Comprehensive Review: Various Clinical and Radiologic Manifestations of Endometriosis

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Learning objectives

Learning Objectives:

1. Describe the various clinical and imaging manifestations of endometriosis.

2. Identify which imaging features are more specific for endometriosis.

3. Discuss MR strategies for identification and characterization of endometriosis.

4. Identify unusual imaging features and involving sites.
Background

Endometriosis is an important gynecologic disorder primarily affecting women during their reproductive years, and defined as functional endometrium located outside the uterus. The clinical manifestations may provide only limited information which often overlaps that of other diseases, and are protean, from asymptomatic to the disabling chronic pelvic pain. The three hallmarks of endometriosis are peritoneal endometrial implants in peritoneal cavity, endometriomas (endometriotic cysts) in ovary, and adhesions.

Pathogenesis: Three theories of histogenesis have been proposed: (a) metastatic theory (retrograde menstrual implantation, vascular and lymphatic spread, and intraoperative implantation), (b) metaplastic theory (possibility of peritoneal cells differentiating into functioning endometrial cells), and (c) induction theory (combination of the first two. Shed endometrium releases substances that induce undifferentiated mesenchyma to form endometriotic tissue). The most widely accepted one is metastatic theory.

The purpose of this presentation is to show the various clinical and radiologic manifestations of endometriosis.

Although the usual manifestations and sites of the endometriosis are well known, various unusual manifestations and sites can be particularly misleading; therefore, both usual and unusual manifestations and sites should always be carefully assessed. We reviewed the usual and unusual manifestations of endometriosis.

1. Usual manifestation of endometriosis.

Ultrasonography (US) (Fig.1)

US is the first-line imaging modality although limited to the detection of ovarian endometriosis. The classic endometrioma on US shows diffuse low-level internal echoes (95%). Echogenic foci in the wall (wall nodularity) is seen in 36% of endometrioma in one retrospective review, which is helpful for diagnosis. Endometriomas may be unilocular or multilocular and may have septations and thickened walls and often have bilaterality. Acute hemorrhagic cyst can be differentiated with endometrioma which show shows little change in size and internal echogenicity over time.

MRI (Fig.2)

MR imaging has greater specificity for the diagnosis of endometriomas than other imaging techniques. The classic endometrioma shows shading, defined as a range of low-signal intensities on T2-weighted images and a corresponding high signal on T1-weighted images. This shading reflects the chronic nature of the endometrioma resulting from bleeding with accumulation of high concentrations of iron and protein in endometriomas. The MR imaging (high SI on T1WI and shading on T2WI) shows high performance.
(sensitivity: 90-92%, specificity: 91-98%, overall accuracy: 96%). Fat saturation on T1-weighted images improves visualization of smaller endometriomas or implants on peritoneal surfaces and helps to differentiate endometriomas from cystic teratomas.

2. Clinical issue

- Adhesion
- Malignant Transformation
- Deep Pelvic Endometriosis
- Rupture
- Infection
- Decidualized Endometriosis
- Associated with Uterine Anomaly
- Associated with Adenomyosis

2.1. Adhesion(Fig.3) is fibromuscular hyperplasia that surrounds foci of endometriosis. At MR imaging, anterior rectal triangular attraction, hydrosalpinx, irregular border and spiculation converging toward lesions, angulation of bowel loop, posterior displacement of uterus and ovary, elevation of posterior vaginal fornix and loculated fluid collection suggest the presence of adhesion.

2.2. Malignant transformation(Fig.4 and 5) is a well-described, but rare (<1% of cases) complication. Sampson in 1925 established the criteria for the diagnosis of malignancy arising from endometriosis as follows: Clear evidence of endometriosis is found close to the tumor, histopathologic appearance should be such that the origin of the tumor from endometriosis is plausible, and no other primary site is found. The most common histologic types of malignancy are endometrioid carcinoma and clear cell carcinoma. Stromal sarcoma is rare. Suggestive findings of malignancy are endometriomas with solid components or papillary projections and intermediate or high SI on T2WI (loss of T2 shading) and may be related to the enlarged size of cyst or dilution of hemorrhagic fluid by tumor secretions.

