In vivo Proton MR Spectroscopy in Ovarian Pathology

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Introduction

Patients with suspected ovarian pathology usually undergo ultrasound as the initial examination, however, ultrasound is unreliable and its accuracy in characterizing these lesions can be as low as 68%[1]. MRI is normally reserved for patients with inconclusive ultrasound findings. The accuracy of MRI can be as high as 97%[2]. However, false positives do occur affecting appropriate management of patients. Other modalities that could improve the specificity of MRI in the diagnosis of ovarian malignancy are needed. One such modality is proton MR spectroscopy (MRS). Proton MRS in the female pelvis has been largely neglected. There are only a handful of reports using high field strength MRS to study ovarian cyst fluid, surgically excised tissue or ovarian cancer cell lines. There are even fewer reports of in vivo MRS in the female pelvis. The purpose of this work was to determine if in vivo MR spectroscopy using a clinical scanner could provide information to help characterize ovarian lesions.

Methods

30 patients who had a pelvic MRI examination for suspected ovarian pathology underwent MR spectroscopic examination. All MRI and MRS examinations were performed on a 1.5T scanner (GE Signa Advantage, GE medical systems, Milwaukee, USA) in combination with a dedicated phased array pelvic coil. Proton MRS examination was performed using two-dimensional chemical shift imaging (2D-CSI) with the following parameters, TE=70 or 144ms, TR=1000ms, FOV=16cm and 8 X 8 matrix. Spectral processing included 2.5Hz Gaussian line broadening, zero-filling to 4K points before Fourier transform and peak areas were calculated using Gaussian fitting. Both peak area to noise ratio (PNR) and signal to noise ratio (SNR) were calculated for the metabolite peaks.

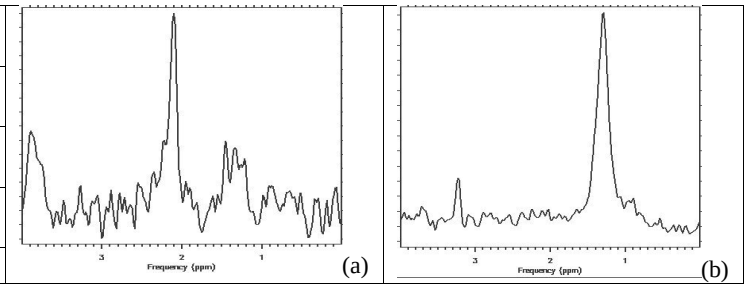
Results

Overall, 24 patients were new and six were follow-up. 12 patients had benign lesions, two had borderline lesions and 16 had malignant lesions. None of the 12 patients with benign lesions had choline nor did the two with borderline lesions. Of the 16 patients with malignancy, 11 were new patients and five were follow-up. Six of the 11 new patients had choline and all of them were greater than FIGO stage 1. Of the remaining five new patients, four were FIGO stage 1. Three of the five follow-up patients had choline (Table 1). The spectroscopic examination was carried out using two different TEs (TE=70 in 16 patients and TE=144 in 14 patients). A long TE is generally used either to reduce the signal from lipid or to detect coupled metabolites such as lactate. We found that lipid contamination in pelvic tumours was minimal and hence were able to use the shorter TE. The average SNRs for the choline peaks when TE=70 and when TE=144 were 10.78 (SD 4.96) and 5.03 (SD 3.38) respectively. The groups were not significantly different (p=0.10, t-test). However, the average PNRs for the choline peaks when TE=70 and when TE=144 were 231.27 (SD 69.85) and 103.88 (SD 72.05) respectively. The difference between the groups was significant (p=0.03, t-test). Two patients had peaks in the 2.07 to 2.10 ppm region (N-acetyl group). Both patients had mucinous tumours (1 benign and 1 borderline). In the benign lesion, SNR for the N-acetyl peak was 4.48 and PNR was 71.42. In the borderline lesion they were 6.36 and 101.51 respectively. The signal and peak area for choline peaks as well as N-acetyl peaks were closely correlated r=0.97 and 0.90 respectively.

Table 1.

16 Malignant				
	11/16 ***New***		5/16 ***Follow-up***	
	6/11	5/11	3/5	2/5
Choline	+	-	+	-
Stage	>1	4/5 = 1		

Figure 1: (a) metabolite peak at 2.09ppm in borderline mucinous tumour. (b) choline peak at 3.20ppm in stage 3c cystadenocarcinoma.



Discussion

Characterization and pre-operative staging are important for correct management of patients with ovarian tumours. Presence of choline in ovarian tumours has been reported previously[3 4 5]. In vitro studies have shown choline concentration to be significantly higher in malignant compared to benign ovarian tumours at high field strengths[3]. Our results show that detection of choline on proton MR spectroscopy at 1.5T is 100% specific in diagnosing ovarian malignancy. However, sensitivity is poor. Combining MR spectroscopic examination with conventional MR examination, which has high sensitivity, will address this issue. Absence of choline in tumour confined to the ovaries (stage 1) will help in accurate pre-operative tumour staging in early disease. We have shown that there is significant difference in signal from choline peaks when a short TE is used and hence a short TE should be used in ovarian tumours. Calculating SNR and PNR provides a more reliable operator independent method of quantification than visual estimation previously reported[4]. We have also shown that the peak areas and signal correlate closely, as expected, and therefore either can be used for metabolite quantification. The presence of N-acetyl peaks in mucinous tumours has not been reported previously. This metabolite peak has been described in cyst fluid from ovarian serous cystadenoma at high field strengths previously[3] and it needs further investigation.

Conclusion

In combination with conventional MR imaging, MR spectroscopy is a powerful tool, which can help in characterization of ovarian lesions and aid in the correct staging of malignant ovarian tumours.

References

[1]Komatsu T, et al., Radiology 1996; **198(1)**:109-115.[2]Medl M, et al., Anticancer Research 1995; 15(3):1123-1125.[3]Boss EA, et al., NMR in Biomedicine 2000;**13**:297-305. [4]Okada T, et al., Journal of Magnetic Resonance Imaging 2001;**13**:912-917. [5]Ferretti A, et al., British Journal of Cancer 2002;**86**:1180-1187.