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Solid non-invasive ovarian masses on MR: Histopathology and a diagnostic approach

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ABSTRACT

Purpose: The purpose is to clarify the histopathology of the solid, non-invasive ovarian masses and to investigate the MR characteristics that distinguish benign from malignant.
Materials and methods: From 1996 to 2008, we identified 38 cases with predominantly solid non-invasive ovarian masses examined by contrast MR. We evaluated the signal intensity on T2WI and degree of contrast enhancement. In 31 of these cases with dynamic contrast study, we classified the enhancing patterns of the masses into gradually increasing and plateau after rapid increase patterns.
Result: Sixteen cases were benign sex-cord stromal tumors, three were other types of benign tumors, nine cases were diagnosed with primary malignant ovarian tumors, and 10 showed metastatic tumors. Low intensity on T2WI was observed in 15 benign and 2 malignant tumors. The gradually increasing pattern was observed in all 17 benignancies and 5 of the 14 malignancies. In the equilibrium phase, the masses were weakly enhanced in all 19 benignancies and only 4 of 19 malignancies. The diagnostic criteria, that low signal intensity masses with gradual weak enhancement are benign showed 93.3% accuracy and 100% positive predictive value.
Conclusion: Benign solid ovarian masses tended to show low signal intensity on T2WI and gradual weak enhancement.

1. Introduction

Since the introduction of ultrasound (US), solid ovarian masses are often considered as malignant by US [1,2], computed tomography (CT) [3–5], and magnetic resonance imaging [5,6]. However, benign predominantly solid ovarian masses, such as fibrothecoma [7–10], Brenner tumor [11–13], and sclerosing stromal tumor [14–16], have been reported. Ancillary findings such as direct invasion, intraperitoneal dissemination, and lymph node metastases are diagnostic clues to distinguish between benign and malignant ovarian tumors [6]. In the absence of ancillary findings, the tumors have to be diagnosed with parameters characterizing the ovarian mass proper, such as T1 and T2 relaxation time, degree and pattern of contrast enhancement, and the apparent diffusion coefficient (ADC) [17].

The purpose of this study was to identify histopathology and MR findings that help to distinguish between benign and malignant solid non-invasive ovarian masses.

2. Materials and methods

From June 1996 to March 2008, we performed 3404 consecutive MR examinations for gynecologic disease; these examinations were conducted according to the Declaration of Helsinki. By reviewing our institutional database, we identified 67 cases with solid non-invasive pelvic masses in which more than half of the mass was solid and without ancillary findings for malignancy, such as direct invasion to the adjacent organ, lymph node metastases, or intraperitoneal dissemination. Cases with massive ascites were included because even benign tumors sometimes accompany massive ascites; this condition is known as the Meigs or pseudo-Meigs syndrome. Among the 67 cases, 28 were excluded due to extra ovarian origin, without histopathology, with torsion or subtle ancillary findings discovered during past analysis. An additional case was excluded after total hysterectomy, because the signal intensity of the mass could not be compared to that of the uterus. Therefore, the remaining 38 cases were included in this study; the patients were 12–80 years old (mean, 48.6 years old).

MR examinations were performed with a 1.5-T superconducting unit (Gyroscan, Philips Healthcare, Best, The Netherlands). Images were obtained with a phased-array body coil and butyl scopolamine (Buscopan, Boehringer Ingelheim, Ingelheim am

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Table 1
Histopathological diagnosis of the cases.

Benign	Benign sex-cord stromal tumors	Fibrothecoma	15
		Stromal tumor with minor sex-cord elements	1
		Sclerosing stromal tumor	1
	Brenner tumor		1
	Leiomyoma		1
Malignant	Malignant epithelial tumors	Serous borderline tumor	1
		Mucinous adenocarcinoma	1
	Carcinofibroma		1
	Granulosa cell tumor		1
	Dysgerminoma		1
	Malignant lymphoma		4
	Metastatic tumors		10

Rhein, Germany) was administered intramuscularly, just before the examination to reduce bowel peristalsis. Axial or sagittal T1- and T2-weighted images (T1WI and T2WI) with a 28-cm field of view were obtained. T1WI were obtained with a spin-echo sequence (TR/TE = 340–545/11–20 ms, 4–10 mm slice thickness with a 0.4–2 mm intersection gap, and 2–4 excitations), and T2WI were obtained with a fast spin-echo (TR/TE = 1800/100 ms, 16 echo train length, 4–10 mm slice thickness with a 0.4–2 mm intersection gap, and 2 excitations). After administration of contrast materials (5 mmol of gadopentetate dimeglumine; Magnevist, Beyer-Schering Pharma, Berlin, Germany), T1WI (the same parameters as before contrast enhancement) were obtained in all cases. A 2D dynamic contrast study with a Turbo Field Echo (TR/TE = 12/4.6 ms, 8–10 mm slice thickness, 2–6 planes, 6 excitations, and temporal resolution of 10–31 ms) was performed in 31 cases.