2.3. Deep Pelvic Endometriosis(Fig.5 and 6): Subperitoneal infiltration of endometrial implants in the uterosacral ligament, rectum, rectovaginal septum, vagina, or bladder is responsible for severe pelvic pain. Accurate preoperative assessment of disease extension is required for planning complete surgical excision. Diagnostic tools for deep pelvic endometriosis are US, laparoscopy and MR. Various approach is available in US but panoramic evaluation is not allowed. Laparoscopic exam has limitation in hidden lesion by adhesion or location in the subperitoneal space. MR directly demonstrates deep pelvic endometriosis, infiltrating small implants and solid deep and visceral lesions. The lesion may be composed of a large proportion of glandular material with little fibrotic reaction resulting in high SI on T2WI.

2.4. Rupture(Fig.7) is a rare condition and most commonly occurs during pregnancy. Clinically and at imaging, it may mimic rupture of a hemorrhagic ovarian cyst or other mass. Ruptured endometrioma is usually large cyst(mean; 8.2 cm) with thick wall (mean;
2.7 mm). Peritoneal change and elevation of CA-125 may be associated. Rupture of hemorrhagic cyst shows hematoma around the cyst.

2.5. Infection(Fig.8 and 9) occurs most commonly after surgical drainage or aspiration but may also result from adjacent inflammation or spread hematogenously in patients with bacteremia. It may be overlooked as a cause of fever in the absence of a high clinical suspicion. The radiologic Findings are similar to uninfected endometriosis but more complex or thick wall.

2.6. Decidualized Endometriosis(Fig.10): Decidualization refers to hypertrophy of the stromal cells of the endometrium that occurs during pregnancy to form the vascular decidual lining of the gravid uterus. This process results primarily from the effects of progesterone and may also involve ectopically located endometrium. Decidualization are very rare. CA-125 level is of very limited value because it is increased during pregnancy. Malignant transformation of an endometrioma during pregnancy has not been reported. On imaging study, A decidualized endometrioma increases in size and is more complex in appearance, and increases solid mural nodules or papillary excrescences. Presence of normal ovarian tissue, same signal intensity with the placenta on all sequences on MR, and broad based hyperintense mural nodules on T2WI are characteristic findings. ADC is significantly higher than malignant tumor.

2.7. Associated with Uterine Anomaly(Fig.11): The incidence of endometriosis increases in patients with müllerian duct anomaly, especially obstructed or noncommunicating uterine horn. If outflow tract is obstructed, retrograde menstruation occurs and endometriotic implants involves both the fallopian tube and the ovary. It manifested in an adolescent patient with chronic pelvic pain.

2.8. Associated with Adenomyosis(Fig.12): Endometriosis associated with adenomyosis is common etiologic factor and impact on infertility. Adenomyosis involves basal endometrial glands, which are resistant to hormonal stimulation and cyclic changes but endometriosis shows the same cyclic changes as normal endometrium. The incidence of coincidence of adenomyosis and endometriosis is vary widely, from 7% to 40%. However, it has strong association before 36 years old - 90% of endometriosis patients have adenomyosis.

3. Unusual manifestation

- Infrequently Involving Sites
  - Gastrointestinal (GI) Tract
    - Rectosigmoid colon, Appendix
  - Genital System
    - Fallopian tube, Cervix
  - Urinary Tract
    - Bladder, Ureter
  - Thorax
  - Cutaneous & Muscular Lesions
3.1. GI tract endometriosis (Fig. 13) occurs in 5%-37% of patients with endometriosis. The frequent sites are rectosigmoid colon, small intestine, cecum, and appendix. It may produce a mass and mimic malignant lesion. Barium enema shows presence of extraperitoneal mass effect, tethering and spiculation of the bowel wall.

3.2. Genital system endometriosis

3.2.1. Fallopian Tube Endometriosis (Fig. 14): Approximately 28% of them shows abnormalities on HSG. They confined to the serosal surface but can transmural or mucosal involvement. They manifested as hematosalpinx and show low-level echoes, corresponding to blood products at US. MRI shows tubular nature and high SI on T1WI.

