Analysis of slice based versus volume based localization techniques for Echo-Planar Correlated Spectroscopic Imaging (EP-COSI).

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Introduction

Multi-dimensional NMR is performed in vitro and ex vivo to characterize tissues through detection of metabolic concentrations and connectivity of 1H protons. The in vivo counterpart, multi-dimensional MR Spectroscopy, has been performed clinically using a single localized voxel with diagnostic potential in the brain, prostate, breast, and skeletal muscle (1,2). However, these studies were limited by the requirement of pre-determination of the volume of interest (VOI). Fast MRS imaging can be achieved using EPSI readout [3-5]. We present two multi dimensional Magnetic Resonance Spectroscopic Imaging (MRSI) techniques. Echo Planar Correlated Spectroscopic Imaging (EP-COSI) (6) can be performed with both slice localization and volume localization. The benefits and potential pitfalls to each are presented in this research using phantom studies.

Methods

The EP-COSI sequence diagrams shown in Figure 1a and 1b represent the slice and volume based localization methods, respectively. They were performed 5 times each using a brain phantom using a 3T scanner (Tim Trio, SIEMENS Medical Solutions, Erlangen, Germany) and a 8 channel phased array head coil. EP-COSI data sets were acquired from a phantom containing brain metabolites 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 160x160x30mm3 with 512 spectral points and 64 Δt1s. The total scan time was 1:08 hours. For clinical scans the scan time can be reduced to under 30 minutes. Even and odd echoes were reconstructed separately using a non-water suppressed reference scan for phase and frequency shift correction (4,5).

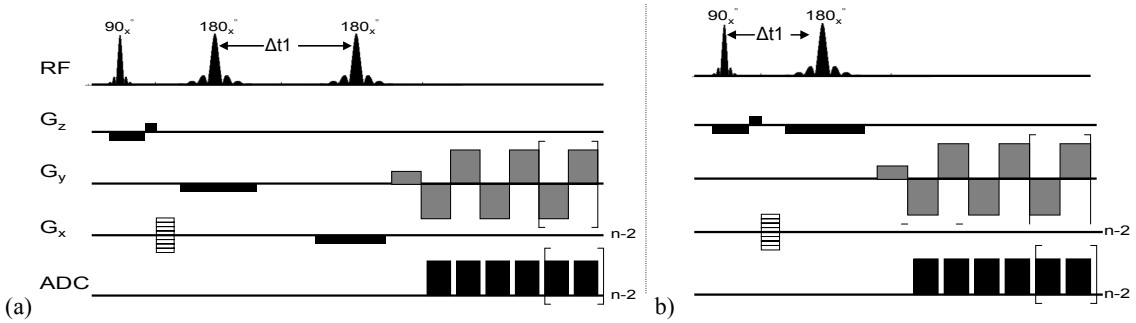

Figure 1: EP-COSI pulse sequence diagram for volume-based localization (a) and slice-based localization (b).

Results

The phantom studies showed that the data from the slice and volume localized EP-COSI sequences displayed the same spatial profiles while the SNR was significantly higher in the slice based technique. There were some leakage coming from the water signal outside of the volume of interest. The increased signal enables improved detection of off diagonal cross peaks resulting from j-coupled metabolites. Figure 2a shows the t1 weighted MRI used for localization of the EP-COSI data sets, with the yellow box indicating the FOV and the white box the volume of interest. Figures 2b and 2c show the spectra from (b) the volume localized data set and (c) shows the slice localized data sets.

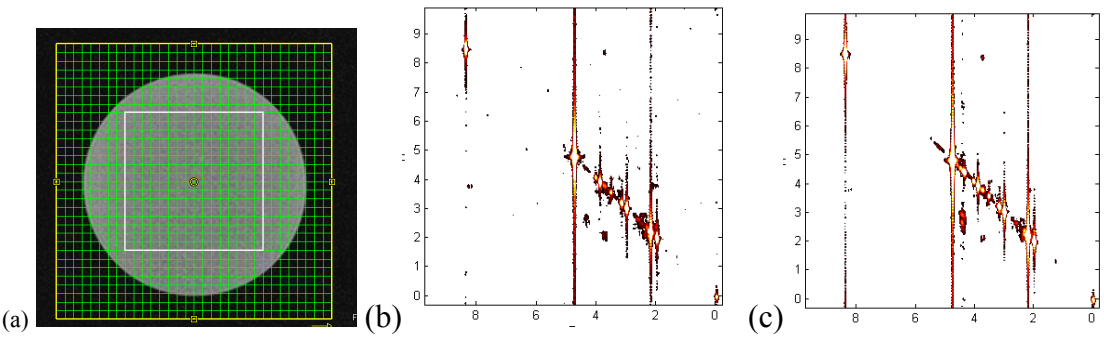

Figure 2: (a) is the MRI used for localization, (b) the slice based NAA spatial profile, (c) the volume localized NAA spatial profile, and (d) the SNR increase from volume to slice based EPSI.

References

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