CSI without water suppression at 3T

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Introduction

The main problem in [1]HMRS without water suppression is a high amplitude of the water signal and the presence of the sideband artifacts caused by oscillations of the gradient coils [1]. Recently a few solutions for these problems has been demonstrated. The best results so far offers the technique which consist of using matrix pencil method (MPM) for the water signal suppression and opposite gradient technique combined with phase cycling for the sidebands reduction [2, 3]. This method suppress the water signal very well and leads to almost complete cancellation of the sidebands. It needs however multiple excitations, careful gradient adjustments and complex computations, therefore might be time consuming. We examined a technique based on the Gaussian convolution for the water signal suppression and subtraction of the water phantom FID for sidebands reduction. It was previously showed that this technique offers CSI spectra without phase problems [4].

Materials and methods

All spectra were acquired at 3T (Siemens, Enlargen) scanner with the PRESS sequence for volume selection. Parameters of CSI acquisition were as follows: TR = 1500 ms, CSI matrix size 24 x 24 voxels (interpolated to 32 x 32 voxels), voxel size 4 x 4 x 10 mm^3, number of acquisition: 5. SVS spectrum was acquired with following parameters: TR = 1500, TE = 144 ms, voxel size 20 x 20 x 20 mm^3, number of excitations 128. Both datasets were zerofiiled from 512 to 2048 datapoints. SVS spectrum was collected with water suppressing pulses while CSI data without. The water signal and the sidebands were reduced in postprocessing. It consisted of three steeps: chemical shift correction, suppression of the water signal with Gaussian convolution and reduction of the sidebands by subtraction of water phantom FID from in vivo data.

Results

Figure 1 presents results of two CSI examinations. Both datasets were acquired during one examination and comes from the same area (fig. 1a). A 3 x 3 CSI matrix was acquired from the upper level of the lateral ventricles, where phase distortions in spectra suppressed with RF pulses are usually present (fig. 1b). However in case of spectra where the water signal was suppressed with proposed technique, phase correction is not necessary(fig. 1c). Figure 2 demonstrates a comparison between the described method and single voxel spectroscopy. Both showed spectra were acquired at the brainstem (fig. 2a). The first one is a result of SVS acquisition (fig. 2b) and the second one of CSI without water suppression (fig. 2c). In this case presented spectrum is calculated as a sum of spectra from the 4 x 4 voxel CSI matrix placed in the brainstem. All spectra used for that calculation were in phase and were individually corrected regarding to the water peak position.

Discussion

Proposed method offers a sufficient reduction of the water signal and the sidebands. Individual correction of local resonant frequency can be performed even for small voxel. This correction can be done by an evaluation of the water signal position. Therefore it is possible to calculate a sum of spectra from a certain area which corresponds with certain anatomical structures. Such spectrum offers a better SNR and higher spectral resolution than SVS spectrum.

References

[1] Clayton DB et al, J Magn Reson Imaging 153:203-209 (2001); [2] Dong Z et al, Magn Reson Med 51:602-606 (2004); [3] Dong Z et al, Magn Reson Med 55:1441-1556 (2006); [4] Chadzynski GL et al, Proc ESMRMB 199-200 (2008).

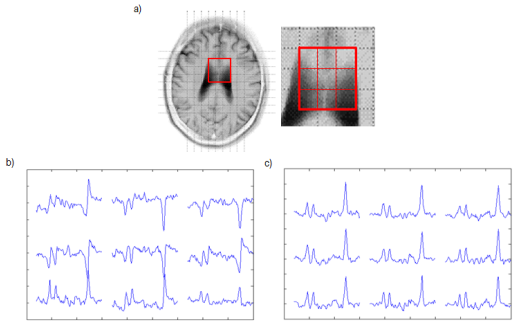

Figure 1) CSI dataset from in vivo measurements
a) Localizer image with the plane of the data acquisition, square indicates directly the region where spectra were acquired. **b)** A 3 x 3 voxel CSI matrix, where spectra were suppressed with RF pulses. **c)** Spectra from the same area, for the same volunteer acquired without water suppression.

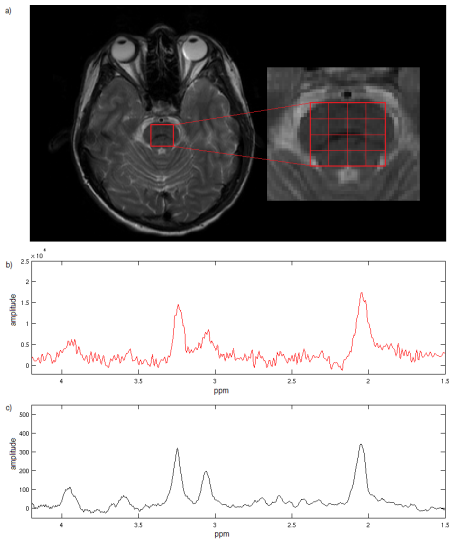

Figure 2) Comparison between SVS and CSI of the brainstem
a) Localizer image with the area of the data acquisition, marked with the square. **b)** Spectrum collected with SVS. **c)** The sum spectrum, calculated form a 4 x 4 voxel CSI matrix.