

A simple experimental protocol for determining orientation, localisation accuracy and spatial uniformity in proton spectroscopic imaging studies

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Introduction

Proton magnetic resonance spectroscopic imaging (^1H -MRSI) has been shown to be useful in the diagnosis/prognosis of human intracranial tumours [1] and in guiding radiotherapy [2]. The accuracy of localisation and orientation of the MRSI voxel grids and the spatial uniformity of measured metabolite levels are both vital in such applications and a simple protocol to determine them, which does not require the construction of sophisticated, multi-compartmental phantoms [3, 4], has been developed.

Methods

^1H -MRSI (TR/TE = 1000/144ms) was carried out at 1.5 Tesla using an IGE Signa whole-body scanner (birdcage head coil) and two pulse sequences: PRESS and PROSE which utilises spectral-spatial RF pulses [5]. Two PROSE sequences were used: the default optimised for choline/citrate detection in prostate (providing partial NAA excitation with negligible out-of-volume lipid contamination) and brain-optimised providing full excitation of lactate and NAA. Excitation profiles were improved using the OVERPRESS facility, whereby a larger-than-required volume-of-interest (VOI) was excited (130% isotropic elongation) then trimmed back using very selective spatial saturation (VSS) bands.

A uniform spherical phantom (IGE) filled with a model solution (including choline and NAA) was used. Fields-of-view and phase-encode matrices were 12cm/16² in-plane (axial) and 8cm/8 through-plane. 2D spatial uniformity was assessed using 11x11 voxel VOIs and measurement of peak amplitude ratios (spatial/spectral apodisation = 90%/5% Fermi & 1.5Hz Gaussian). 3D reconstruction/orientation was assessed using 11x11x5 voxel VOIs without water suppression (pulses nulled for PRESS; centre-frequency shifted by 125Hz for PROSE) and additional VSS bands placed within the VOI, coincident with specific rows/columns of voxels, to produce a completely asymmetrical pattern (see figure).

Results

Choline:NAA ratios, relative to the median ratio in the central 3x3 voxels, ranged from 90%-132% for PRESS, 89%-129% for PROSE/brain and 65%-420% for PROSE/prostate (NAA coincided with the steep edge of the frequency excitation profile and even small B_0 variations across the VOI produced extreme spatial variability in partial NAA excitation). The asymmetrical pattern of VSS bands permitted confirmation of grid orientation and accurate localisation in all cases.

Conclusion

This protocol is an easily applied method of validating orientation and localisation in MRSI. Prostate-optimised PROSE should not be used for brain investigations, despite assurance of negligible lipid contamination.

[1] Preul, *NMR Biomed.* 11 192 (1998); [2] Nelson, *JMRI* 16 464 (2002); [3] Vikhoff-Baaz, *Magn. Reson. Imag.* 19 1227 (2001); [4] Keevil, *Magn. Reson. Imag.* 19 1217 (2001); [5] StarLack, *JMRI* 7 745 (1997)

