IN VIVO SPECTROSCOPY AND IMAGING OF THE OVARY AT 3 TESLA

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INTRODUCTION: Ovarian cancer is the fifth leading cause of cancer death among U.S. women [1]. Each year in Australia there are 1200 new cases and almost 800 deaths from ovarian epithelial malignancy [3]. To individualize management and allow a conservative approach, where evidence and circumstances warrant, requires a diagnostic accuracy beyond present capabilities. Currently, the best option is an intraoperative frozen section examination, a procedure not always readily available. MRS at 8.5T on biopsies can reliably distinguish invasive cancer from both atypical but non-invasive (i.e. borderline) epithelial neoplasms and from normal tissue/benign ovarian neoplasms [4]. These MR spectra from biopsies can be used to extend the technology to non-invasive *in vivo* spectroscopy [2], in this instance to the human ovary at 3T.

METHODS: Patients were recruited from those presenting with primary ovarian neoplasms to the Gynaecological Oncology Unit at Royal North Shore Hospital. Patients referred for pelvic imaging were recruited as control volunteers.
In vivo MR data was collected on a 3T Magnetom Trio system (Siemens AG, Erlangen, Germany) using a USA Instruments torso phased-array coil. Ovaries were identified on T2-weighted (TE/TR 98/4000ms, FOV 22-cm, matrix 266x512, 3-mm slice thickness, iPAT 2) axial and coronal images. 2D CSI (TE/TR 135/1380-ms, matrix 16x16, FOV 18-cm, 12-mm slice thickness) was undertaken using PRESS [5] to define VOI. Spatially selective pulses [6], were placed at the edges of the VOI to reduce unwanted signals from outside. MRS data was processed using the manufacture's software. Biopsies were collected intraoperatively and placed into a tube containing phosphate buffered saline and snap frozen in liquid nitrogen and stored at -70.
1D MRS spectra were collected on a Bruker Avance (8.5T) at 37C. 1D spectra are obtained (SW 3600 Hz, and 8K data points, relaxation delay 1s) & gated decoupling to reduce water, NE = 128. COSY spectra were acquired as described [7].
Histopathology: Tissue was fixed using standard protocols and subtypes identified according to the WHO Histological Classification.

RESULTS AND DISCUSSION: A typical 3T pelvic image of a patient with ovarian cancer is shown in figure 1. The voxel placed in the ovarian mass shows a spectrum (left) containing choline, creatine, other metabolites and lipid. Choline is absent in spectrum from cystic component (right) of lipid alone. The 1D and COSY spectrum obtained at 8.5T from a biopsy obtained from this patient is shown in figure 2. The *ex vivo* (8.5T) and *in vivo* (3T) spectra from the malignant area are similar. Spectral region (3.8-4.5 and 1.0-1.6ppm), expanded from the COSY, shows cell surface fucosylation pattern consistent with a poorly differentiated tumour [2, 4]. The independent histopathological diagnosis was a malignant mixed mullerian tumour showing mainly grade three serous papillary component. Spectra from healthy ovary acquired *in vivo* at 3T show lipid alone and no metabolites

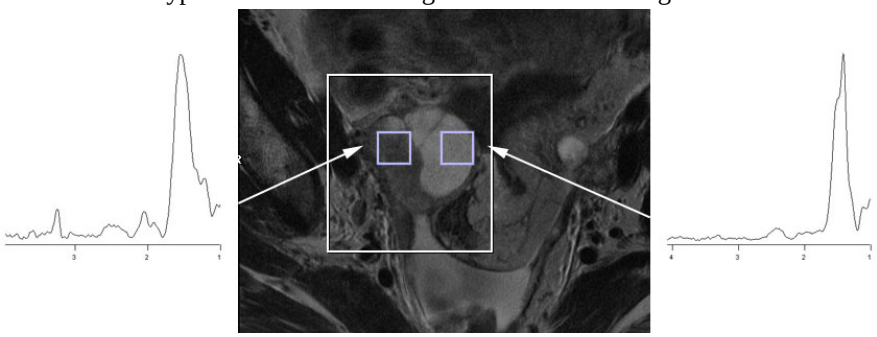

Figure 1: Axial T2-weighted 3T image showing cystic ovarian mass and from 2D-CSI. Spectrum to left is from malignant mass. Spectrum on right is from cystic component.

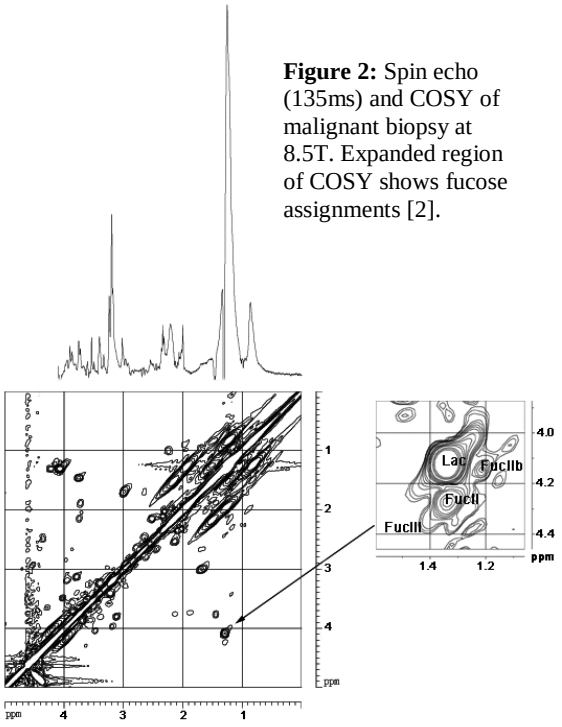

Figure 2: Spin echo (135ms) and COSY of malignant biopsy at 8.5T. Expanded region of COSY shows fucose assignments [2].

CONCLUSION: MRI and MRS (3T) can provide diagnostic information preoperatively on patients with ovarian masses. MRS at 8.5T on biopsies shows comparable spectral features to those obtained *in vivo*. Spectral profiles confirm the histopathological diagnosis of adenocarcinoma. COSY shows level of de-differentiation of the tumour based on altered cell surface glycosylation [2].

References

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