Single voxel in vivo proton spectroscopy of gynaecology lesions: initial experiences of choline quantification at 1.5T and 3.0T

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Introduction. Utilising ^{1}H spectroscopy a number of groups have revealed an elevated choline peak to be an indicator of malignancy while decreasing choline levels are representative of a successful treatment response. However, for choline levels to aid management decisions it must be detected and quantified reliably with minimum subjectivity. This can be particularly problematic in pelvic tumours where a combination of low SNR and limited metabolites (choline and lipids) presides. In this study single voxel ^{1}H spectra were obtained with water reference and water suppressed frames from pelvic lesions at 1.5T and 3.0T in separate cohorts of patients. Spectral processing and quantification was undertaken with LCModel.

Methods. Examinations were undertaken at 1.5T or 3.0T in combination with an external phased array receiver for two separate cohorts of patients with similar lesions. Following standard clinical imaging, to facilitate voxel placement, point resolved spectroscopy (PRESS) was undertaken with the following parameters: TE 144ms, TR 1500ms, averages 8, spectral width 5000Hz (3.0T) or 2500Hz (1.5T), points 4096 (3.0T) or 2048 (1.5T), 16 water reference excitations and 128 water suppressed excitations. LCModel processed the resulting time domain data as follows: eddy current correction, zero-filling (to twice original size), Fourier transformation, phase and baseline correction, and metabolite concentration estimation. As a quality control procedure only metabolite concentrations with an estimated standard deviation of <20% were entered into the final analysis. Quantification of metabolites was achieved by a water-scaling technique within LCModel. While easy to implement this technique does suffer from some uncertainty, consequently concentrations were expressed in institutional units.

Results. At 1.5T 8 patients (4 ovarian malignancies and 4 benign lesions) were examined while at 3.0T 19 patients (8 ovarian, 6 cervical, 1 endometrial and 1 uterine malignancies, and 3 benign lesions) were examined. Choline was not detected in any of the benign lesions examined at 1.5T and was only identified in one of the 4 (25%) malignant ovarian tumours interrogated at 1.5T. In contrast at 3.0T choline was observed in 11 out of 16 (69%) malignant lesions and 1 of the three benign lesions. The difference in choline detection between field strengths for malignant lesions was 44% (SE±25%) resulting in a borderline ($p<0.08$) difference in detection. Table I presents the choline concentration (median, range) for the malignant primaries at 3.0T

Primary	Choline concentration
Ovarian	13.42, 3.55 - 44.09 (n=6)
Cervix	7.92, 5.95 - 11.75 (n=4)
Endometrial	1.22, (n=1)

Table I.

Conclusion. In summary this study has suggested the use of external receiver coils in combination with single voxel ^{1}H spectroscopy and LCModel to provide spectral processing and quantification of metabolite concentration of pelvic lesions, only provides the necessary sensitivity of choline detection at 3.0T as opposed to 1.5T. Consequently if choline detection is to aid patient management decisions ^{1}H spectroscopy must be undertaken at an appropriate field strength.

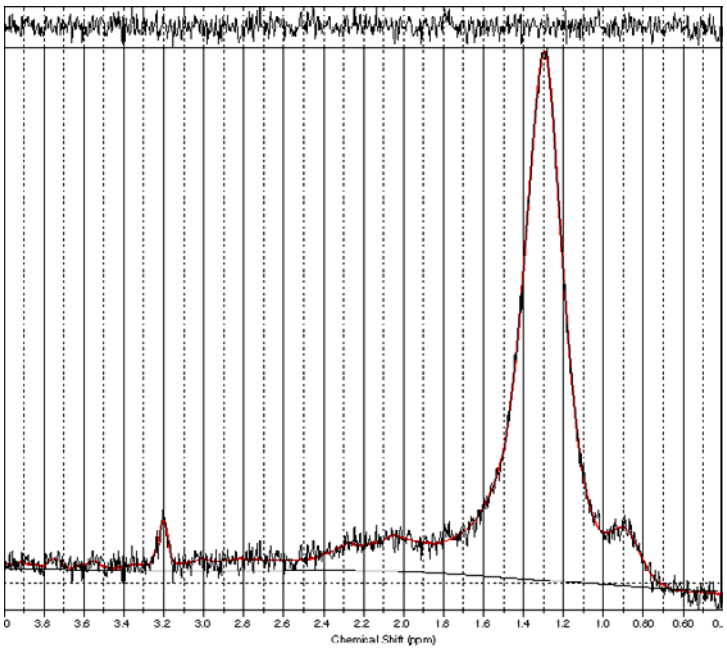

Figure I. LCModel plot output, black line represents frequency domain data, while superimposed red line is LCModel fit to this data. Baseline is additionally illustrated (black line). Top row represents residuals. Peaks are as follows: 3.21ppm choline, 1.3ppm lipid -$(CH_2)_n$- and 0.9ppm lipid (-CH_3)