CASE REPORT

Diffusion-weighted Imaging of a Malignant Brenner Tumor

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(Received September 16, 2011; Accepted November 2, 2011)

Microscopically, ovarian malignant Brenner tumor shows components of malignant transitional cell tumor intermixed with benign and borderline elements. We report a case of this tumor with components that transition from benign to malignant on diffusion-weighted images (DWI) and in histologic findings. The benign component showed low signal intensity on T₂-weighted images, whereas the malignant component showed high signal intensity on T₂-weighted images and high signal intensity on DWI with low apparent diffusion coefficient (ADC) value.

Keywords: *ADC, DWI, malignant Brenner tumor, MRI, ovary*

Introduction

Ovarian Brenner tumor is an uncommon epithelial tumor that comprises only one to 2% of all ovarian tumors, and only 2 to 5% are malignant.^{1–4} Although computed tomography (CT) and magnetic resonance (MR) imaging features of benign Brenner tumors have been described,^{5–7} reports of findings of borderline and malignant Brenner tumors are limited.^{6–9} Moreover, findings of diffusion-weighted imaging (DWI) of malignant Brenner tumor are not reported. We report a case of malignant ovarian Brenner tumor with components that transition from benign to malignant, and we correlate findings from CT and MR imaging, including DWI, with pathological findings.

Case Report

An 85-year-old woman, gravida 2, para 2, with a history of total abdominal hysterectomy for uterine leiomyoma at age 35, underwent surgery for cancer of the cecum at our hospital 2 years prior to this report. At routine follow-up examination, contrast-enhanced CT showed a unilocular cystic mass of 9-cm diameter with solid mural components that included dense calcification in the pelvis (Fig. 1),

and we suspected recurrence or ovarian tumor. Biochemistry revealed serum cancer antigen 125 (CA 125) elevated to 241 IU/mL (reference values, <35 IU/mL).

MR imaging showed a unilocular cystic mass with 2 solid mural components. A part of the solid components that originated from its anterior wall contained dense calcifications on CT and showed very low signal intensity on T₂- (Fig. 2a) and T₁-weighted images (Fig. 2b). The other parts of the solid components that originated from its right side

Fig. 1. Malignant ovarian Brenner tumor in an 85-year-old woman. Contrast-enhanced computed tomography (CT) shows a unilocular cystic mass with mural solid components. Dense calcification was observed in part of the solid components (arrow).

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Fig. 2. Malignant ovarian Brenner tumor in an 85-year-old woman. (a) Axial spin-echo T₂-weighted image (repetition time [TR]/effective time to echo [TE], 4610/94 ms) shows a unilocular cystic mass with 2 mural solid components. The one solid component, which originates from its anterior wall and corresponds with areas of dense calcifications on CT, shows very low intensity (arrow), whereas the other solid component, which originates from the right side wall, is slightly hyperintense with tiny hyperintense spots (curved arrow). (b) Axial spin-echo T₁-weighted image (TR/TE, 659/10 ms) shows the one solid component originating from its anterior wall as an area of low intensity (arrow). (c) Axial diffusion-weighted image (DWI) (b factor = 0, 1000 s/mm²) shows the solid component originating from the right side wall with strong abnormal signal intensity (curved arrow).

wall showed slightly high signal intensity with tiny hyperintense spots on T₂-weighted images (Fig. 2a) and high signal intensity on DWI (Fig. 2c). The apparent diffusion coefficient (ADC) value of the anterior solid component obtained from DWI (b = 0, 1000 s/mm²) was $1.15 \pm 0.12 \times 10^{-3}$ mm²/s, whereas that of the right solid component was $0.84 \pm 0.11 \times 10^{-3}$ mm²/s. Gynecologists performed surgery including right oophorectomy and omentectomy. The tumor originated in the pelvis, replaced the right ovary, and was attached to the greater omentum; macroscopically, it comprised 2 adjacent hard solid areas and one cystic space containing fluid. The cut surface of the solid components of the anterior wall was whitish-yellow and hard with calcification, and that of the right side wall was whitish yellow with a cavitation (Fig. 3a). Histologically, the solid component of the anterior wall showed a

feature of typical benign Brenner tumor that consisted of transitional cells in fibrous stroma with hyalinization and calcification (Fig. 3b). We made a pathological diagnosis of malignant Brenner tumor of the right ovary. The solid area of the right side wall adjacent to the former lesion composed of the solid tumor resembling Brenner tumor with significant atypia and infiltrating high-grade poorly differentiated carcinoma (Fig. 3c). We made a pathological diagnosis of malignant Brenner tumor of the right ovary. Immunohistochemically, both the typical area of Brenner tumor and malignant component were positive for cytokeratin 7 and negative for cytokeratin 20, which was consistent with the immunophenotype of Brenner tumor. Follow-up biochemistry after surgery revealed an elevation of CA-125, from 60 IU/mL following surgery to 128 IU/mL after 3 months, but neither

