Benign physiologic conditions and tumor-like lesions simulating neoplasms in the female pelvis: Clues to the differential diagnosis

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Learning objectives

To demonstrate various benign physiologic conditions and tumor-like lesions simulating neoplasms in the female pelvis, and to describe clues to the differential diagnosis.

Background

Physiologic conditions may affect the morphologic appearances of female reproductive organs. Benign physiologic conditions and tumor-like lesions may mimic neoplasms in the female pelvis.

Imaging findings OR Procedure details

[Non-neoplastic ovarian enlargement]
Non-neoplastic ovarian enlargement mimicking solid or multilocular cystic tumors may occur under various conditions: Massive ovarian edema following chronic incomplete torsion, Polycystic ovaries and Ovarian fibromatosis with stromal proliferation, Hyperreactio luteinalis and Ovarian hyperstimulation syndrome caused by the endogenous or exogenous hormonal stimulation, and Oophoritis/Tubo-ovarian abscess due to infection. Recognition of preserved follicles on imaging and understanding of clinical information are important for the diagnosis.

Massive ovarian edema (MOE) (Fig. 1 on page ) is benign ovarian enlargement affecting young women. Intermittent torsion causes partial obstruction of venous / lymphatic drainage, accumulation of edema fluid within the stroma, and ovarian enlargement. Patients complain lower abdominal pain, which is intermittent of several months to years’ duration. Diagnosis based on imaging is important in selecting conservative treatment. On CT US, MOE appears as non-specific solid mass mimicking ovarian tumor. By demonstrating multiple peripherally located high-intense ovarian follicles and enlarged high intense edematous stroma on T2WI, MOE is distinguishable from neoplasms exhibiting edematous or myxoid appearance such as fibroma, sclerosing stromal tumor or Krukenberg’s tumor. Contrast enhancement after the administration of contrast medium is helpful in differentiating MOE from complete torsion, which may occasionally cause tumor-like ovarian enlargement (Fig. 2 on page ).

Polycystic ovaries (PCO) (Fig. 3 on page ) may occur as a result of various disorders leading to abnormal gonadotropin secretion. Clinical manifestations of PCO are infrequent - anovulation, infertility, obesity, and hirsutism. Usually patients with PCO have bilateral enlarged ovaries, and in 28 to 40% of patients have normal sized ovaries. Ovarian enlargement in PCO is caused by stromal proliferation due to chronic stimulation by luteinizing hormone. Endometrial hyperplasia and endometrial cancer may occur by estrogenic stimulation, typically in obese patients under 40 years of age. Typical MR manifestations are multiple, small peripheral high intense cysts beneath low intense thickened outer cortex, and abundant low intense central stroma on T2WI. Thickened
outer cortex and central stroma show prominent contrast enhancement, in contrast to unenhanced subcapsular follicular cysts. **Ovarian fibromatosis** (Fig. 4 on page ) is rare benign, non-neoplastic condition with ovarian enlargement in young women affecting one or both ovaries. Patients may be asymptomatic, or complain menstrual abnormalities, abdominal pain, hirsutism or virilization. Ovarian fibromatosis is characterized by a proliferation of collagen-producing spindle cells surrounding normal ovarian structures. On MRI, fibroma-like signal intensity pattern due to fibrous stromal proliferation, and preservation of the ovarian structures within the mass: thickened low intense fibrous stroma of cortex surrounding normal ovarian structures on T2WI as "black garland"-like appearance is characteristic, but not always observed. **Hyperreactio Luteinalis** is ovarian enlargement caused by the endogenous (during pregnancy) or exogenous hormonal stimulation (during ovulation induction therapy: **Ovarian hyperstimulation syndrome: OHSS**). Hyperreactio luteinalis (Fig. 5 on page ) usually affects bilateral ovaries, and may occasionally affect unilateral ovary. Prominent enlargement of follicles is characteristic, and residual parenchyma, which shows high signal intensity on diffusion-weighted imaging (DWI) and contrast enhancement, may mimic solid portion of mucinous tumor. OHSS manifests as bilateral ovarian enlargement with ascites (Fig. 7 on page ). Ovarian involvement in pelvic inflammatory disease (PID) usually takes a form of bilateral **Oophoritis/tubo-ovarian abscess** (Fig. 8 on page ) (Fig. 9 on page ) (Fig. 10 on page ) secondary to salpingitis due to infection. Symptoms are typically lower abdominal pain, and less consistently fever, vaginal discharge or bleeding, and urinary symptoms. Subclinical patients are common and a history of infection is present only in one-third to one-half of patients. Because the symptoms vary in large scale and may be atypical, and 20% of the patients have a normal leukocyte count and are afebrile, the clinical diagnosis is often difficult on the basis of clinical signs and symptoms. On imaging, ill-defined adnexal mass with thick, irregular walls containing fluid suggests tubo-ovarian abscess. Oophoritis may appear as Polycystic ovaries (PCO)-like appearances. Tortuous, fluid-filled tubal lumen with or without thickened wall suggests hydro/pyosalpinx may often be associated with oophoritis/tubo-ovarian abscess. In some cases with mild to moderate degrees of inflammatory processes, preserved ovarian follicles may be observed peripherally on T2WI and suggest their benign nature. Pyogenic abscess may show very high intensity on DWI, and may be easily distinguished from other cystic pathologies (Fig. 10 on page ).

