



Research article

Longitudinal changes in magnetic resonance imaging of malignant and borderline tumors associated with ovarian endometriotic cyst comparing with endometriotic cysts without arising malignancy



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ABSTRACT

Purpose: To investigate magnetic resonance (MR) findings and to detect malignant transformation of ovarian endometriotic cysts by comparing longitudinal changes in patients with ovarian malignant/borderline tumors associated with ovarian endometriotic cysts (tumor group) with those of patients with endometriotic cysts (control group).

Methods: Tumor group patients ($n = 10$) had ovarian malignant/borderline tumors with pathologically confirmed association with endometriosis and available prior MRI of endometriotic cysts. Control group patients ($n = 40$) had been diagnosed more than two times as having ovarian endometriotic cysts by MRI examination. The tumor and solid portion sizes were measured. Two radiologists independently evaluated signal intensity (SI) of the cystic portion on both T1-weighted and T2-weighted images (WI), presence of shading on T2WI, and T2 dark spot sign in both groups and evaluate longitudinal changes of those findings.

Results: Pathological diagnoses of the tumor group were clear cell carcinoma ($n = 6$), endometrioid carcinoma ($n = 1$), serous carcinoma ($n = 1$), mucinous borderline tumor ($n = 1$), and endometrioid borderline tumor ($n = 1$). Tumor size had increased significantly in the tumor group ($p = .004$), but not in controls. Solid portions were identified in all cases only when neoplasms were suspected. Disappearance of shading during the follow-up period was observed more in tumor group ($n = 2$) than in the controls ($n = 0$). No significant difference was found between groups in the SI on T1 and T2WI, and T2 dark spot sign for the two MR examinations.

Conclusions: The MR findings suggesting malignant transformation were emergence of a solid portion and increase in cyst size. Disappearance of shading also facilitates the follow-up of endometriotic cysts.

1. Introduction

Endometriosis is a common gynecological disorder affecting up to 10% of women of reproductive age [1]. In addition to dysmenorrhea and infertility, women with endometriosis confront a higher risk of malignancy [2,3]. An increasing amount of evidence suggests that pre-existing endometriosis increases the risk of developing tumors. The risk of ovarian cancer with a standard incidence ratio is 2.48–8.95 [3,4]. Endometrioid carcinoma, clear cell carcinoma, and seromucinous borderline tumor (SMBT) are associated with endometriotic cysts [5,6]. Advanced age and a large size of the endometriotic cyst are independent predictors of the development of ovarian cancer [7].

Although slightly elevated serum cancer antigen 125 (CA125) level and benign-appearing ovarian cysts are usually present several years before the diagnosis of ovarian cancer, especially in patients with non-serous type ovarian cancer, CA125 level is often elevated in patients with endometriosis without malignancy [4,8,9].

Ultrasonography (US) remains the primary modality of choice for evaluation of ovarian endometriotic cyst, whereas magnetic resonance imaging (MRI) is used as a problem-solving tool for more detailed evaluation. When surgical treatment for endometriosis is under consideration, including pain, infertility and clinical suspicion of malignancy, MRI is commonly used [10]. In MRI studies comparing benign endometriotic cysts with endometriotic cysts associated with malignant

