Clinical significance of creatine peak in in-vivo 1H-MR spectroscopy of gynecologic tumors

M. Takeuchi[1], K. Matsuzaki[1], and M. Harada[1]

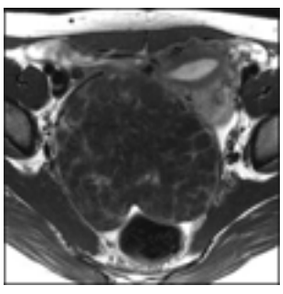
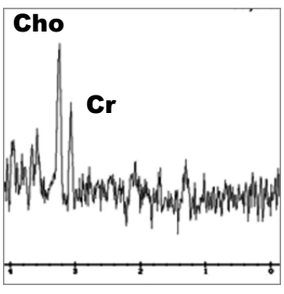
[1]Department of Radiology, University of Tokushima, Tokushima, Tokushima, Japan

[Introduction] Gynecologic tumors may exhibit various morphologic appearances, and specific diagnosis on MR imaging is often difficult. Some uterine tumors such as subserosal leiomyomas may mimic ovarian tumors such as fibromas, and preoperative diagnosis based on imaging is important for the adequate treatment. 1-H MR spectroscopy (MRS) provides metabolic information, and may add valuable information for the diagnosis. The choline peak (3.2 ppm) may be observed in solid tumoral components reflecting metabolic activity of tumor cells and tend to show higher peaks in malignant tumors. However, detecting the choline concentration in the tumor may not contribute to differential diagnosis of gynecologic tumors. Creatine (3.0 ppm) is a marker of normal energy metabolism in the brain. Creatine is a nitrogenous organic acid, which is produced in the human body from amino acids, and helps to supply energy to the body cells by increasing the formation of ATP. About 95% of creatine in the body is located in the muscle. In gynecologic tumors and organs, Okada et al. demonstrated bimodal peaks of choline and creatine in uterine leiomyoma (J Magn Reson Imaging 13, 2001), and Celik et al. reported the presence of creatine peaks in leiomyomas and normal myometrium (Gynecol Obstet Invest 58, 2004). We hypothesized that high concentration of creatine may suggest uterine tumors containing myogenic components, and may contribute to distinguish leiomyomas from ovarian tumors.

[Materials and Methods] Pathologically diagnosed 17 uterine leiomyomas and 61 ovarian tumors (29 primary/secondary cancers, 8 borderline epithelial tumors, 10 sex-cord stromal tumors, 9 benign epithelial tumors, 4 dermoid cysts and 1 fibromatosis) were retrospectively evaluated. MRS (PRESS, TR/TE = 2000ms/144ms) was performed in all subjects on a system with a 3T superconducting units (Signa HDx 3T, General Electric, Milwaukee, WI) with 8ch body-array torso coils. Single voxel of interest (VOI=8ml) was placed on solid tumoral components for heterogeneous lesions so as not to contain cystic or necrotic areas as much as possible by referring all MR images. VOI was placed on cystic area for essentially cystic lesions. The creatine peak was visually evaluated (no, low, high). Quantitative evaluation of the creatine concentration was made by using LCModel (Stephen Provencher Inc.) on the workstation. Mann-Whitney's U test was used to compare the creatine concentration among leiomyomas (n=17) and ovarian tumors (n=16, 45 lesions with no creatine concentration were excluded from all 61 ovarian tumors). A value of $p<0.05$ was considered statistically significant. The creatine concentration cut off value (mM) to differentiate leiomyomas from ovarian tumors was calculated, with their sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

[Results] The creatine peak was observed in all 17 leiomyomas (high, n=13; low, n=4), and 16 of 61 (26%) ovarian tumors (high, n=1; low, n=15). The creatine concentration in leiomyomas (9.17 +/- 6.19 mM) was significantly higher than that in ovarian tumors (3.92 +/- 2.66 mM) ($p<0.01$). Using a cut off value of 6 mM for leiomyoma had a sensitivity of 65%, specificity of 81%, PPV of 79%, and NPV of 68%. One ovarian cancer (endometrioid carcinoma) showed high creatine peak, and 15 ovarian tumors (10 cancers and 5 sex-cord stromal tumors) showed low creatine peaks. 45 ovarian tumors (18 cancers, 8 borderline epithelial tumors, 5 sex-cord stromal tumors, 9 benign epithelial tumors, 4 dermoid cysts and 1 fibromatosis) showed no creatine peak.

[Conclusions] We conclude that high creatine peaks may suggest the presence of myogenic components, and may contribute to distinguish uterine subserosal leiomyomas from ovarian tumors, especially tumors which show low signal intensity on T2-weighted images such as fibromas.

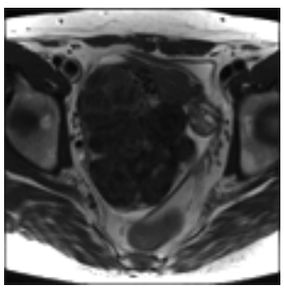
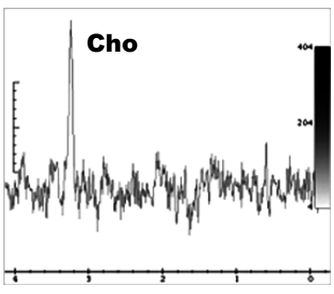



Fig. 1: Subserosal leiomyoma shows low signal intensity on T2-weighted image, and bimodal peaks of choline and creatine on MRS.

Fig. 2: Ovarian fibroma shows low signal intensity on T2-weighted image mimicking leiomyoma, and single high peak of choline on MRS.

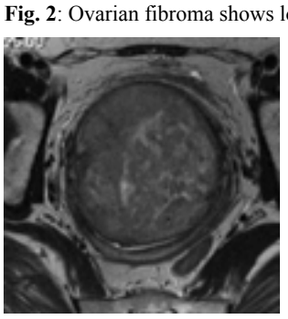
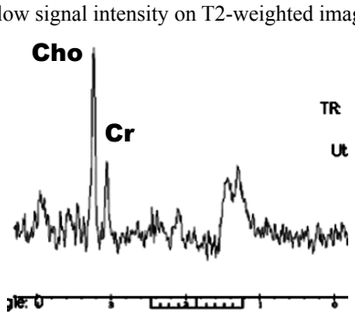



Fig. 3: Cellular leiomyoma shows high signal intensity on T2-weighted image, and bimodal peaks of choline and creatine on MRS.