**[Endometriosis-associated benign pathologies mimicking tumors]**

Endometriosis may occasionally mimic neoplasms: Decidualization associated with pregnancy, and polypoid endometriosis may mimic malignancies in ovaries, vagina or peritoneal cavity. Endometriosis may involve intestine, bladder, and abdominal wall, and simulate cancers. **Decidualization**: With the hypertrophy of the endometrial stromal cells, the normal uterine endometrium may thicken and transform to the decidua induced by progesterone during pregnancy. This phenomenon may also occur in ectopic endometrial tissue such as ovarian endometrioma. Decidualization in endometrioma may manifest as mural
nodules and mimic malignant transformation (Fig. 11 on page ) (Fig. 12 on page ). The signal intensity of mural nodules in decidualized endometrioma on MRI are similar to that of the endometrium or placenta: prominent high intensity on T2WI, which is atypical for mural nodules in endometrioma with malignant transformation: slightly high to intermediate intensity on T2WI. The decidualized mural nodules show contrast-enhancement like malignant transformation of endometrioma. The morphologic appearance of the mural nodules are various such as linear, small nodular, broad-based nodular, or polypoid. Most nodules are small less than 1 cm, but occasionally may be over 2 cm in size. On DWI, decidualized mural nodules show high signal intensity mimicking malignant mural nodules. The edematous, vascularized decidualized endometrial tissue may cause T2-prolongation and relative high apparent diffusion coefficient (ADC) values (2.10 +/- 0.32) compared to those of malignant tumors (1.05 +/- 0.13) with high cellularity and reduced extracellular space, which may cause restriction of the water motion (Fig. 12 on page ). (Takeuchi. JCAT:32, 2008) Decidualization of ectopic endometrium may also occur in extra-ovarian endometriosis such as vagina or peritoneal cavity and may mimic malignancy. DWI may be also useful in such lesions (Fig. 13 on page ).

**Polypoid endometriosis** (Fig. 14 on page ) is a rare variant of benign endometriosis with histologic features resembling uterine endometrial polyp, forming large, often multiple polypoid masses simulating malignant tumors at operation. Hormonal factors such as unopposed estrogen therapy or tamoxifen use may play a role in its pathogenesis. The morphologic appearance of polypoid endometriosis is similar to that of malignant tumors such as peritoneal dissemination. The presence of surrounding adhesive fibrous tissue showing hypointensity on T2WI as "black rim sign" suggests its origin from pelvic endometriosis. Endometrial stromal sarcomas may arise from extra-ovarian endometriosis and the problematic lesions to differentiate from polypoid endometriosis. Infiltration to the adjacent organs or vessels may suggest their malignant nature.

