

# Carcinosarcoma of the Uterus: MR Findings including Diffusion-weighted imaging and in-vivo proton MR Spectroscopy

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**[Target audience]** The target audience of this article includes gynecologic radiologists, general radiologists with an interest in gynecologic MR imaging, residents, fellows, and other health professionals interested in the science and practice of gynecologic MR imaging.

**[Purpose]** Carcinosarcoma is the most common subtype of uterine sarcomas. Because the clinical course of carcinosarcomas is aggressive with poor overall prognosis, carcinosarcomas should be differentiated from other common uterine corpus tumors such as endometrial carcinomas, or benign endometrial polyps /hyperplasia. Various imaging characteristics of carcinosarcomas have been reported, however, there is no previous reports of MR findings of carcinosarcomas with diffusion-weighted imaging (DWI) and MR spectroscopy (MRS). The purpose of this study was to clarify the MR imaging characteristics of carcinosarcomas including DWI with ADC measurement and MRS with quantitative metabolite evaluation.

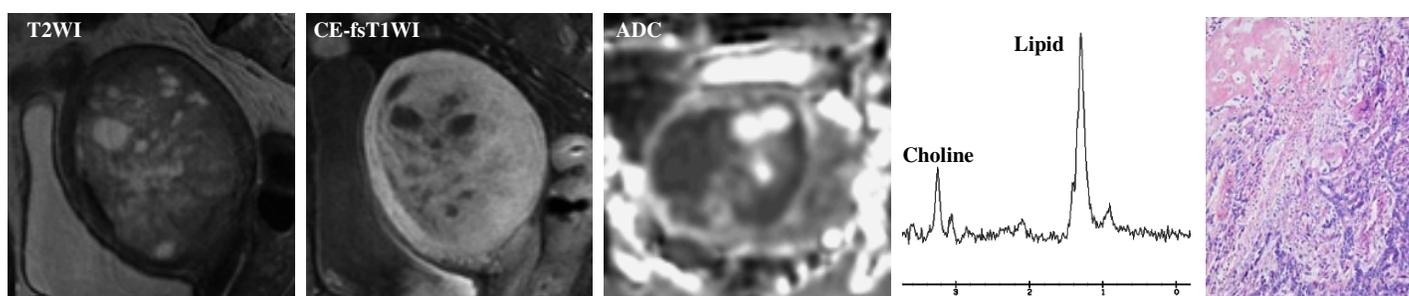
**[Methods]** 11 pathologically proven uterine carcinosarcomas were retrospectively evaluated. MRI and MRS were obtained by using 3T (Signa HDx 3T, General Electric) superconducting unit. Spin-echo, single-shot EPI DW images ( $b=800 \text{ sec/mm}^2$ ) were obtained in all subjects. The mean and minimum ADC values ( $\times 10^{-3} \text{ mm}^2/\text{seconds}$ ) of the tumors were measured in a circular ROI from ADC maps on the workstation. ROI was placed on solid portion of the lesions so as not to contain necrotic or cystic areas as much as possible by referring all MR images. MRS (PRESS, TE = 144ms) was performed in all subjects. Single voxel of interest (VOI=8ml) was placed on solid tumoral components. The choline peak (3.2ppm) and lipid peak (1.3 ppm) were evaluated. The metabolite concentration was classified into three classes, in comparison with the noise level by visual estimation: high, i.e., twofold higher than the average noise level; low, i.e., higher than the average noise level but lower than a twofold higher noise level; none, i.e., the same as the average noise level. Quantitative evaluation of the choline and lipid concentration was made by using LCModel (Stephen Provencher Inc.) on the workstation. We also studied the growth pattern and contrast enhancement (performed in 10 of 11 cases) in each case. 11 carcinosarcomas included 6 homologous (4 endometrial stromal sarcomas, 1 fibrosarcoma, and 1 leiomyosarcoma) and 5 heterologous (4 rhabdomyosarcomas and 1 osteosarcoma) subtypes. The ages of the 11 patients ranged from 53 to 80 years (mean age: 68 years). The tumor size ranged from 49 to 162 mm (mean; 98 mm) at their maximum diameter.

**[Results]** 6 of 11 cases (55%) showed broad-based exophytic growth, 2 cases (18%) showed exophytic growth with a stalk and 3 cases (27%) showed invasive growth. In addition, 4 pedunculated tumors (36%) prolapsed through external os into the vagina. 7 of 10 cases with contrast enhancement (70%) had a strongly enhanced area equal to the myometrium, whereas 3 cases (30%) showed weaker contrast enhancement compared to the myometrium. The mean and minimum ADCs in 11 carcinosarcomas were  $0.92 \pm 0.21$ , and  $0.73 \pm 0.16$ , respectively. In evaluating the MRS, 1 of 11 patients was excluded due to suboptimal spectrum. The choline peak was observed in all 10 carcinosarcomas: 2 low and 8 high peaks. The choline concentration in 10 carcinosarcomas was  $5.38 \pm 2.83 \text{ mM}$ . The lipid peak was observed in all 10 carcinosarcomas: 1 low and 9 high. The lipid concentration in 9 of 10 carcinosarcomas (1 lesion with low lipid peak was excluded because  $\%SD > 20\%$ ) was  $145.39 \pm 122.65 \text{ mM}$ .

**[Discussion]** Tanaka et al. reviewed MR findings of 17 carcinosarcomas and concluded that strongly enhanced areas within the exophytic endometrial lesion may suggest the possibility of carcinosarcomas<sup>1</sup>. In our study the most of carcinosarcomas showed exophytic growth and had strongly enhanced areas corresponded to their results. "Tumor prolapse" may be another characteristic MR findings. The low minimum ADC value may reflect hypercellular viable tumoral component, whereas the relatively higher mean ADC value (compared to the previously reported ADC of endometrial carcinomas:  $0.84 \pm 0.19$ )<sup>2</sup> may reflect heterogeneity of the tumor due to necrosis and epithelial glandular cystic components, which may cause ADC increase. Takeuchi et al. reported the choline concentration in benign ( $4.59 \pm 2.22 \text{ mM}$ ) and malignant ( $9.21 \pm 2.21 \text{ mM}$ ) uterine corpus tumors<sup>3</sup>. Relatively low choline concentration in our series of carcinosarcomas may reflect the reduction of viable tumor cells due to necrosis and epithelial glandular cystic components. The high frequency of high lipid peaks (90%) may also reflect the high necrotic tendency of carcinosarcoma<sup>4</sup>.

**[Conclusion]** Large exophytic endometrial mass, often exhibiting "tumor prolapse", containing strongly enhanced areas may suggest carcinosarcoma. Relatively higher mean ADC with low minimum ADC, relative low choline concentration and high lipid peak may reflect internal heterogeneity of carcinosarcoma due to the admixture of high-grade malignant tumor cells, necrosis, and epithelial glandular cystic components.

**[References]** 1) Tanaka YO. JMRI 2008;28:434-9. 2) Takeuchi M. Acta Radiol 2009;50:947-53. 3) Takeuchi M. Eur Radiol 2011;21:850-6. 4) Takeuchi M. Eur Radiol 2013;23:2358-63.



Large broad-based exophytic mass containing necrosis and epithelial glandular cystic components shows heterogeneous high intensity on T2WI, heterogeneous contrast-enhancement with strongly enhanced areas on CE-fsT1WI. ADC map demonstrates heterogeneous ADC values (mean 0.97/minimum 0.82). Choline concentration is relatively low (3.34mM), whereas necrosis-associated high lipid peak (124.58mM) is observed.