Analysis of slice based versus volume based localization techniques for Echo-Planar Spectroscopic Imaging (EPSI)

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Introduction

Magnetic Resonance Spectroscopic Imaging (MRSI) enables recording of spatially resolved metabolite resonances in human tissues non-invasively. The speed of MRSI imaging can be enhanced/accelerated using the echo-planar imaging (EPI) readout [1-3]. We present a comparison of two different localization schemes, volume selective versus slice selective, for echo-planar spectroscopic imaging (EPSI) techniques. The differences of the two localization schemes were analyzed in both phantom and healthy human volunteers. Our results show the slice localized EPSI offers significantly higher SNR than volume localized; however, there is also increased leakage from regions outside of the volume of interest.

Methods

The EPSI sequence diagrams shown in Figure 1A and 1B represent the recently implemented volume based (4) and slice localization methods, respectively. They were performed 5 times each using a brain phantom as well as on 6 healthy volunteers (mean age of 30 years) using a 3T scanner (Tim Trio, SIEMENS Medical Solutions, Erlangen, Germany) and a 8 channel phased array head coil. EPSI data sets were acquired from an axial slice located in the central portion of the brain superior to the ventricles with a TR=2s, TE=30ms for the volume based localization and TE=15ms for the slice based localization, with using a 32x32 spatial image matrix, a FOV of 200x200x20mm^3 with 512 spectral points. The total scan time was 8:40 min. Outer volume suppression was applied in the outside of the volume of interest (VOI) suppress lipid and water signal. Even and odd echoes were reconstructed separately using a non-water suppressed reference scan for phase and frequency shift correction (2, 3).

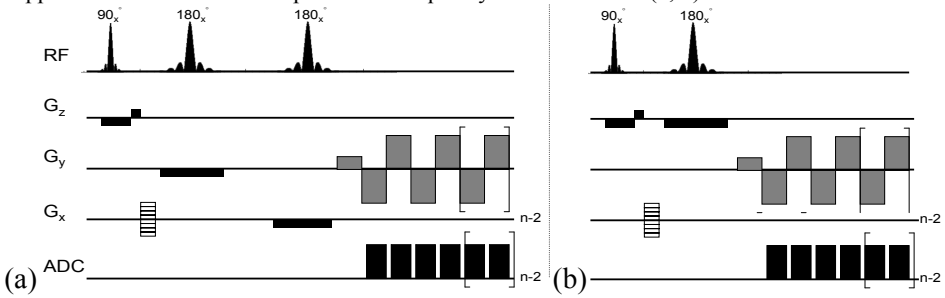

Figure 1: Two versions of the EPSI pulse sequence for volume-based localization (a) and slice-based localization (b).

Results and Discussion

The phantom studies showed that the data from the slice and volume localized EPSI sequences displayed the same spatial profiles while the SNR was significantly higher in the slice based technique. The result for the human studies are presented in this abstract. Figure 2a shows the t1 weighted MRI used for localization of the EPSI data sets, with the yellow box indicating the FOV and the white box the volume of interest. Figures 2b and 2c show the spatial profile of the NAA peak in the same healthy volunteer as fig 2a. Figure 2d shows the increases in SNR for the three main metabolites within the brain (Choline, Creatine, and N-acetyl Aspartate [NAA]), which are in the range (24-36%).

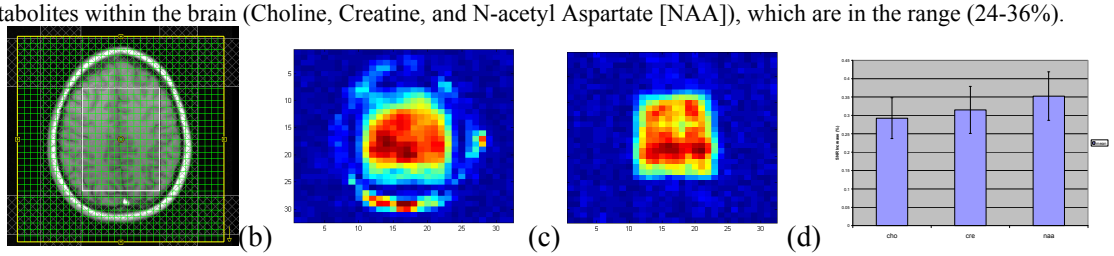

Figure 2: (a) is the MRI used for localization, (b) the slice based NAA spatial profile, (c) the volume localized NAA spatial profile, and (d) the SNR increase from volume to slice based EPSI.

Slice based localization requires only two slice selective pulses along the same plane to obtain a spin echo, where as the volume localization requires three orthogonal planes. A shorter TE allows for signal acquisition with less T2 losses and thus, higher signal to noise ratios (SNR).

Conclusion: Our pilot results demonstrate that shorter echo times (TEs) can be achieved using the slice based EPSI technique compared to its volume localizing counterpart to minimize T2-weighting of different metabolites. However, one draw back of the slice based technique is the required outer volume suppression in order to achieve localization within the slice of interest and to minimize the skull marrow lipid contamination in the brain.

References

1. Mansfield P. MRM., 1: 370-386 (1984). 2. Posse S, et al.. MRM., 33: 34-40 (1995). 3. Maudsley AA, et al. NMR Biomedicine., 19: 492-503 (2006). 4. Lipnick et al. MRM 2009 (revised).