**Extra-ovarian endometriosis** such as abdominal wall, bladder and bowel involvements may mimic neoplasms. **Bladder endometriosis** (Fig. 15 on page ) may appear as a bladder wall mass. The posterior wall and the dome are common affected areas. Less than 30% of patients suffer from cyclical hematuria, because endometrial deposits are usually submucosal and mucosal infiltration is relatively rare. Endometrial lesion in the bladder wall may show hypointensity on T2WI reflecting fibrosis. Small hemorrhagic foci may show hyperintensity on T1WI. The rectosigmoid is the most common areas of bowel endometriosis (Fig. 16 on page ). Endometrial implants adhere to the bowel serosa and may invade the muscle layers with marked smooth muscle proliferation, which may cause irregular bowel wall thickening with stricture formation resembling carcinomas. Bowel endometriosis does not cause mucosal involvement unlike carcinomas, which is a helpful finding to differentiate endometriosis from carcinomas on barium enema examination or colonoscopy. **Abdominal wall endometriosis** (Fig. 17 on page ) usually develops in association with previous surgical scars such as cesarean section, but spontaneous abdominal involvement may also occur. Cyclic abdominal discomfort or pain with a palpable mass may suggest endometriosis. Endometriosis involving abdominal wall or other subcutaneous regions may appear as inhomogeneous intense masses on T2WI.
reflecting the admixture of fibrosis and endometrial tissue, within which small hyperintense hemorrhagic foci are observed on T1WI and DWI. Revealing hemosiderin-deposition by susceptibility-weighted imaging (SWI) is helpful for the diagnosis (Fig. 18 on page ).

[Uterine lesions mimicking tumors]
In the uterus, deep nabothian cyst/lobular endocervical glandular hyperplasia and adenoma malignum, edematous/decidualized adenomyosis and sarcomas, adenomyotic cyst and uterine/ovarian malignancy, myometrial contraction and leiomyomas should be differentiated by characteristic MR manifestations, sequential morphologic changes and clinical information of physiologic conditions.

*Adenoma malignum* (minimal deviation adenocarcinoma) may appear as multiple small conjugated cystic lesions in enlarged cervical stroma. Although the presence of solid components suggests its neoplastic nature, wholly multicystic lesion is difficult to be differentiated from benign *deep nabothian cysts* or *lobular endocervical glandular hyperplasia (LEGH)* on imaging (Fig. 19 on page ). Large amount of watery cervical discharge is suggestive symptom for adenoma malignum, however, may occasionally be observed in patients with LEGH.

*Adenomyosis* (Fig. 20 on page ) is typically appears as ill-demarcated low intense lesion on T2WI with uterine enlargement. However, various physiologic or pathologic states may influence MR appearances of adenomyosis; amount of functional endometrial tissue, phase of the menstrual cycle, endogenous hormonal abnormality, and exogenous hormonal stimulation. Secretory transformation of adenomyotic endometrium including stromal decidualization, and congestion/edematous change may cause heterogeneous signal increase on T2WI mimicking *uterine sarcomas*. In such conditions, MR manifestations may fluctuate, and follow-up MR study may be helpful for the differentiation from sarcomas. *DWI with ADC measurement* is helpful for the differential diagnosis, because these conditions usually increase the ADC in tissues. Relatively high ADC in adenomyosis exhibiting high intensity on T2WI may be distinguishable from sarcomas with low ADC due to their high cellularity.

*Adenomyotic cyst (cystic adenomyosis)* (Fig. 21 on page ) is a rare variation of adenomyosis appearing as an endometrioma-like hemorrhagic cystic mass surrounded by adenomyotic tissue. Adenomyoticcyst may appear as subserosal polypoid cystic masses mimicking *ovarian cancer*. High intense hemorrhagic cyst on T1WI surrounded by lowintense cyst wall corresponding to adenomyotic tissue on T2WI is characteristic. Demonstrating the continuity to the myometrium as "beak sign" suggests its uterine origin.

