Whole Brain 1H MR Spectroscopic Imaging with 3-T Phased-Array Detection

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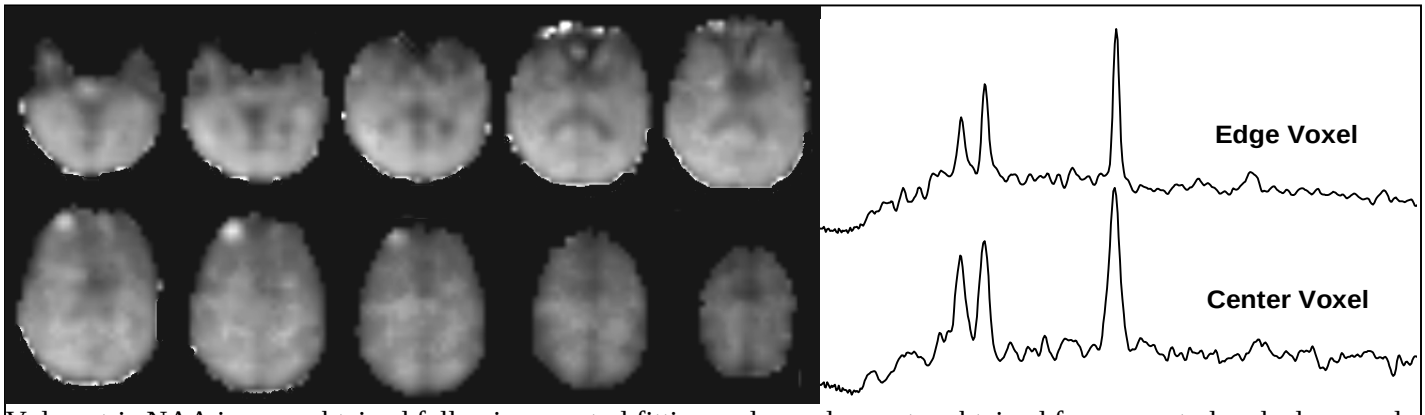
INTRODUCTION: The increasing availability of three-Tesla instruments and phased array detection coil technology is of particular interest for MR Spectroscopic Imaging (MRSI) studies of human brain, to provide ether increased spatial resolution or reduced data acquisition times. However, implementation of phased array detection for volumetric MRSI of whole brain, presents a challenge in terms of data sizes and data processing procedures. For example, when a currently-implemented EPSI sequence is used with eight-channel phased array coil detection this provides 13.3 Gb of data per study. An additional concern for all ^{1}H MRSI studies of brain, that is enhanced for volumetric measurements, is the presence of a strong subcutaneous lipid signal that is located in the most sensitive region of the phased-array coil. It is impractical to apply saturation pulses to remove this signal in all regions, as well as being undesirable due to the loss of information from the cortical surface regions; therefore alternative approaches must be used. In this report we describe the technical implementation of phased-array coil volumetric EPSI and evaluate the resultant image quality.

METHODS: A volumetric EPSI sequence was implemented at 3 Tesla (Siemens Trio) with an 8-channel phased-array head coil (MRI Devices, Inc.). This acquisition uses an over-sampled spatial-spectral EPI readout of 100x1240 points, FOV = 280x280x180 mm, phase encoding of 50x18 points, and includes an interleaved water reference acquisition of the same data dimensions (1). Additional parameters include low flip angle excitation with TR=1710 ms, TE=70 ms, and TI=198 ms. On acquisition, data was saved dynamically to disk, to enable the 13.3 Gb data to be saved and all processing done off-line. Data processing used the following procedures: 1) FT reconstruction of the 8 water reference data sets from which spatial-weighting and phase correction factors were obtained; 2) Phase correction and weighted combination of the water reference MRSI (2); 3) Generation of a B_0 correction map, a brain-region mask, and a lipid-region mask from the reference MRSI; 4) FT reconstruction of the 8 metabolite MRSI data including B_0 correction; 5) Combination using the previously determined phase and weighting correction functions; 6) Lipid extrapolation; and 7) Automated spectral fitting (3).

RESULTS AND DISCUSSION: In the following Figure are shown sample NAA images and spectra from normal human brain. A voxel volume of ≈0.6 cc (0.31 cc nominal) is obtained with good SNR. The improved spatial resolution aids in the reduction of lipid contamination and B_0 inhomogeneity induced distortions and image quality is significantly improved over that obtained with the standard receiver coil.



Volumetric NAA images obtained following spectral fitting and sample spectra obtained from a central and edge voxel.

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