MR examinations were reviewed without knowledge of the histopathological diagnoses by two radiologists' consensus reading. We classified signal intensity on T2WI into low, iso, and high signal intensity compared to those of the outer myometrium (Fig. 1). The enhancing pattern of the dynamic contrast study was classified into gradually increasing and plateau after rapid increase pattern (Figs. 2 and 3). At the beginning, we constructed a time-intensity curve in each case and after visual inspection, classified it into two patterns. Contrast enhancement in the equilibrium phase was also classified into weak, iso, and strong compared to those of the outer myometrium (Fig. 4).

Surgery, including oophorectomy of the affected side, was performed in all cases. Our institutional pathologists performed the histopathological diagnoses.

3. Results

The histopathological diagnoses are listed in Table 1. Seventeen of the 19 benign tumors were sex-cord stromal tumors (15 fibrothecoma, 1 stromal tumor with minor sex-cord element and 1 sclerosing stromal tumor). The remaining benign tumors were a Brenner tumor and a leiomyoma. Ten of the 19 malignant tumors were metastatic. The primary site of these tumors was the stomach in 4, the colon in 2, the breast in 2, and the endometrium in 2. Among the remaining nine malignant tumors, four were lymphoma and the remaining were a serous surface papillary borderline tumor, a mucinous adenocarcinoma, a carcinofibroma, a granulosa cell tumor, and a dysgerminoma.

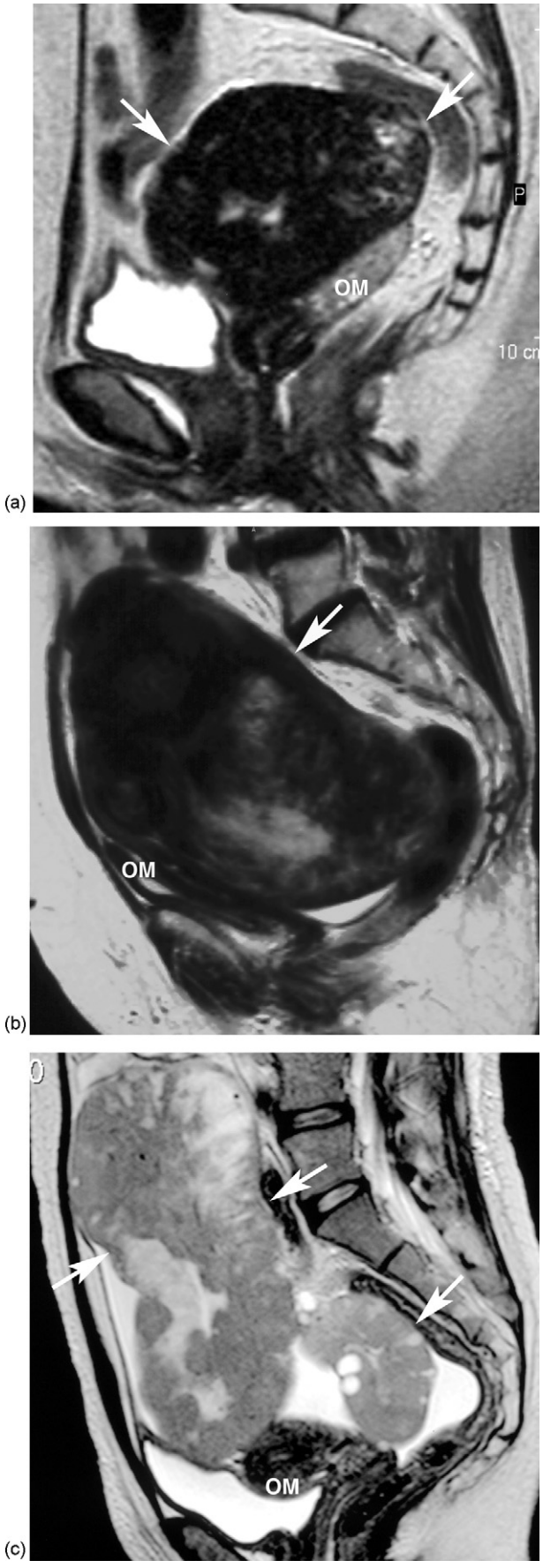

Fig. 1. Signal intensity on T2-weighted images. The signal intensity on the T2-weighted images was classified into three types compared to the outer myometrium (OM): (a) low, (b) iso, and (c) high.