Improved water and lipid suppression in volumetric brain 3D-EPSI

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Introduction: 3D echo planar spectroscopic imaging (EPSI) is becoming increasingly popular for metabolic imaging with whole brain coverage [1]. Challenges to successful implementation of 3D-EPSI with extensive spatial coverage include obtaining sufficient B_o field homogeneity, water and lipid suppression. This abstract describes improved water and lipid suppression in 3D-EPSI with a newly developed dualband suppression sequence [2].

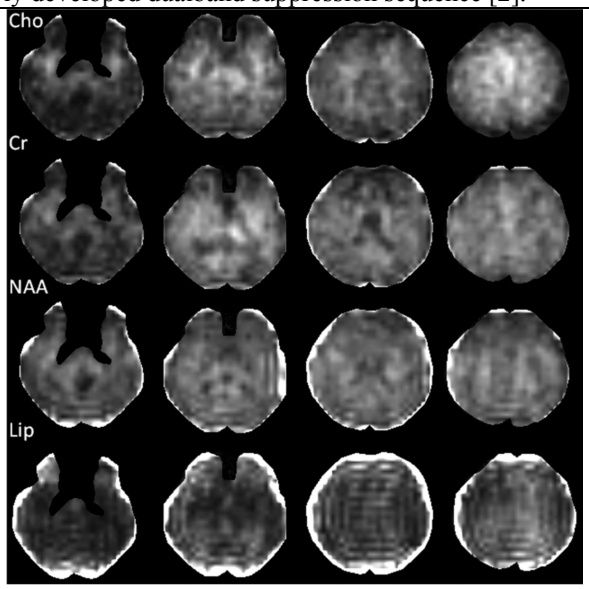

Figure 1. Metabolic images of Cho, Cr, NAA and lipid using conventional CHESS and SPAIR suppression

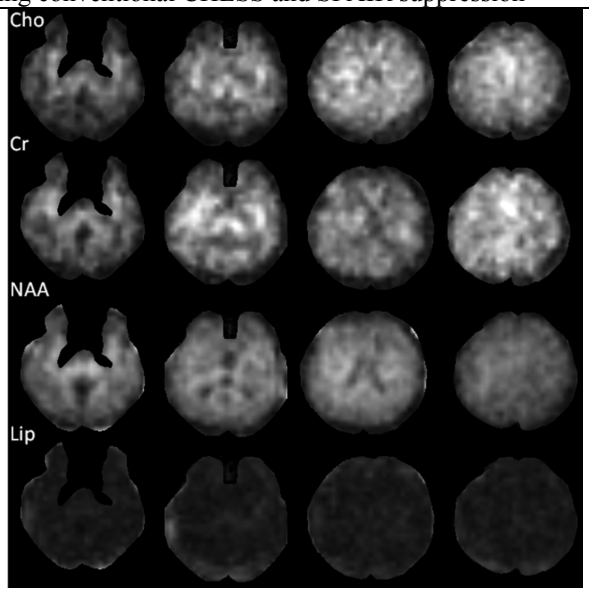

Figure 2. Metabolic images of Cho, Cr, NAA and lipid using dualband suppression and integrated OVS

Materials and Methods: All experiments were performed on a healthy normal volunteer using a slice-selective, spin-echo 3D EPSI on Philips 3T Achieva system. The EPSI readout is implemented in the anterior-posterior direction without ramp sampling (i.e. data acquisition only during the flat top of the read gradient). Acquisition parameters were: TR/TE = 1710/70 ms, image matrix: 50 x 50 x 8, spectral data points: 512, spectral bandwidth: 1661 Hz, acquisition rate: 125 kHz, FOV: 280 x 280 mm x 80mm, excitation slab: 40mm; nominal voxel size: 5.6mm x 5.6mm x 10mm, acquisition time: 11 min 24 sec.

Two experiments were performed: (1) conventional CHESS water suppression combined with an adiabatic pulse for lipid suppression ('SPAIR'), and (2) dualband water lipid suppression [1], composed of five frequency modulated pulses based on hyper geomagnetic functions with integrated outer-volume suppression (OVS). High order shimming (2^{nd} order) was performed based on a field map prior to EPSI. The spectroscopic raw data were resorted and processed according to reference [3], and spectroscopic images processed using software developed in-house.

Results: Examples of metabolic images of choline (Cho), creatine (Cr), NAA and lipid (lip) are shown in figures 1 and 2 for conventional and dualband suppression techniques respectively. Inspection of the metabolic images (particularly for NAA and Lip) shows markedly reduced lipid contamination artifacts in the dualband data. Table 1 shows scaled residual water and lipid values (1 = no suppression, 0 = perfect suppression) for the central 4 EPSI slices. On average, water suppression was a factor of 2.65 better with dualband, while lipid suppression was a factor of 8.61 better (0.035 vs. 0.299).

Discussion: The current study demonstrates that improved water and lipid suppression factors can be achieved in EPSI with large brain coverage using an optimized dualband suppression sequence with integrated OVS.

TABLE 1	Water				Lipid			
Slices	1	2	3	4	1	2	3	4
CHESS+SPAIR	0.038	0.023	0.028	0.027	0.329	0.246	0.355	0.267
Dualband	0.019	0.0087	0.008	0.008	0.042	0.033	0.035	0.029

References: [1] Maudsley et al, NMR Biomed 19 (2006), 492-503; [2] Zhu et al, ISMRM 17(2009), 138; [3]. Schär et al, MRM 51(2004), 799-806; [4]. Hu et al, JMR B 103 (1994), 30-38.

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