3.2.2. Uterine Cervix Endometriosis (Fig. 15): Uterine cervix is a rare site of endometriosis. It is usually an incidental microscopic finding but can rarely be a cause of abnormal vaginal bleeding. There is often a history of cervical trauma (curettage, biopsy). It may result from müllerian rests persist in the cervical stroma. It may present as a cystic or polypoid mass in the cervix and may cystic nature with hemorrhagic content at MR.

3.3. Urinary tract endometriosis

3.3.1. Urinary Bladder Endometriosis (Fig. 16) is the most common in the urinary tract endometriosis. When the bladder is involved, endometriotic implants are often confined to the serosal surface but can infiltrate the muscle and appear as mural masses projecting into the bladder lumen. These masses are typically near the dome of the bladder. Localized bladder wall thickening is the main diagnostic criteria. Occasional the masses protrude inside the bladder lumen, mimicking the bladder cancer.

3.3.2. Ureter endometriosis (Fig. 17) is 2nd common in the urinary tract. Distal ureter is the most common site. Endometriotic foci may implant on ureteral adventitia but direct invasion of the ureter can lead to hyperplasia and fibrosis of muscularis and lamina propria, resulting in luminal narrowing. Ureterography reveals a short or medium length ureteral strictures, usually near the inferior aspect of the sacroiliac joint.

3.4. Thoracic endometriosis

Thoracic endometriosis syndrome (Fig. 18) is uncommon and the diagnosis is usually established on clinical ground. It is associated with coexistent pelvic endometriosis, and usually occurs 5 years after the diagnosis of pelvic endometriosis. Radiographic findings include pneumothorax, hemothorax, and lung nodules. Presenting signs are pneumothorax in 73%, hemothorax in 14%, hemoptyysis in 7%, and lung nodules in 6%. The two theories entertained for the development of TES are microembolization and peritoneal-pleural migration. Pleural lesions are almost exclusively right-sided, whereas lung lesions have no such predilection.
3.5. Cutaneous and muscular endometriosis

3.5.1. Abdominal Wall Endometriosis (Fig. 19) is the most common site of extrapelvic endometriosis. It may occur after pelvic surgery (like C-section) or by iatrogenic transfer. Some lesions occur spontaneously. Patients can present weeks to years after surgery with a palpable mass or focal pain associated with menses. Rectus abdominals muscle and subcutaneous soft tissue may be involved. US feature is variable (cystic masses, and complex cystic and solid masses). Contrast enhancement of implants is seen at CT and MRI.

3.5.2. Perineal Endometriosis (Fig. 20) is uncommon and approximately 70 cases are reported. Two possible pathogenesis are direct implantation during vaginal surgery (at the site of an episiotomy scar in vulvar disease) and retrograde menstruation. The role of endorectal US is preoperative assessment of sphincter involvement. Complete wide excision and primary sphincteroplasty are treatment of choice.

4. Mimicker and pitfall (Fig. 21)

- Mimicker (Ovarian Cystic Lesions)
  - Hemorrhagic Cyst
  - Struma Ovarii
  - Mucinous Tumor
- Huge Endometriosis
  - Mimic Epithelial Neoplasm

4.1. Hemorrhagic cyst (Fig. 22 and 23)

Hemorrhagic cyst develops from corpus luteal or follicular cyst and cause acute pelvic pain. It regresses spontaneously between 6 to 8 weeks on follow-up. On US, the cyst is unilateral, unilocular, and complex echogenic cyst with fluid-debris level. Fibrin strands can mimic the septations seen in an endometrioma, but they are generally thinner and are weaker reflectors compared with true septations. Endometriosis tend to have thicker walls, more likely to be bilateral and multiple, display greater T2 shortening with lower T2 SI, and shows signal voids on susceptibility-weighted MR image.

4.2. Struma ovarii (Fig. 24)

Struma ovarii contains thyroid tissue and variable-sized follicles with colloid material. They account for 1% of all ovarian tumors. 5% show thyrotoxicosis and 95% are benign. They usually occur in premenopausal women. CT scan shows complex cystic and solid mass. MRI is more helpful and shows Low SI on both T1- and T2WI owing to the thick, gelatinous colloid of the struma.

