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Magnetic resonance imaging evaluation of non ovarian adnexal lesions☆

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ABSTRACT

Differentiation of nonovarian from ovarian lesions is a diagnostic challenge. MRI (Magnetic Resonance Imaging) of the pelvis provides excellent tissue characterization and high contrast resolution, allowing for detailed evaluation of adnexal lesions. Salient MRI characteristics of predominantly cystic lesions and predominantly solid adnexal lesions are presented along with epidemiology and clinical presentation. Due to its excellent soft tissue resolution, MRI may be able to characterize indeterminate adnexal masses and aid the radiologist to arrive at the correct diagnosis, thus positively affect patient management.

1. Introduction

A wide array of pathologies may present as a nonovarian adnexal lesion. Accurate differentiation of such lesions from ovarian lesions and accurate lesion characterization are important, as correct diagnosis is crucial to avoid treatment delay or unnecessary therapy [1]. These lesions are usually first encountered with ultrasound; however, pelvic ultrasonography may sometimes lack specificity and will not be covered in this review [2]. MRI offers excellent tissue characterization due to high soft tissue contrast and can aid in the diagnosis of such pathologies when incompletely evaluated with pelvic ultrasonography [2]. MRI also offers high spatial resolution and multiplanar imaging capability, such that differentiation between nonovarian and ovarian lesions is feasible. The presence of a normal-appearing ipsilateral ovary essentially excludes the presence of an ovarian lesion, whereas lack of visualization of a normal ovary may indicate an ovarian or nonovarian origin. MRI characterization of a nonovarian adnexal lesion is based on its morphology, signal intensity, and enhancement characteristics [1]. The purpose of this pictorial review is to discuss the key MRI features and clinical highlights of the most common cystic and solid nonovarian adnexal lesions.

2. Normal anatomy

The ovarian fossae, where the ovaries are generally seen in nulliparous women, are shallow peritoneal depressions occupying the lateral aspects of the rectouterine space bilaterally, located posterior to the broad ligaments and anterior to the ureters and internal iliac arteries [3]. Ovarian position may be quite variable depending on urinary bladder distention, uterine size, recto-sigmoid distention, and presence of a pelvic lesion [3].

3. MRI technique

MRI of the female pelvis may be performed on a 1.5 or 3 Tesla magnet. Three Tesla imaging provides increased signal to noise and CNR (contrast to noise ratio) to improve image resolution and shorter image time [4]. Drawbacks of using higher magnetic field strength include increased magnetic susceptibility, chemical shift, and RF (radio frequency) inhomogeneity [4]. The exact MRI protocol is guided by the clinical setting and by the available MRI scanner. Typically, axial T1-weighted images without and with fat suppression are obtained in order to differentiate macroscopic fat (which has high signal intensity on T1-weighted images without fat suppression and low signal intensity on fat-suppressed T1-weighted images) from proteinaceous fluid or subacute hemorrhage (which have high T1-weighted signal intensity without or with fat suppression). In addition, multiplanar T2-weighted images are also obtained, often with fat suppression in the coronal plane to demonstrate lesional internal architecture including cystic and solid components (Table 1), and to delineate the anatomical relationship of the lesion with respect to the ipsilateral ovary and other pelvic organs. They are also useful for visualization of the internal

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Table 1
Differential diagnosis of nonovarian adnexal lesions

Cystic	Solid
❑ Tuboovarian abscess	❑ Uterine leiomyoma
❑ Ectopic pregnancy	❑ Fibrotic endometriosis
❑ Paraovarian cyst	❑ Fallopian tube carcinoma
❑ Peritoneal Inclusion cyst	❑ Retrorectal masses
❑ Hydro-/Pyo-/Hematosalpinx	❑ Congenital uterine anomalies
❑ Pelvic congestion syndrome/pelvic varices	❑ Pelvic metastases
❑ Tarlov cyst	
❑ Mucocele of appendix	
❑ Bladder diverticulum	
❑ Pelvic hematoma	
❑ Lymphocele	
❑ Endometriosis	

architecture of the uterus and cervix. Diffusion-weighted Imaging (DWI) [with associated apparent diffusion coefficient (ADC) parametric map images] may also be obtained for improved detection and characterization of pelvic pathology [2]. Qualitative assessment of signal intensities on diffusion-weighted images has shown significant differences in benign and malignant pathology, with high signal intensity observed more frequently in malignant lesions [5]. The combination of diffusion-weighted images with conventional MRI has been shown to improve the staging of ovarian cancer and peritoneal metastases. While ADC values for differentiating benign and malignant pathologies has widely varied among institutions for certain diseases such as cervical cancer, other entities such as peritoneal implants demonstrate restricted diffusion on DWI images with associated ADC values [5–7]. Multiplanar fat-suppressed T1-weighted images after administration of intravenous gadolinium-based contrast agent (IV GBCA) are also obtained when possible in order to detect solid tissue components, peritoneal extension of disease, and vascular involvement. Please note, however, that IV GBCA is not administered to women who are pregnant or suspected to be pregnant.