*Synchronous motion* of cystic mass and uterus on cine-MRI may also suggestive for the diagnosis of subserosal adenomyotic cyst(movie 1 on page ). Transient *myometrial contraction* (Fig. 22 on page ) as a physiological phenomenon may mimic benign myometrial pathologies such as *focal adenomyosis* or *leiomyoma*. Myometrial contraction may disappear in subsequent images or during cine-MRI, whereas myometrial pathologies persist in subsequent images or during cine-MRI (movie 2 on page ).

[Urethral lesion mimicking tumors]
*Clear cell adenocarcinoma of the female urethra* (Fig. 23 on page ) is a rare malignant tumor arising from urethral diverticulum or paraurethral ducts and glands,
and extends to the submucosa surrounding the urethra. On MRI, the tumor shows high signal intensity with central low intense dot reflecting preserved urethra on axial T2WI as "target-like appearance". This manifestation mimics urethral diverticulum (Fig. 23 on page ), however, high signal intensity on DWI and intense contrast enhancement after the administration of contrast medium are suggestive for clear cell adenocarcinoma.

Images linked within the text of this section:
Chronic Torsion

Peripherally located preserved follicles suggesting benignity

Fig.

HE (LPF)

T2WI

Convergence of engorged vessels

CE-CT

Chronic torsion may cause tumor-like ovarian enlargement

T2WI

Reactive ascites

CE-T1WI

Complete torsion: Lack of CE
PCO: Polycystic Ovaries

T2WI

Thickened *tunica albuginea* and fibrous stromal proliferation:
Low on T2WI, intense CE(+) 

Symptoms: Obesity, Hirsutism, Infertility, and Oligomenorrhea

Endometrial cancer

High prevalence of endometrial lesion

Enlarged follicles lining under the thickened tunica albuginea

Fibrous stromal Proliferation (HE, HPF)

Loupe photograph (HE)

Fig.
Fig. 4

Fibromatosis

Non-specific, soft tissue mass

CE-CT

T2WI

CE-T1WI

Preserved follicles beneath the thickened cortex show high on T2WI; ring-enhancement on CE

Preserved parenchyma: High

Thickened fibrous cortex: Low

"Black Garland"-like appearance

Fibrous cortical thickening exhibits Low on T2WI

Fig.

"Black Garland"

X’mas Garland

HE(LPF)

HE(HPF)

Loupe photograph (HE)
Hyperreactio Luteinalis

Caused by Endogenous or pregnancy-related hormonal stimulation

Ovarian parenchyma may mimic solid components of multiloculated cystic mass such as mucinous tumors

Multiple dilated theca lutein cysts
Hyperreactio Luteinalis

Caused by Endogenous or pregnancy-related hormonal stimulation

T2WI

Twin pregnancy

T2WI

Pregnancy + Hydatid Mole

Hydatid Mole (after Curettage)

Usually bilateral, however, occasionally unilateral.
OHSS: Ovarian Hyperstimulation Syndrome

Caused by Exogenous hormonal stimulation

Side effect of Ovulation induction therapy

Ascites and pleural effusion

Bilateral ovarian enlargement

CE-CT

P-CT

Fig.
Salpingo-Oophoritis

Tortuous, fluid-filled, dilated Tube with thickened wall

33-year-old woman with Chlamydia infection

Fibrous thickened wall of the Tube

U: uterus

Content of Pyosalpinx

Fig.
Salpingo-Oophoritis

**Fig. 9**

**T2-WI**

Preserved ovarian follicles suggest their benign, non-neoplastic nature.

