Computed diffusion-weighted imaging for differentiating decidualized endometrioma from ovarian cancer

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A B S T R A C T

Purpose: To evaluate the clinical diagnostic ability of computed diffusion-weighted imaging (DWI) for differentiating decidualized endometrioma from ovarian cancer.
Materials and methods: Computed DWI technique was retrospectively applied to 20 mural nodules in 9 decidualized endometriomas during pregnancy and 20 ovarian cancers. Signal intensities on measured DWI with b values of 800 s/mm^2 (DWI$_{800}$) and on computed DWI with b values of 1500 s/mm^2 (cDWI$_{1500}$) were visually evaluated.
Results: Mural nodules of all decidualized endometriomas showed high signal intensity on DWI$_{800}$ with significantly higher ADC ($2.01 \pm 0.26 \times 10^{-3}$ mm^2/s) and low signal intensity on cDWI$_{1500}$, whereas solid components of all ovarian cancers showed high signal intensity on both DWI$_{800}$ with lower ADC ($1.08 \pm 0.20 \times 10^{-3}$ mm^2/s) and on cDWI$_{1500}$.
Conclusion: Mural nodules in decidualized endometriomas may show high signal intensity on DWI$_{800}$ due to T2 shine-through effect, and cDWI$_{1500}$ can distinguish decidualized endometriomas from ovarian cancers by visual evaluation.

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1. Introduction

Endometriosis is a common benign gynecologic disorder defined as endometrial glands and stroma located outside the uterus. Endometriosis usually affects ovaries as endometriomas, and malignant transformation is a rare but often fatal complication of endometrioma [1]. The most important magnetic resonance (MR) imaging finding for a diagnosis of malignant transformation is the presence of mural nodules within endometrioma [2,3]. Ovarian cancer arising from endometrioma may affect younger women, and may occur during pregnancy [1]. Decidual changes of endometrial tissue in endometrioma during pregnancy may appear as mural nodules mimicking malignant transformation [4–6]. Takeuchi et al. reported that both decidualized endometrial tissues in endometrioma and malignant mural nodules in ovarian cancer showed high signal intensity on diffusion-weighted images (DWI) (b = 800 s/mm^2), and the apparent diffusion coefficient (ADC) of decidualized endometrial tissues was significantly higher than

that of ovarian cancers [6]. Because the vascularized, edematous decidualized endometrial tissue may cause T2 prolongation and show relative high ADC value compared with that of ovarian cancer, signal increase of mural nodules in decidualized endometrioma on DWI may be caused by T2 shine-through effect [6]. Computed DWI is a mathematical computation technique, which synthesizes DWI from at least two acquired DWIs with different b-values, and allows higher b-value images without T2 shine-through effect with maintaining a good signal-to-noise ratio (SNR) [7]. The purpose of this study was to evaluate the clinical diagnostic ability of computed DWI for differentiating decidualized endometrioma from ovarian cancer.

2. Material and methods

The institutional review board in our hospital approved this retrospective study, and waived the requirement for written informed consent of patients. We cross-referenced the database of the Department of Obstetrics and Gynecology to identify all patients with decidualized endometrioma during pregnancy who had undergone MR examinations, including DWI between March 2005 and July 2013. A total of 9 pregnant women (9 weeks 3 days-19 weeks 6 days of gestation) with a mean age of 31 years (range, 25–37 years) were

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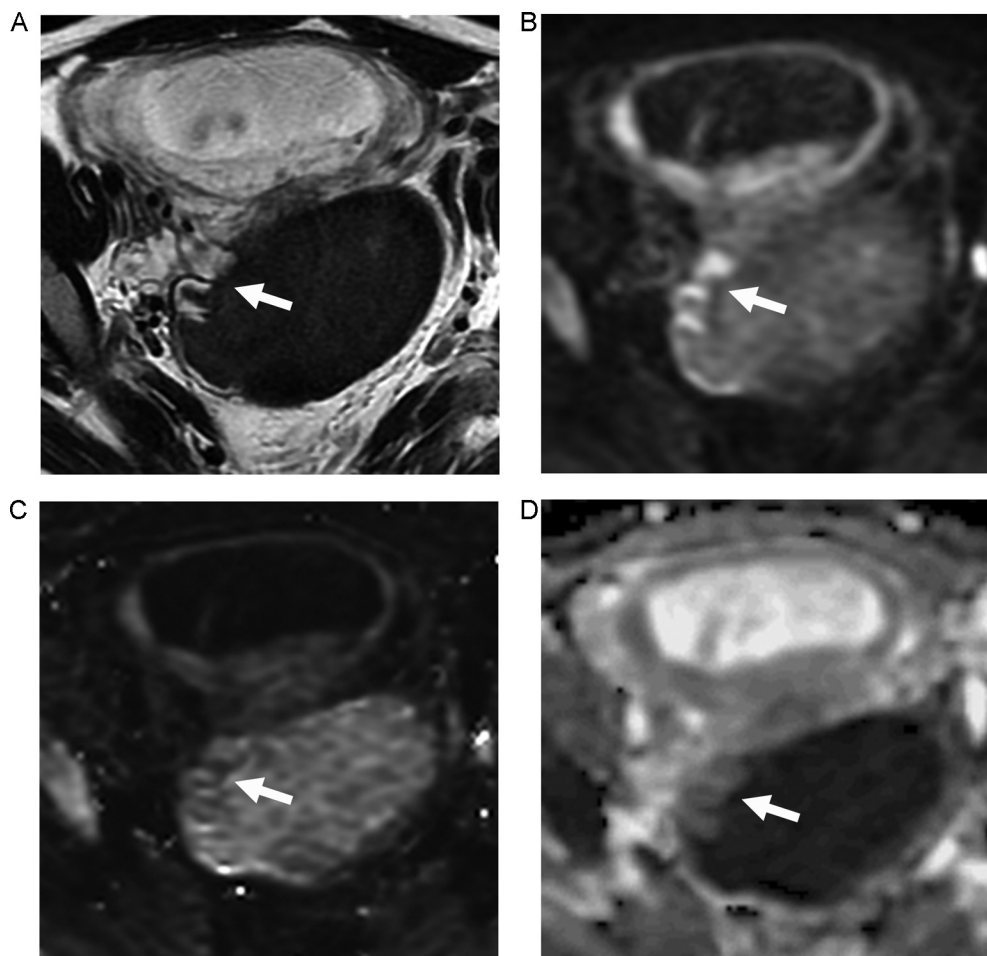masafumi@tokushima-u.ac.jp (M. Harada).

