Reproducibility and effect of voxel compartments on cerebellar GABA MRS in an elderly population

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Introduction: The aging brain is known to suffer from substantial structural and neurochemical changes[1]. For example, the cerebellum, a potential key structure in aging, does not only show age-related volumetric differences, but is also involved in age-related motor and learning deficits[2]. Studies on the reproducibility of gamma-amino butyric acid (GABA) MRS in the aging population are lacking. Therefore, this study aimed to explore the feasibility and reproducibility of GABA MRS in the aging cerebellum at 3T and to examine the effect of voxel compartments on GABA measurements.

Methods: 10 healthy elderly volunteers (three males; age: mean ± SD, 75.2 ± 6.5 years) were recruited. 5 subjects were scanned twice to assess short-term reproducibility. MRI and ^{1}H MRS exams were performed on a 3T Siemens Tim Trio scanner (Siemens Healthcare, Erlangen, Germany) with a 32-channel head coil. The MEGA-PRESS J-editing sequence[3,4] was used for GABA detection (TR/TE = 1500/68 ms, 196 avg with editing pulse at 1.9 ppm and 196 avg at 7.5 ppm) in volumes of interest (VOIs) in the left and right cerebellar dentate (both 25 mm × 25 mm× 25 mm). The GABA signal at 3.0 ppm will be referred to as GABA+ due to contribution of co-edited macromolecules and homocarnosine. High-resolution MPRAGE images were acquired to determine voxel tissue composition. FASTESTMAP shimming was performed before each voxel measurement to achieve water line width of < 20 Hz[5]. MRS data processing and quantification were performed with LCModel 6.3-0L[6]. An LCModel basis set was generated from density matrix simulations using known chemical shift and J-coupling values[7]. Raw metabolite levels were corrected for CSF contamination and for T1 and T2 relaxation of the water signal[8,9]. Metabolite ratios were corrected for CSF contamination. Coefficients of variation were calculated for measured metabolites.

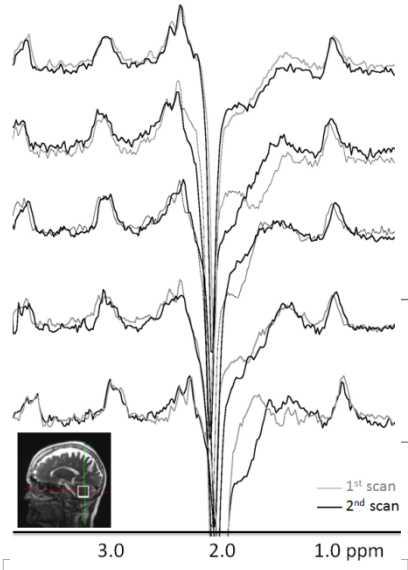

Figure 1 Pairs of GABA-edited spectra from the right dentate and representative voxel placement.

Results: Fig. 1 shows 5 pairs of scan/rescan GABA spectra from the right cerebellar dentate. Raw and CSF contamination- and relaxation-corrected GABA+, GABA+/creatine (GABA+/Cr) and GABA+/N-acetyl aspartate (GABA+/NAA) from the right dentate are reported in Table 1. Averaged CVs for all GABA measurements within each individual ranges from 5.0 % to 14.1 %. Uncorrected GABA+, GABA+/Cr and GABA+/NAA (with CVs ranging from 5.0 % to 13.9 %) significantly correlated with corrected GABA+ (R^2=0.698, 0.772 and 0.735, respectively).

Table 1 Raw and corrected GABA+ measurements in the right dentate and corresponding mean coefficients of variation in parenthesis.

Raw GABA+	1.86±0.32 (5.0%)
Corrected GABA	1.67±0.29 (5.0%)
Raw GABA+/Cr	0.19±0.05 (6.9%)
Corrected GABA+/Cr	0.20±0.05 (6.7%)
Raw GABA+/NAA	0.17±0.02 (7.9%)
Corrected GABA+/NAA	0.17±0.03 (7.7%)

Discussion: Our results in an elderly population are in line with previous reports in young subjects[10,11]. This information might be relevant for studies that explore age-related GABA changes and brain deficits using this technique.

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This work was supported by NINDS R01 NS085136 from the National Institutes of Health.