Echo Planar based J Resolved and Correlated Spectroscopic Imaging of Human Prostate Using External Coil

R. Nagarajan[1], J. Furuyama[1], D. Margolis[1], S. Raman[1], M. K. Sarma[1], and M. A. Thomas[1]
[1]Radiological Sciences, University of California Los Angeles, Los Angeles, California, United States

Introduction: Prostate cancer is the second most common cancer among men in the United States. Cancer of the prostate is primarily a disease of older men and tends to grow more slowly than other types of cancers. Magnetic Resonance Imaging (MRI) and Magnetic Resonance Spectroscopic Imaging (MRSI) provide anatomical and metabolite characterization of citrate (Cit), creatine (Cr), choline (Cho), spermine (Spm) and myo-inositol (mI) of the entire prostate (1-3). The J-coupled multiplet of Spm overlaps with the Cr and Cho resonances and is not resolvable in the prostate clearly by single-and multi-voxel based one dimensional (1D) spectroscopic imaging (4).The goal of the study was to implement and evaluate novel echo-planar imaging based four dimensional (4D) MRSI sequences: J-resolved spectroscopic imaging (EP-JRESI) and correlated spectroscopic imaging (EP-COSI) (5).

Methods: Two sequences, namely EP-JRESI and EP-COSI were implemented on a Siemens 3T Tim-Trio MRI/MRS scanner (Siemens Medical Systems, Erlangen, Germany) running on the VB17A platform and the volume of interest (VOI) was localized using three slice-selective radio-frequency (RF) pulses (90^0-180^0-180^0 for the EP-JRESI) and (90^0-180^0-90^0 for the EP-COSI). We have selected the appropriate one or two three element coil arrays from the supine coil matrix and one or two three-element coil arrays from the body matrix coil placed on top of the subject. The parameters for the EP-JRESI and EP-COSI were: TR/TE/Avg = 1.5s/30ms/1, 16 phase encoding steps, 512 complex points with an F2 bandwidth of 1190Hz. For the second dimension (F1), 64 increments with bandwidths of 1000Hz and 1250Hz for EP-JRESI and EP-COSI, respectively were used. The individual voxel volumes were 2.0ml for EP-JRESI and 3.0ml for EP-COSI. Two sets of data were collected, one with water suppression (WS) and one with non water suppression (NWS) with total scan time of 25mins for each sequence. Phantom measurements were also conducted for sequence optimization. Six healthy subjects (mean age 29.3 years) underwent MRI and MRSI with external radiofrequency surface coils for signal reception.

Results and Discussion: Fig. 1 shows the T_2 weighted MRI recorded in a 27 yo healthy male, the yellow box indicating the field of view (FOV) and the inner white box displaying the excited volume of interest (VOI). The spatial profile of Cho, Spm and Cr using the resonances at 3.2 ppm, 3.1 ppm and 3.0 ppm were plotted in the Fig 2. The 2D diagonal peaks were extracted between 2.8 and 3.4ppm. In 1D MRS, the Spm peaks are not clearly resolvable. However, 2D MRS shows the Spm peaks clearly. Figure 3 shows the diagonal and cross peaks of Cit extracted between 2.4 and 3.0ppm. As reported previously, the methylene protons of Cit are strongly coupled showing the cross peaks close to the diagonal (6).

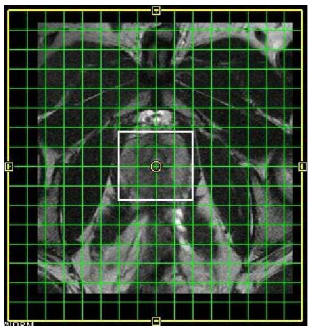

Fig.1. T_2 weighted MRI recorded in a 27 yo Healthy male with MRSI voxel location

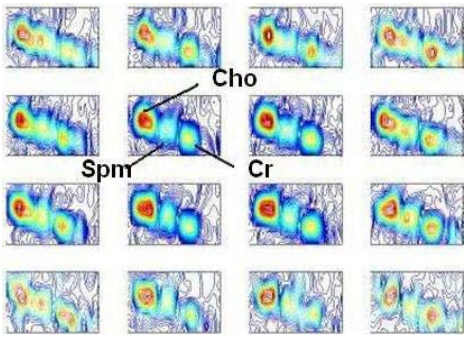

Fig.2. Multi-voxel distribution of Cr, Cho and Spm peaks extracted from the EP-JRESI data

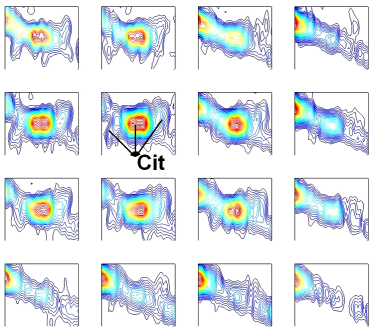

Fig.3. Multi-voxel distribution of Cit peaks extracted from the EP-COSI data

Conclusion: Our preliminary results using the EP-JRESI and EP-COSI sequences using the external phase-array matrix coil show reliable 2D MR spectra in multiple locations of healthy prostates. However, further optimization is required to increase the overall sensitivity and reduce the total duration and the small voxel size.

References:

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