Fig. 1. A 29-year-old pregnant woman with left ovarian decidualized endometrioma. A, Axial fast spin-echo T2-weighted image shows a unilocular cystic mass with "shading" and with very hyperintense small mural nodules (arrow). B, The mural nodules (arrow) show high signal intensities on DWI_{800}, and C, low signal intensities on $cDWI_{1500}$. D, The mural nodules (arrow) show high signal intensities on ADC map.

included in the current study. One case was histologically proven during pregnancy, and the other 8 cases were clinically diagnosed with follow-up of 1 year or more; all mural nodules had shrunk and/or disappeared after delivery on transvaginal ultrasonography and/or MRI. MR images were obtained by using 1.5-T superconducting units (Signa Excite/Excite HD, General Electric, Milwaukee, WI) with 8ch body-array torso coils. Fast spin-echo T2-weighted images and DWI ($b = 800 \, s/mm^2$) were obtained in all 9 patients. The mean ADC values ($\times 10^{-3} \, mm^2/s$) of 20 mural nodules in 9 decidualized endometriomas were measured in a circular region of interest (ROI) from ADC maps on the workstation (AW 4.2, General Electric, Milwaukee, WI). The mean ADC values of 20 pathologically proven ovarian cancers in 18 women (10 clear cell carcinomas, 7 endometrioid carcinomas, 2 serous carcinomas, and 1 mucinous carcinoma) were also measured for comparison. These ovarian cancers were randomly selected from the database. The circular ROI was placed on the solid portion of the lesions so as not to contain cystic areas as much as possible by referring all MR images. The Mann-Whitney *U* test was used to compare ADC values among decidualized endometriomas and ovarian cancers. A value of p < 0.05 was considered statistically significant. Computed DWIs of 9 decidualized endometriomas and 20 ovarian cancers with b values of 1500 s/mm² ($cDWI_{1500}$) were generated from real measured DWIs with b values of 0 and 800 s/mm² (DWI_{800}) by fitting a mono-exponential model by using OsiriX (http://www.osirix-viewer.com) with computed DWI plugin (medITools, Tokyo) on a personal computer (MacBookPro, Apple, OSX). Signal intensities of

the mural nodules in decidualized endometriomas and that of solid portion in ovarian cancers on DWI_{800} and on $cDWI_{1500}$ were visually evaluated and classified as high or low by 2 radiologists with 25 and 16 years of experience in gynecologic MR imaging. Agreement between the 2 reviewers was reached in consensus after careful individual evaluation.

3. Results

All 9 decidualized endometriomas contained one or more high signal intensity mural nodules on T2-weighted images. These mural nodules exhibited high signal intensity on DWI_{800}, whereas all 20 ovarian cancers contained high intensity solid components on DWI_{800}. The ADC value of 20 mural nodules in 9 decidualized endometriomas was 2.01 ± 0.26, which was significantly higher than that of 20 ovarian cancers (1.08 ± 0.20) (p < 0.001). The signal intensity of mural nodules in decidualized endometriomas decreased on cDWI with higher b values, and all mural nodules were classified as low on $cDWI_{1500}$ (Fig. 1). On the other hand, all 20 ovarian cancers still contained high signal intensity solid components on $cDWI_{1500}$ (Fig. 2).

4. Discussion

Decidual change of endometrium of the uterus during pregnancy is induced by gestational progesterone, and may also occur in ectopic endometrial tissue in endometrioma [8]. Decidualized