Tubo-ovarian abscess formation

Fig.
Salpingo-Oophoritis

T2WI

CE(++): thick fibrous wall - surrounding inflammation

Very high on DWI
The heavily impeded water mobility of pus may be related to the hyperviscosity

CE-fsT1WI

Tubo-ovarian abscess formation

Fig.
Decidualized Endometrioma associated with Pregnancy

U: Pregnant uterus

Edematous decidualized aberrant endometrium appear as broad-based mural nodules

T2-high broad-based mural nodules

High on DWI similar to Endometrium/ Placenta
Decidualized Endometrioma associated with Pregnancy

T2WI  DWI  ADC map

fsT1WI  SWI

Hemosiderin deposits on SWI suggesting Endometrioma

Polypoid mural nodule: High on T2WI/DWI, high ADC (1.98)

High ADC suggests benign, edematous decidualized tissue

Fig. 12

Fig.
**Decidualized Endometriosis of the Vagina associated with Pregnancy**

**Fig. 13**

**Mass at vaginal vault with small cyst and hemorrhagic foci**

**High on DWI with high ADC (1.52) suggesting benign, edematous decidualized tissue rather than malignancy.**
Polypoid Endometriosis

Multiple solid masses in the pouch of Douglas
High intense on T2WI+ peripheral low intense rim as “Black rim sign” corresponds to adhesive fibrosis of peritoneal endometriosis

Masses and fibrosis show intense CE(+)  

Abundant endometrial glands in Endometrial polyp-like mass may cause High intensity on T2WI  

Fig. 14  

Peripheral fibrosis
Bladder Endometriosis

High intensity hemorrhagic foci (+)

T2WI

Nodular thickened bladder wall shows low intensity on T2WI due to fibrosis.

fsT1WI

The posterior wall and the dome are common affected areas.

Fig.
Bowel endometriosis

Marked stricture with irregular wall thickening mimicking Rectosigmoidal cancer

CT colonoscopy

T2WI

T1WI

DWI

Fig.
Abdominal wall Endometriosis

Inhomogeneous intensity on T2WI due to the admixture of fibrosis and endometrial tissue.

Hemorrhagic foci show high intensity on T1WI/DWI.
Extra-ovarian endometriosis on SWI

Fig. 18

Signal voids (+): Hemosiderin deposits

Small high intense areas on T1WI (methb)

Fig.
Multicystic Cervical Lesion

- CE-T1WI
- T2WI

LEGH: Lobular Endocervical Granular Hyperplasia

Multiple small conjugated cystic lesions in enlarged cervical stroma

Deep Nabothian Cysts

Adenoma Malignum

Fig. 19
Adenomyosis

Various physiologic changes such as edema, congestion, secretory transformation, decidualized changes, hemorrhage, etc. depending on patient's hormonal state may cause signal complexity in adenomyosis.

Not very high on DWI with high ADC

Tumor-like T2-high focal edema

Focal or diffuse T2-signal increase

Signal decrease on follow-up T2WI

Fig.
Subserosa Cystic adenomyosis mimicking ovarian cancer

Fig. 21

Beak sign suggesting uterine origin

Benign fibrous tissue shows low intensity on DWI

Intense enhancing benign fibrous tissue mimicking malignant mural nodule

Hemorrhagic cystic mass like endometrioma

Fig.
Uterine myometrial contraction

Fig. 22

Contraction disappears during Cine-MRI.

Transient myometrial contraction may disappear in subsequent images.

Focal Adenomyosis does not disappear during cine MRI or in subsequent images.
Lesion surrounding the Urethra

Clear cell carcinoma  
Inhomogeneous intense CE (+)

T2WI  
CE-fsT1WI  
DWI

High on DWI

High intense mass surrounding the Urethra on T2WI

T2WI  
CE-fsT1WI  
CE (-)  
sagT2WI

Fig.
Conclusion

Recognition of imaging manifestations of normal organs and benign tumor-like lesions under various physiologic conditions is important for making accurate diagnosis and appropriate management of the patients.

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