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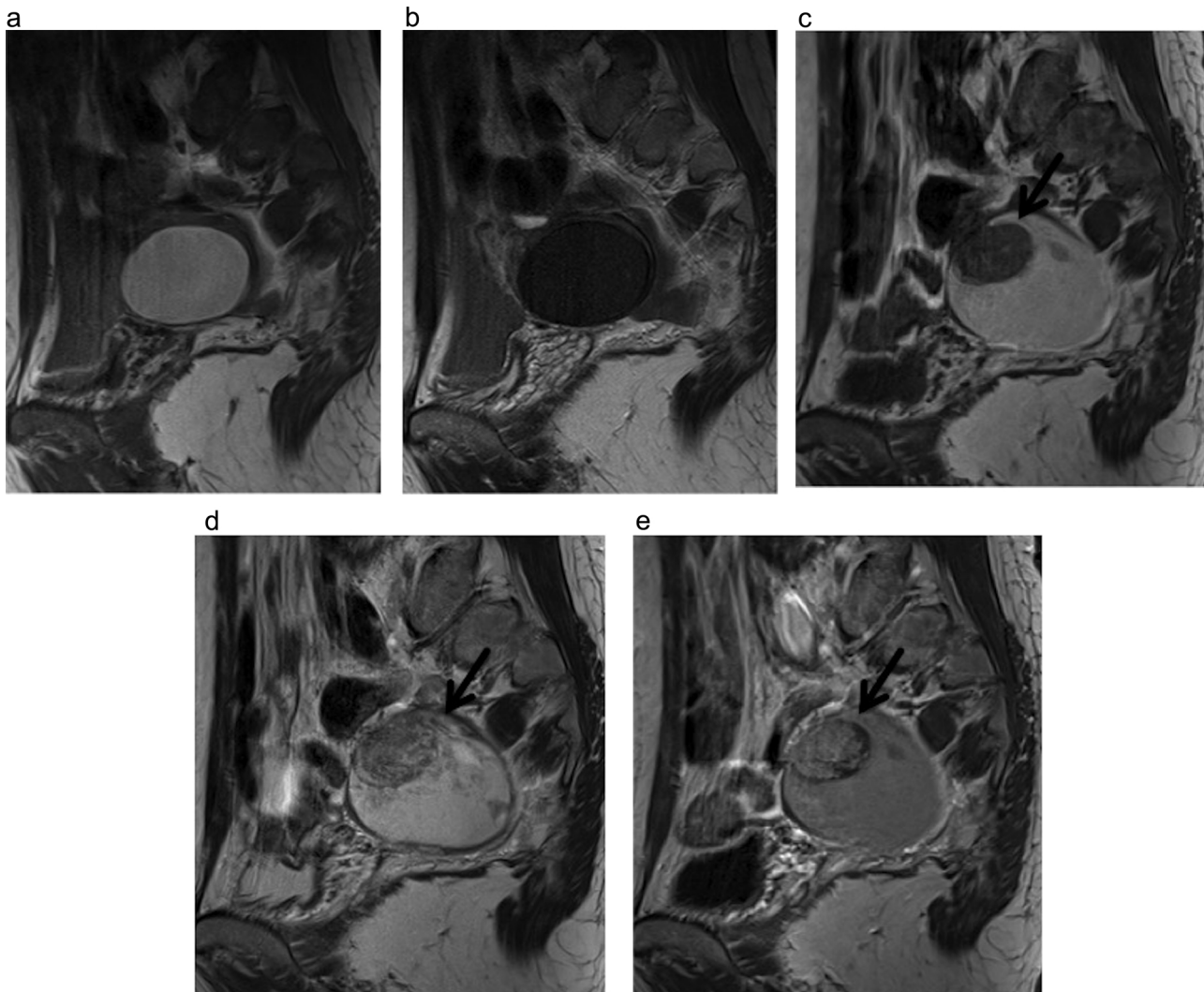


Fig. 1. Longitudinal Change from Endometriotic Cyst to Clear Cell Carcinoma Associated with Endometriotic Cyst of the Left Ovary in a 47-year-old Woman (Case 5, on Tables 1 and 2). A–B. Cystic lesion in the left ovary showed high signal intensity (SI) on T1-weighted image (WI) (A), low SI on T2WI with shading (B). No mural nodule was identified and diagnosed as endometriotic cyst. C–E. T1WI (C), T2WI (D), Post-contrast T1WI (E) of the same woman after 4.5 years. The tumor was enlarged from 54 to 65 mm at largest diameter. Nodular portion on the anterior wall was enhanced after the administration of contrast agent (arrow).

ovarian tumors, enhanced solid portion and large cyst size are signs suggesting malignancy [11–13]. Disappearance of shading within the tumor on T2-weighted images (WI) also suggests malignant transformation [11,13,14]. Obtaining these MR findings would be useful to diagnose malignancy associated with endometriotic cysts. Nevertheless, other than case reports, no report in the relevant literature has described a study confirming the longitudinal changes of the MR findings and the development of previously described findings in a follow up study with the same patients comparing the longitudinal change of endometriotic cysts [15]. The comparison conducted for the present study facilitates detection of early signs of malignancy in the follow-up of endometriotic cysts (Fig. 1).

Therefore, we aimed at evaluating MR findings for detecting malignant transformation of ovarian endometriotic cysts. To do so, we compared longitudinal changes in MRI of patients with endometriotic cysts and of patients with ovarian malignant/borderline tumors associated with ovarian endometriotic cysts.

2. Material and methods

2.1. Study population and patient information

Our institutional review board approved this study. Because of the retrospective study design, informed consent was not necessary. Regarding the tumor group, the radiology database of our institution from 1988 to 2016 was searched to identify patients who had been diagnosed as ovarian malignant or borderline tumors associated with endometriotic cysts on MRI and who underwent surgical resection at our institution. Inclusion criteria were 1) patients with pathologically confirmed ovarian cancer or borderline tumors associated with ovarian endometriotic cysts, and 2) available prior MR images obtained before existence of the neoplastic component (i.e., benign-appearing ovarian endometriotic cyst), either at our institution or at an affiliated private imaging center. After determining the patient group, a control group was selected. Their inclusion criteria were the following: 1) The patients were diagnosed from clinical symptoms and MRI as having an endometriotic cyst and underwent MRI scans more than two times between 2000 and 2016. Patients were selected from that duration because our institution adopted a Picture Archiving Communication System (PACS) in 2000. 2) Patients were confirmed as having

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