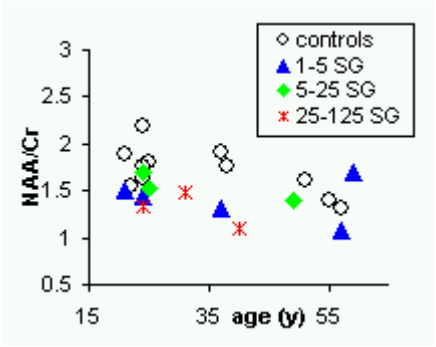

Figure 1: Mean NAA/Cr ratio in the left frontal lobe. SG: number of secondary generalized seizures

References: [1] - Dodrill CB. Epilepsia 1986;27:399-411.