High intense myometrial tumors on T2-weighted images: Differentiation with diffusion-weighted imaging and 1H-MR spectroscopy

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[Introduction] Most myometrial tumors of the uterus are benign leiomyomas, which typically appear as well-circumscribed low intense masses on T2-weighted images. However, some leiomyomas show high intensity on T2-weighted images and to distinguish them from malignant tumors is often difficult. Various histological conditions (i.e. increase of cellularity, hydropic, cystic or myxoid degeneration) may cause signal increase on T2-weighted images. The purpose of this study is to verify the feasibility of the combination of diffusion-weighted imaging (DWI) with ADC measurement and 1-H MR spectroscopy (MRS) to differentiate high intense benign leiomyomas on T2-weighted images from malignant myometrial tumors with hypercellularity and high metabolic activity.

[Materials and Methods] Surgically proven 37 myometrial tumors including 7 malignant tumors (2 undifferentiated sarcomas, 2 rhabdomyosarcomas, one leiomyosarcoma, one endometrial stromal sarcoma, and one malignant lymphoma) and 30 benign leiomyomas (6 cellular and 24 degenerated leiomyomas) were retrospectively evaluated. All lesions showed predominantly hyperintensity compared to the myometrium on T2-weighted images. DWI with high b-value (b=800 sec/mm^2) was performed in all subjects with a spin-echo, single-shot EPI sequence on a system with a 1.5T/3T superconducting units (Signa Excite/Signa Excite HD 3T, General Electric, Milwaukee, WI) with 8ch body-array torso coils. The parallel image-encoding techniques (the array spatial sensitivity encoding techniques: ASSET, General Electric, Milwaukee, WI) were employed. Signal intensity of the lesions on DWI was visually evaluated (high; slight high; iso to low) compared to the myometrium. The ADCs (x 10^{-3} mm^2/seconds) of the pathologies were measured in a circular ROI from ADC maps on the workstation (AW4.2). ROI 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. Mann-Whitney's U test was used to compare ADCs among malignant tumors and benign leiomyomas, and among cellular leiomyomas and degenerated leiomyomas. A value of $p<0.05$ was considered statistically significant. Among these 37 lesions, MRS (PRESS, TR/TE = 2000ms/144ms) was performed in 4 malignant tumors (one undifferentiated sarcoma, one rhabdomyosarcoma, one endometrial stromal sarcoma, and one malignant lymphoma) and in 9 leiomyomas (2 cellular and 7 degenerated leiomyomas) on a 3T superconducting unit. The choline peak was visually evaluated (high; moderate; low).

[Results] All 7 malignant tumors showed homogeneous or heterogeneous high intensity on DWI, whereas 10 leiomyomas (4 cellular and 6 degenerated leiomyomas) also showed high intensity on DWI. Differentiation of benign and malignant lesions based on the signal intensity on DWI was considered to be difficult. 10 leiomyomas (one cellular and 9 degenerated leiomyomas) showed slight high intensity on DWI, and the other 10 leiomyomas (one cellular and 9 degenerated leiomyomas) showed iso to low intensity on DWI. The ADCs in 7 malignant tumors and in 30 leiomyomas were 0.79 +/- 0.26 and 1.54 +/- 0.35, respectively ($p<0.01$). The ADC in the 6 cellular leiomyomas was 1.18 +/- 0.16, which was significantly lower ($p<0.01$) than that in 24 degenerated leiomyomas (1.64 +/- 0.32) and significantly higher ($p<0.05$) than that in 7 malignant tumors. High choline peaks were observed in all 4 malignant tumors, and in one cellular leiomyoma which showed rapid growth. 3 degenerated leiomyomas showed moderate choline peaks, and 5 leiomyomas (one cellular and 4 degenerated leiomyomas) showed low choline peaks.

[Conclusions] We conclude that it is difficult to differentiate malignant myometrial tumors from cellular/degenerated leiomyomas on the basis of signal intensity on DWI, however, the ADC measurement and MRS may be helpful to distinguish malignant myometrial tumors, cellular leiomyomas, and degenerated leiomyomas.

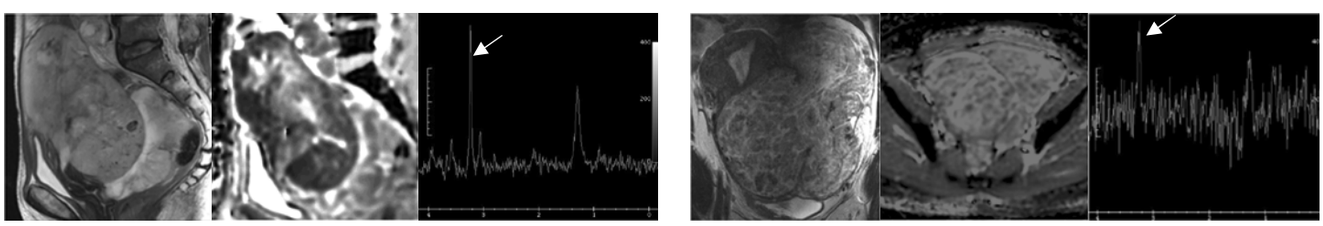

Fig.1: Rhabdomyosarcoma: **a.** T2WI; **b.** ADC map; **c.** MRS, Viable solid part shows low ADC (0.65) and high choline peak (arrow).

Fig.2: Degenerated leiomyoma: **a.** T2WI; **b.** ADC map; **c.** MRS, Solid part shows high ADC (2.21) and low choline peak (arrow).

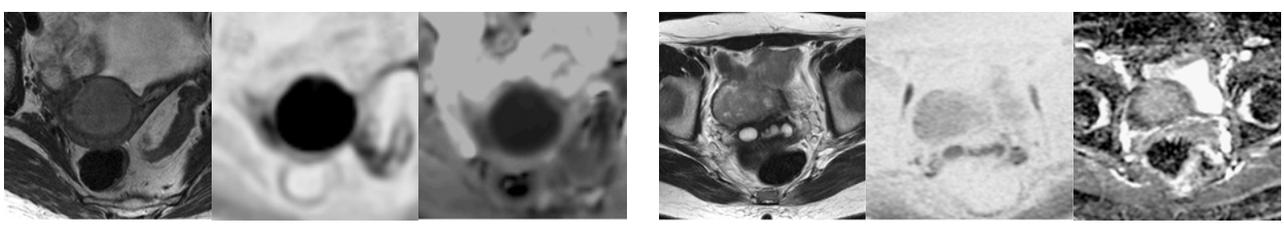

Fig.3: Malignant lymphoma: **a.** T2WI; **b.** DWI; **c.** ADC map, Myometrial mass shows very high intensity on DWI with low ADC (0.56).

Fig.4: Degenerated leiomyoma: **a.** T2WI; **b.** DWI; **c.** ADC map, Myometrial mass shows low intensity on DWI with high ADC (1.84).