Increase of GABA Concentration in Patients with Tuberous Sclerosis Estimated by MEGA-PRESS with LCModel fitting on 3T MRI

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Introduction

Tuberous sclerosis is a heredofamilial neurocutaneous syndrome or phacomatosis with multisystem involvement including neurological manifestations. The essential neuropathological hallmark of tuberous sclerosis is hamartomatous lesions that occur subependymally, cortically and subcortically. We examined these hamartomatous lesions by proton MR spectroscopy with not only a conventional short STEAM sequence but also MEGA-PRESS for separate detection of γ-amino butyric acid (GABA). MEGA-PRESS has been reported as a useful tool to detect GABA signal separated from other major metabolites. We referred the previous report to establish MEGA-PRESS sequence and installed it into our clinical 3 Tesla apparatus. The purpose of this study was to evaluate metabolic change of absolute concentration of GABA and other metabolites in patients with Tuberous Sclerosis.

Materials and Method

Our created MEGA-PRESS was the almost same as the previous reported one and employs gradients surrounding the frequency selective pulses at 1.9 ppm to dephase transverse magnetization. Water suppression was used conventional three CHESS pulses after manual optimization. The sequence parameter was as following: TR = 1500 ms, TE = 68 ms, ROI = 3.0 x 3.0 x 3.0 cm3 (27ml), summation = 256 signals for each spectrum, total acquisition time = 13 min. The measurements with and without the frequency selective pulses were conducted alternatively, i.e. during odd-numbered acquisitions, J evolution for the GABA was refocused and during even-numbered acquisitions, it was not refocused. The difference of the acquired spectra provided an edited spectrum of GABA. The in-vitro data of NAA, Glutamine, Glutamate and GABA were acquired by MEGA-PRESS and set as a basis-set for LCModel. The quantification of signals in the difference spectra by MEGA-PRESS was conducted by LCModel.

The subjects were five normal volunteers (3-5 years of age) and three patients with Tuberous Sclerosis. The measurements by a conventional short TE sequence and MEGA-PRESS were conducted in hamartomatous lesions appeared with hyperintenesity on T2-WI. The measurements of normal controls were done in right parietal white matter. This study was permitted by the institutional committee of the University Hospital of Tokushima and the informed consents were obtained from all subjects.

Results:

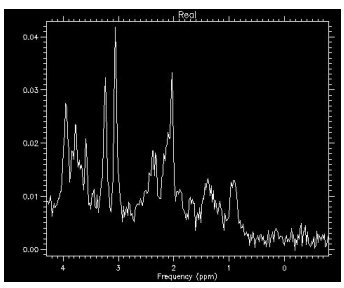
An example of a GABA-edited spectrum and conventional spectrum on hamartomatous lesion was shown in Fig.1. The peak of GABA was found at 3.02 ppm, and those of Glx and macromolecule were observed in this spectrum. The quantified result of GABA concentration in the lesion was 2.8 ± 0.8 mM which was higher than that of normal control (1.1±0.3 mM). The concentration of NAA was decreased and the signal of macromolecule in the lesion was not change remarkably.

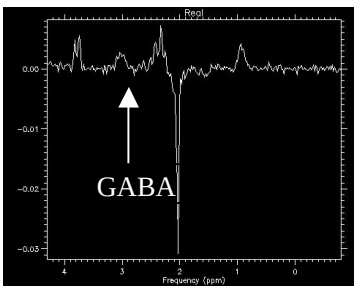
Conclusions:

In addition of Glutamine and Glutamate, the concentration of GABA could be evaluated by MEGA-PRESS, and the increase of GABA compared to NAA was found in hamartomatous lesion with Tuberous Sclerosis..

Reference

M. Mescher et al. NMR in Biomed. 11, 266-272, 1998





(a) (b)

Fig.1: a TS patient (a)Conventional MRS (b)MEGA for GABA,

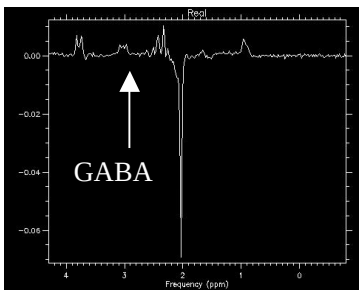


Fig.2 Normal MEGA for GABA