Optimization of echo time for GABA editing using MEGA-PRESS

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Introduction: The previous report demonstrated that γ-Aminobutyric acid (GABA) can be detected using MEGA-PRESS methods in about 10 minutes acquisition on 4T MR unit.(1) Therefore the evaluation of GABA has been prospected in clinical setting on 3.0T MR scanner.. However, since the sensibility of *in vivo* MRS is limited, the precise analyses of scan parameters have been awaited to obtain spectra with sufficient signal-to-noise ratio from small amount of metabolite such as GABA. For the detection of GABA by MEGA-PRESS, TE = 68 ms (=1/ 2J) is usually chosen for J=7.35Hz of GABA. In this work, we propose the optimization of echo time to increase NMR signal from GABA based on MEGA-PRESS methods.

Materials & Methods: All studies were performed on 3.0 T clinical MR Scanner (Signa 3T VH3m4, GE Medical Systems, Milwaukee, USA) with a standard ^{1}H birdcage Head coil. MEGA-PRESS sequence was developed in house for this work. In phantom experiments, a spherical flask of 300ml was used. Phantom sample contained 200 mM GABA (Sigma A2129) in 200 mM Na formate, buffered using K_2HPO_4 + KH_2PO_4 to pH = 7.2. The line width of water peak was adjusted to about 7.3 Hz in shimming procedure. We acquired spectra with changing the value of TE in every 2 ms from 60 to 72ms each with the number of excitation = 64. Line broadening with 1.5 Hz exponential function was applied in time domain data. Curve fitting was performed using SAGE software built on the console of MR scanner. Peak areas were calculated using curve fitting software on frequency domain after automatic peak picking. For volunteer acquisition, spectrum was obtained from occipital lobe with 3x3x3 cm3 voxel. Scan parameters employed for in vivo study were as followings: TE = 61 ms and 68 ms, NEX = 512, and TR = 1500 ms. Water line width was adjusted to about 9.3 Hz. Informed consent was obtained from all normal subjects.

Results and Discussion: Figure 1 demonstrates the spectral change at 3.0ppm respect to TE value. The highest peak was apparently observed at TE = 60ms. The peak area of TE 68 ms was decreased to 87% relative to that of TE 60 ms. Figure 2 shows spectra of TE 60 and 68 ms without editing pulse. The area of spectrum with TE68ms was reduced to 92% of that with TE 60 ms. This signal intensity reduction was probably due to coupling effects is larger at TE = 60 than in TE = 68. Since the difference spectrum was obtained by subtracting the spectra without frequency selective decoupling pulse from those obtained with the pulse, the spectra acquired at TE 60 ms is expected to be larger than those acquired at TE 68 ms. The amplitude of the GABA peak at TE 68 ms is expected to decrease by T2 effect only. In short, the signal decay from elongation of TE is larger than the resumption of decoupled effect in TE 68 ms than in TE 60. Figure 3 shows a volunteer spectrum. Signal intensity of GABA of 3.0ppm obtained at TE 61 ms is higher than TE 68 ms spectrum.

Conclusions: We have shown that the signal intensity of the GABA obtained MEGA-PRESS with TE 61 ms was higher than TE 68 ms spectrum both in vivo and vitro condition. Although the signal gain may be small using TE = 61 ms instead of TE 68 ms in GABA editing acquisition, this is very important especially for the clinical application, since the acquisition time is limited in clinical setting. Moreover, this effect should be further evaluated by the point of discrimination of glutamine and glutamate (Glx) at 2.5 ppm. We are now under research in discriminating GABA and Glx based on MEGA-PRESS. This effect may be exploited for editing spectra to obtain other peaks.

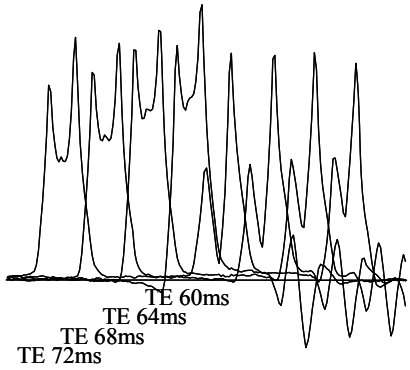

Fig.1. ^{1}H NMR spectroscopy of 3.0ppm GABA phantom using MEGA-PRESS. TE was 60ms to 72ms.

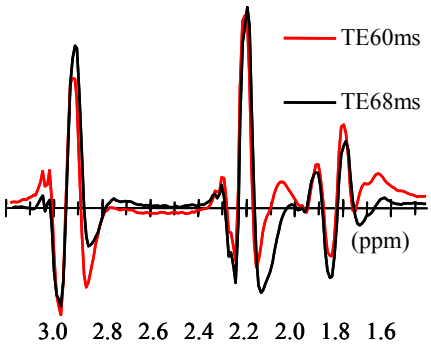

Fig.2. TE 60 ms and TE 68 ms GABA phantom spectrum under the absence of the editing pulses.

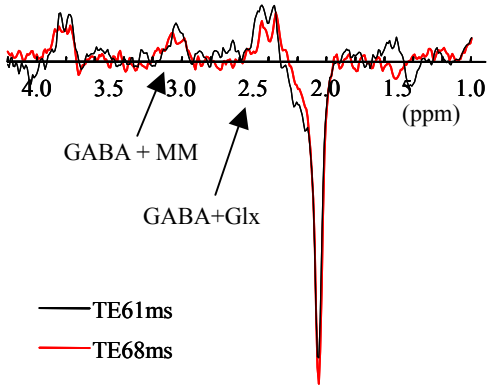

Fig.3. In vivo ^{1}H NMR spectroscopy of GABA using MEGA-PRESS. TE 61 ms and TE 68

[1] M. Mescher, etl. Simultaneous in vivo spectral editing and water suppression. NMR Biomed 11, 266–272 (1998)