Enhancing Glutamine Signals in TE-Averaged PRESS Spectra

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Introduction

Glutamate (Glu) C4-proton multiplets appear as a pseudo singlet at about 2.35 ppm with the TE-averaged PRESS technique [1]. Although the contribution of Glutamine (Gln) becomes minimal after averaging, the Gln signals are readily available in the same data set. Therefore, to fully utilize the existing data and justify the longer acquisition time in comparison to the conventional PRESS technique, this study has the goal to demonstrate the feasibility to recover Gln signals while removing the interference of Glu signals by applying an optimized filter prior to averaging.

When averaged over different TE values, Glu signals sum up constructively at 2.35 ppm, whereas Gln signals are attenuated as shown in Fig 1A. Conversely, filter functions that aim at summing up Glu signals destructively while enhancing Gln signals can be developed. A simple filter involves a step function which applies subtracts data after a certain TE point, so as to minimize the overall sum of Glu signals while recovering the overall sum of Gln signals. The Gln signal at 2.45 ppm is of particular interest, since it is the most prominent and well-isolated pseudo singlet after TE averaging, as indicated in the power spectrum in Fig 1B. The resultant spectra after filtering are shown in Fig. 1C

Methods

In vivo data acquisitions were done on an INOVA 4T scanner (Varian, Palo Alto, California) using a quadrature head coil. Conventional PRESS spectra were acquired using TE/TR = 30/2100 ms and 32 NEX. TE-averaged PRESS spectra were acquired using TE = 30-345 ms at the same TR. Averaging was done over 64 TE steps with 4 NEX/step. Unsuppressed water signals were acquired with the same parameters but a reduced NEX of 2. The total preparation and acquisition time for each voxel was 17-20 minutes. A voxel size of 8 c.c. was prescribed in the anterior cingulate gray matter area. Metabolite data were corrected for eddy current and phase prior to additional post-processing and averaging. The final spectra contained 2048 point over a 2 kHz spectral window. Simulations were performed using GAMMA [2]. The acquisition and post-processing parameters were identical to those in *in vivo* studies wherever applicable. The quantities of Glu and Gln in the simulation system are identical for this purpose. For the filtered TE-averaged PRESS spectra, the step function occurs at TE = 110 and 170 ms for in vivo and simulated spectra, respectively, with the lower TE value to compensate for *in vivo* relaxation.

Results

Fig. 2 shows an *in vivo* spectrum using a conventional PRESS technique (A) at TE = 30 ms and one using TE-averaged PRESS (B), with the filtered portion of the same data set sub-plotted as a solid line.

Discussion

Results show that it is feasible to enhance Gln signals with minimal Glu interference, and *vice versa*. Two useful sets of spectra, one for Glu and the other for Gln, can be obtained by using two different post-processing methods. The step function currently used is a possible candidate for a filter function.

References

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2. Smith SA, Levante TO, Meier BH, Ernst RR. J Magn Reson 1994;106A:75-105.

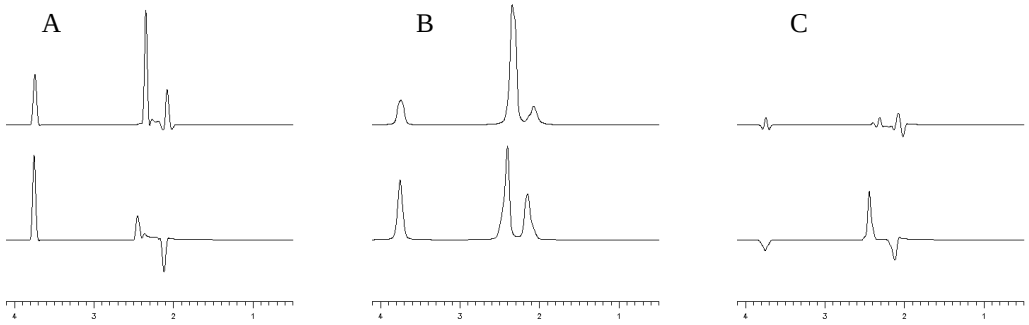

FIG. 1. Simulated Glu (top row) and Gln (bottom row) spectra at 4T.
(A) Unfiltered TE-averaged PRESS spectra.
(B) Power spectra with TE averaging.
(C) Filtered TE averaged PRESS spectra.

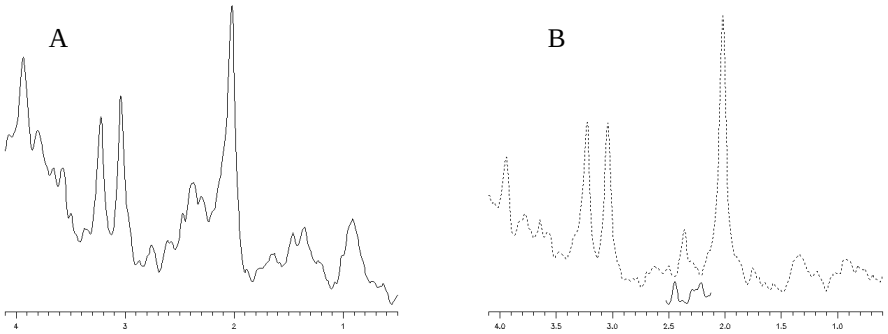

FIG. 2. In vivo spectra at 4T.
(A) PRESS spectrum, TE=30ms, of anterior cingulate gray matter.
(B) Unfiltered TE-averaged PRESS spectrum (dotted line) and a filtered portion of the same data set (solid line) to indicate the recovery the Gln signal.