MR manifestations of ovarian clear cell adenocarcinomas: A pictorial review

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[Introduction] Because clear cell adenocarcinoma of the ovary is resistant to platinum-based chemotherapy and has a poor prognosis in the advanced stage disease, early detection is important to improve the prognosis and to preserve the fertility. High association with endometriosis (50-60%) may suggest their endometriosis origin. We demonstrate the imaging findings of clear cell adenocarcinomas of the ovary with pathologic correlation and describe the diagnostic clues to detect clear cell adenocarcinomas of the ovary in early stage.

[Materials and Methods] MR imaging findings of clear cell adenocarcinomas of the ovary drawn from the teaching collection at our department were retrospectively reviewed. MR images were obtained on systems with 0.5T, 1T, 1.5T, and 3T superconducting units. Spin-echo T1-weighted images before and after the administration of the contrast medium, and spin-echo or fast spin-echo T2-weighted images were obtained in all subjects. High b-value (b=800 sec/mm^2) diffusion-weighted images (DWI) were obtained in ten patients on systems with 1.5T/3T superconducting units (Signa Excite/Signa Excite HD 3T, General Electric, WI). The ADCs (x 10^{-3} mm^2/seconds) of solid tumoral components were measured in a circular ROI from ADC maps on the workstation (AW4.2). All tumors were surgically resected and histologically diagnosed as clear cell adenocarcinomas.

[Results] Gross appearances of clear cell adenocarcinomas were predominantly cystic, appearing as unilocular (most common), or sometimes multilocular cysts, which may contain serous, mucinous or chocolate-like hemorrhagic fluid (Fig. 1). Hemorrhagic fluid may suggest their endometrial cyst origin, but "the shading sign" on T2-weighted images was rarely observed. These cystic masses contained one or more round polypoid mural nodules protruding into the lumens, which showed slight high intensity with/without small cystic areas on T2-weighted images, intense contrast-enhancement on post-contrast T1-weighted images, and very high intensity on DWI with low ADC (1.10 +/- 0.21). Rarely, large cystic mass may contain irregular solid components, and the irregularity may be caused by self-destruction of solid tumoral components. Microscopically, variety of architectural patterns (papillary, tubulocystic, and solid) and cell types (clear, hobnail, eosinophilic, and flattened), which are often admixed, were observed. Macroscopic manifestations were not correlated with microscopic architectural patterns or cell types. Predominantly solid tumors were less common, and essentially cystic masses may transmogrify to solid masses due to concentric growth of mural nodules. In such masses, compressed and narrowed lumen may be observed within the solid tumor (Fig. 2). Essentially solid tumor was rare, and appeared as non-specific heterogeneous masses reflecting the admixture of various architectural patterns and cell types. Essentially solid tumor may show very low intensity on T2-weighted images mimicking ovarian fibroma reflecting abundant fibrous trabeculae as "clear cell adenocarcinofibroma". Endometriosis-associated clear cell carcinomas were demonstrated as unilateral cystic mass containing hemorrhagic fluid with contrast-enhanced mural nodules. Disappearance of "the shading sign" on T2-weigted images with interval enlargement of the cystic mass was often observed in the endometrial cysts with malignant transformation. Hyperintense hemorrhagic fluid on T1-weighted images masked the contrast enhancement of small mural nodules, and contrast-enhanced subtraction images were useful for evaluating such mural nodules (Fig. 3).

[Conclusion] Unilocular large cystic mass containing serous or hemorrhagic fluid with contrast-enhanced mural nodules is the typical imaging finding of ovarian clear cell adenocarcinoma. Various histologic subtypes may be admixed in a tumor and not correlate with imaging features. Clear cell adenocarcinoma may arise from endometriosis in relatively younger women, and prognosis is poor especially in the advanced stage disease. To detect small contrast-enhanced mural nodules is important for the early diagnosis, and contrast-enhanced subtraction images are helpful to evaluate small nodules in hyperintense cyst on T1-weighted images. The presence of very high intense mural nodules with low ADC is another clue to the diagnosis (Fig. 4).
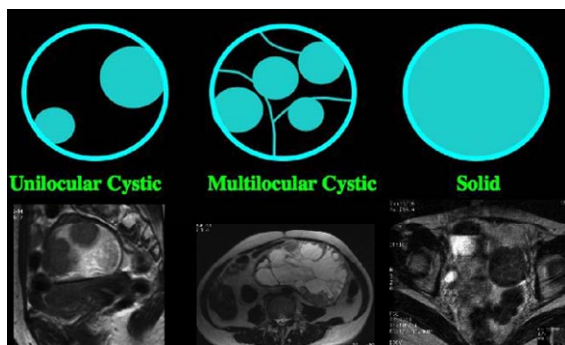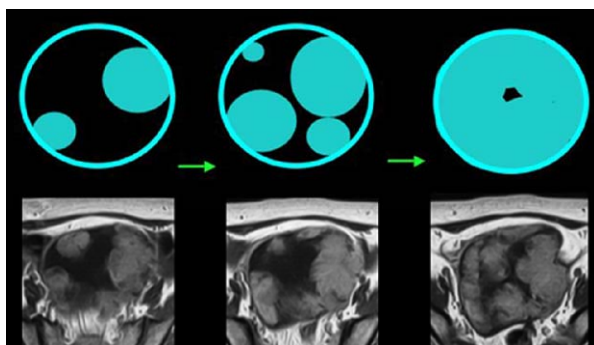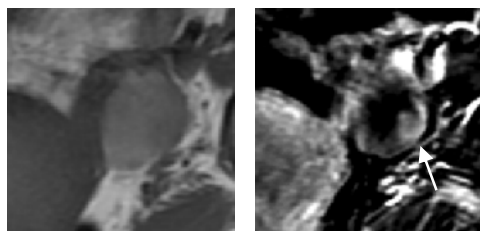

Fig. 1. Gross patterns of clear cell adenocarcinomas **Fig. 2.** Cystic mass may transmogrify to solid mass due to concentric growth of mural nodules
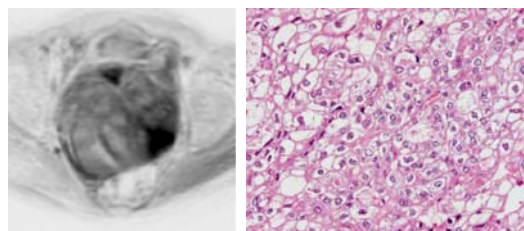

Fig. 3. Malignant transformation of the endometrial cyst: Hyperintense hemorrhagic fluid masked a small mural nodule on T1-weighted image (left). Small contrast-enhanced mural nodule is clearly demonstrated on contrast-enhanced subtraction image (right).

Fig. 4. Mural nodules show very high intensity with low ADC on DWI reflecting high cellularity of tumor cells.