At our institutions, MRI is conducted for all patients by means of a 1.5-T or 3T system (Magnetom Symphony, Siemens, Erlangen, Germany) with the manufacturer's body and spine array coils. First, we obtain axial T2 images through the entire pelvis [repetition time (TR)/echo time (TE): 5700/101; flip angle: 150°; slice thickness: 6 mm; matrix: 180×320) followed by T1 images without fat suppression (TR/TE: 546/12; flip angle: 60°; slice thickness: 6 mm; matrix: 154×320) and T2 spacial coronal images (TR/TE: 1400/163; flip angle 60°; slice thickness: 12 mm; matrix: 154×320). DWI images (TR/TE: 3700/82; flip angle: 70°; slice thickness: 6 mm; matrix: 154×320). Sagittal volumetric interpolated breath hold examination (VIBE) (TR/TE: 10.2/4.85; flip angle: 70°; slice thickness: 4 mm; matrix: 154×320). Axial VIBE DWI images (TR/TE: 9.95/4.73; flip angle: 70°; slice thickness: 4 mm; matrix: 154×320). Post contrast images (TR/TE: 9.95/4.73; flip angle: 70°; slice thickness: 4 mm; matrix: 154×320).

4. Tubo-ovarian abscess (TOA)

TOA typically presents as a complex lesion that involves the fallopian tube and/or ovary [8] and is the most common type of pelvic abscess in women of reproductive age [8]. In patients presenting with clinical symptoms of pelvic inflammatory disease, the presence of an adnexal lesion, age greater than 42 years, and elevated erythrocyte sedimentation rate >50 mm/h (normal 0–10 mm/h) have been shown to be the best predictors of TOA [9]. With widespread use of the broad-spectrum antibiotics, conservative treatment of TOA is usually successful [10]. On MRI, TOA typically appears as a complex cystic lesion with internal septations, fluid–fluid or fluid–debris levels, and a thickened rim of 5 mm or thicker [11]. A tubular fluid-filled structure due to pyosalpinx is also often seen. Low signal intensity foci of nondependent gas may also be seen on T1-weighted and T2-weighted images, and the fluid contents have variable signal intensity depending on the presence and concentration of proteinaceous and cellular material but is often hypointense on T1-weighted images and hyperintense on T2-weighted images (Fig. 1) [10]. Following administration of IV GBCA, enhancement of the septa and walls may be noted [10]. Secondary findings include edema and inflammation of surrounding tissues with associated increased T2-weighted signal intensity and enhancement involving the mesenteric and omental fat, peritoneal thickening and enhancement, and pelvic organs.

5. Ectopic pregnancy

Implantation of the blastocyst at any site outside of the endometrium is termed *ectopic pregnancy*. Adhesions and scarring from prior inflammation lead to delayed tubal transit of embryo and prevent implantation in the endometrium. Several predisposing risk factors have been identified, such as previous ectopic pregnancy, previous tubal surgery, pelvic inflammatory disease, infertility, and smoking [12,13]. The most common location for ectopic pregnancy is the fallopian tube [14]. Levels of serum beta human chorionic gonadotropin are usually abnormally elevated [15]. Although ultrasonography is the primary modality for the diagnosis of ectopic pregnancy, MRI can be helpful in equivocal cases, especially with presence of an interstitial or abdominal ectopic pregnancy. On MRI, a heterogeneous cystic lesion with a thickened wall and variably increased T1-weighted signal intensity components (due to subacute hemorrhage) and variably decreased T2-weighted signal intensity components (due to acute or subacute hemorrhage) may be seen (Fig. 2). Additional findings such as hematosalpinx and hemoperitoneum may also be present [14,15].

6. *Para*-ovarian cyst

The *para*-ovarian (or paratubal) cyst arises within the broad ligament as a remnant of the Wolffian or Mullerian ducts usually adjacent to the ovary. This is most common in women in the third–fourth decades of life [16], accounts for 10–20% of adnexal lesions, and may be bilateral or multiple [17]. A paraovarian cyst does not show cyclical change, whereas an ovarian cyst does. Most paraovarian cysts are benign. Predictors for malignancy include size over 5 cm, internal papillary excrescences and occurrence in reproductive-age women [18,19]. On MRI, *para*-ovarian cysts are round or ovoid cystic lesions that are separate from the ipsilateral ovary (Fig. 3), have thin walls with no or minimal enhancement, and contain simple fluid with low T1-weighted signal intensity and very high T2-weighted signal intensity relative to skeletal muscle [20]. Hemorrhage within the cyst may lead to variably increased T1-weighted signal intensity and variably decreased T2-weighted signal intensity, and wall thickening or internal septations may also be present (Fig. 3). Demonstration of enhancing soft tissue component after IV GBCA is worrisome for neoplasm. *Para*-ovarian cysts may also lead to ovarian torsion or rarely isolated tubal torsion [21] (Fig. 4).

7. Peritoneal inclusion cyst

Localized peritoneal fluid contained by mesothelial lined adhesion is termed *peritoneal inclusion cyst*. It is commonly seen in premenopausal women with functioning ovaries and pelvic adhesions [22]. Other predisposing factors include prior abdominal surgery, trauma, pelvic inflammatory disease, and endometriosis. On MRI, peritoneal inclusion cysts have low T1-weighted signal intensity and very high T2-weighted signal intensity of simple fluid. Peritoneal inclusion cysts may be unilocular or septated, typically have thin minimally enhancing walls, have ill-defined borders defined by the peritoneal cavity, and abut and often surround one or both ovaries which appear normal (Fig. 5). Occasionally, high signal intensity on T1-weighted images may be seen due to presence of proteinaceous fluid or hemorrhage [23].