Proton Spectrscopy of Gynaecology Lesions at 3.0T in a Routine Clinical Setting

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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 believed to represent a successful treatment response [1]. To date little data has been published regarding spectroscopy obtained from the female pelvis at 3.0T. Operating at this field strength provides an advantage in both SNR and spectral resolution over conventional 1.5T systems. Nevertheless there are potential disadvantages such as increased susceptibility artefacts, particularly in the pelvis. For choline levels to guide treatment management decisions in a routine clinical setting, data must be acquired using product sequences by standard users. In this study we describe the acquisition of proton MRS data by standard users from patients referred by the gynaecology department for newly diagnosed pelvic masses, utilising product only spectroscopy sequences. If present the choline signal was quantified utilising the internal water referencing, method a necessary step if choline is to be used to guide patient management.

Methods MR examinations were performed by radiographers/technologists on a 3.0T HDx scanner (GE Healthcare, Milwaukee, WI) in combination with a receive only eight channel phased array torso coil (USA instruments, Aurora, OH). Single voxel proton spectra were acquired utilising the point resolved spectroscopy technique. A voxel was placed within the solid element of the tumour. Consequently, the voxel size depended on the size of the tumour under examination. Spectroscopic data was obtained with the following parameters: TE 144ms or 72ms, TR 1500ms, spectral width 5000Hz, points 4096, 16 water reference excitations, 128 water suppressed excitations and 8 phase cycles. Initially a TE of 144ms was used to acquire spectroscopic data since lactate should be visible as an inverted doublet at 1.3ppm at this TE. However, due a prominent lipid peak at 1.3ppm and/or the absence of lactate no inverted doublets at 1.3ppm were noted in the first 32 patients. Consequently, the TE was reduced to 72ms in the next 25 patients to increase the conspicuity of choline given its reported T2 value of ~160ms [2].
All spectroscopy data were analysed utilising SA/GE software (GE Healthcare, Milwaukee, WI). Initially the signals from the individual elements of the phased array coil were combined. Subsequent processing included: internal water referencing, spectral apodisation (2.5Hz Gaussian), spectral zerofilling from 4096 to 8192 points, Fourier transform, zero order phase was corrected, any baseline errors were corrected with a cubic spline and finally a Marquardt fit (Lorentzian peak shape) was used to calculate the metabolite amplitude and area. Choline signal was quantified as follows: Choline = $[(\text{choline}_{area}/\text{water}_{area}) \times (2/9)] \times 10^{-3}$ expressed in arbitrary units.

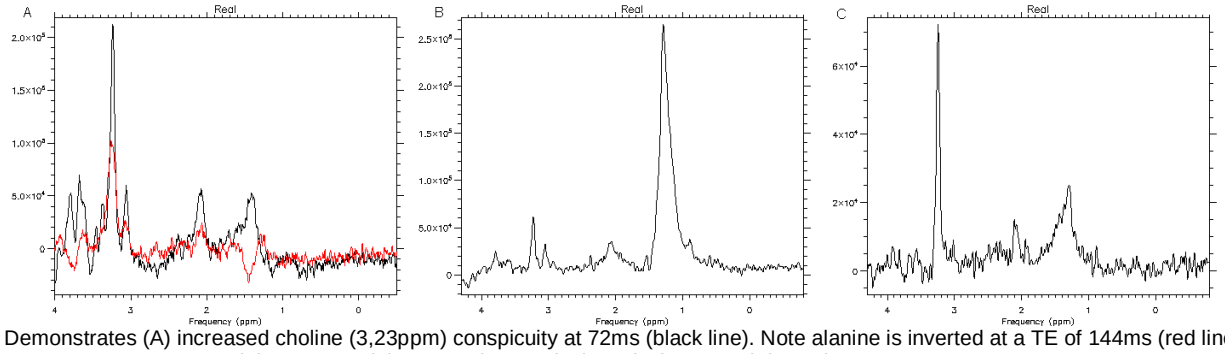

Figure I Demonstrates (A) increased choline (3,23ppm) conspicuity at 72ms (black line). Note alanine is inverted at a TE of 144ms (red line) but is upright at 72ms, (B) spectra from typical cervical cancer, (C) ovarian cancer spectrum

Results In 12 of the 51 patients the spectroscopic data acquired was unusable for the following reasons: no metabolites detected (5) or technical failures (7). Of the remaining 39 patients histopathology revealed five benign lesions (all fibroids) and 34 malignant lesions of differing origins (17 ovarian, 13 cervix, 2 uterus, 1 vulva, and 1 endometrial). The quantified choline levels for these differing pathologies are presented in Table I. For the three largest groups, ovarian, cervix and benign, no significant differences were noted in choline levels between these different pathologies for either TE value (TE = 144 p >0.05 and TE = 72 p >0.05).

Pathology	**Ovarian**		**Cervix**		**Uterus**		**Benign**	
TE (ms)	144 (12)	72 (5)	144 (9)	72 (4)	144 (0)	72 (2)	144 (1)	72 (4)
Mean	0.4	0.2	0.6	0.2		0.5	0.4	0.2
± SD	0.32	0.15	0.57	0.14		0.42	N/A	0.13
n	9	5	9	4		2	1	3

Table I reveals the mean, standard deviation and subject numbers for quantified choline levels at both TE values for the four largest pathology groups

Conclusions Although the collected spectra were unusable in 12/51 patients in 5 of these patients no metabolites were detectable usually due to haemorrhagic products. Of the 7 technical failures these were mainly due to a resulting poor shim over a large volume of interest. It is hoped that a smaller proportion of technical failures will be achieved by limiting the volume of interest in future cases. Nevertheless this study has demonstrated the feasibility of collecting single voxel proton spectroscopy from gynaecological lesions at 3.0T and the ability to quantity the choline signal by using product spectroscopy sequences by standard users.

References [1] Podo F. NMR In Biomedicine 1999; 12(7):413-439. [2] Tan P.C. ISMRM 2005,1855.