Fig. 3. Malignant ovarian Brenner tumor in an 85-year-old woman. **(a)** The cut surface of one solid component of the anterior wall is whitish yellow and hard with calcification (arrow), and that of another component of the right wall is whitish yellow with a cavity and a cystic-fluid space (arrowhead). **(b)** Histologic examination of one solid component shows a typical benign Brenner tumor consisting of transitional cells in fibrous stroma with hyalinization and calcification. **(c)** The photomicrograph of another solid component reveals an infiltrating high-grade poorly differentiated carcinoma on the right, and Brenner nest with moderate to severe atypia on the left.

recurrence nor metastasis was detected on CT or MR imaging. Fused [^{18}F]-fluorodeoxyglucose positron emission tomography (^{18}F -FDG PET)/CT undertaken 4 months later revealed a tiny para-aortic lymph node metastasis, and the patient is undergoing radiotherapy.

Discussion

The current World Health Organization (WHO) classification of transitional cell tumor of the ovary includes benign Brenner tumor, Brenner tumor of borderline malignancy, malignant Brenner tumor, and transitional cell carcinoma (non-Brenner type).⁴ The microscopic findings of malignant Brenner tumor show components of malignant transitional cell tumor intermixed with benign and borderline elements, whereas transitional cell carcinoma comprises only malignant elements.^{2,4} Transitional cell carcinoma may be a more aggressive neoplasm than malignant Brenner tumor and tend to present at a higher stage.

Ovarian Brenner tumor is an uncommon epithelial tumor that comprises only one to 2% of all ovarian tumors, and only 2 to 5% are malignant.¹⁻⁴ The entity contains both benign and atypical transitional components.⁴ On average, malignant varieties occur 10 years later than benign tumors. Most malignant Brenner tumors spread locoregionally, with fewer than 50% presenting with extrapelvic metastases.² The current mainstay of treatment is appropriate surgical staging and cytoreduction, though the efficacy of adjuvant chemotherapy and/or radiation therapy is underestimated.³ Brenner tumors typically contain both solid and cystic components and often appear as a large cystic tumor with papillary or polypoid nodule in the wall.⁴

Several authors have reported that imaging features of benign Brenner tumors include very low signal intensity of the solid component on T₂-weighted images, which reflects dense fibrous collagen tissues, and CT findings of extensive amorphous calcification within the tumors.⁵⁻⁷ There have been only five reports of MR imaging findings

of borderline or malignant Brenner tumors.⁶⁻⁹ All four reports demonstrated that the tumor exhibited a cystic tumor with papillary or polypoid solid component. Although Moon's group⁶ described the signal of the solid component on T₂-weighted images as hypointense, the other four authors reported it as medium to high. Takeuchi and associates⁹ demonstrated that the admixture of very low and hyperintense solid components on T₂-weighted images may well correlate with the transition from benign to malignant Brenner components, which is the pathological feature of malignant Brenner tumors, and may be a diagnostic clue to these rare tumors. The CT and MR imaging appearance of our case and Takeuchi's case were similar.

Moreover, in our case, DWI and ADC value were useful in distinguishing benign from malignant solid component in a malignant Brenner tumor. The benign solid component showed medium ADC value ($1.15 \pm 0.12 \times 10^{-3} \text{ mm}^2/\text{s}$) and low signal intensity on DWI, probably as a consequence of the "T₂ black-out effect," whereas the malignant solid component showed low ADC value ($0.84 \pm 0.11 \times 10^{-3} \text{ mm}^2/\text{s}$) and high signal intensity on DWI, reflecting higher cellularity. We believe no report has demonstrated the usefulness of DWI and ADC value in diagnosing a malignant Brenner tumor, and their clinical usefulness in discriminating benign from malignant ovarian tumors has been controversial.¹⁰⁻¹² Takeuchi's team¹⁰ reported a tendency of the ADC of the solid component of malignant/borderline malignant ovarian tumors to be lower than that of benign ovarian tumors, probably because of the higher cellularity and more enlarged nuclei in the malignant/borderline tumor.

Thomassin-Naggara¹¹ and Fujii¹² and their associates demonstrated that ADC measurement did not contribute to the differentiation of benign from malignant ovarian mass because of the frequently low ADC value of benign ovarian tumors, such as fibroma, fibrothecoma, cystadenofibroma, teratoma, and endometrial cyst, and the usually high ADC value of malignant ovarian tumors, such as serous or mucinous borderline malignant tumor and metastatic tumor.

In conclusion, in addition to T₂-weighted images, DWI and ADC value may be useful in distinguishing malignant from benign solid component in malignant Brenner tumor and may be a diagnostic clue to this rare tumor.

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