4.3. Epithelial ovarian tumor (Fig. 25-27)
Epithelial ovarian tumor is asymptomatic, slowly growing and not spontaneously regress. It must be considered if any cyst is larger than 10cm. The serous tumor is unilocular and thin-walled. The mucinous tumor is multilocular, has varying contents in the locules, and tends to be larger. It may mimic endometriosis. The solid component and papillary suggest malignancy. The MRI findings of mucinous tumor mimic endometriosis - low viscosity mucin (in general) shows low SI on T1WI, high SI on T2WI and high viscosity mucin shows variable SI on both T1- and T2WI, which may be shown T2 shading.
Fig. 1: Typical US findings of endometrioma. A. Transabdominal US shows complex cystic mass with homogeneous diffuse low-level echoes (calibers). B. Transvaginal US shows cystic mass with echogenic foci (arrowhead) within cyst wall and thick septations (arrow).

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Fig. 5: A 41-year-old woman with clear cell carcinoma arising from right ovarian endometriosis. A. Transvaginal US shows multilocular complex cystic mass. Solid components (arrows) within the mass are evident. B. Axial T1-weighted MR image shows large multilocular cystic mass within high SI (M). C. Axial T2-weighted MR image shows sustained high SI (M). D. Axial T1-weighted enhanced fat saturated MR image shows enhancing solid portions (arrows). Radiologic diagnosis was malignant ovarian tumor arising from right ovary. Explolaparotomy was performed. Pathologic results indicated clear cell carcinoma underlying background endometriosis arising from the right ovary.

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Fig. 6: A 37-year-old woman with left ovarian and deep pelvic endometriosis. A. On a T1-weighted fat saturated MR image, high SI mass in the left ovary (M) and another tiny high SI nodule in the anterior rectal wall (arrow). T2-weighted MR image shows shading with low SI in the two lesions (not shown). B. Laparoscopic view shows endometriotic implants (arrows).

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Fig. 7: A 36-year-old woman with vaginal deep pelvic endometriosis. A. T2-weighted sagittal MR image shows hyperintense solid mass (M) in the vagina and surrounding infiltration to the uterine cervix. B. Fat saturated enhanced T1-weighted MR image shows
multicystic lesions within the solid mass (arrows). This finding may be clue to diagnose solid appearing deep pelvic endometriosis involving rectovaginal septum.

Fig. 8: A 44-year-old woman with ruptured left ovarian endometriosis. CA-125 level was elevated (307.5 U/mL). A. Unenhanced CT scan shows large high attenuated mass (M) in the left abdomen. High attenuated ascites (H) is compatible with hemoperitoneum. B. Enhanced CT scan (cranial to the a) shows peritoneal infiltration and changes (arrows).

Fig. 9: A 45-year-old woman with infection of left ovarian endometriosis. A, B. T2-(a) and fat saturated enhanced T1-(b) weighted MR images show relatively thick walled (arrows) cystic mass (M) arising from the left ovary. Note normal appearing right ovary.
(arrowhead). No visible T2 shading effect on T2-weighted MR image. Pathologic results indicated left ovarian endometriosis with chronic inflammation.

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**Fig. 10:** A 40-year-old woman with infection of right ovarian endometriosis. She presented with pelvic pain and fever of unknown origin. A. Transvaginal US shows complex cystic mass (M) within the solid portions (arrowheads) along the cystic wall at right adnexa. Malignancy is suspicious. B, C. T1-(b) and T2-(c) weighted MR images show relatively thick walled (arrows) cystic mass (M) arising from the right ovary. Overt T2 shading effect on T2-weighted MR image is evident. Note adenomyotic cyst (A). D. Subtraction MR image shows relatively thick walled (arrows) cystic mass (M) without solid portions within the cystic mass. Pathologic results indicated right ovarian endometriosis with superimposed acute and chronic inflammation and salpingitis.

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**Fig. 11:** A 36-year-old woman with right ovarian decidualized endometriosis. A. Transabdominal US of the right ovary at 12 weeks of the pregnancy shows complex cystic mass within papillary projection (M). Presence of normal ovarian tissue (arrows) is also noted. B. Color Doppler US of the right ovary at 22 weeks of the pregnancy shows present vascularity (arrow) of the solid portion (M) within the mass. C. Axial T2-weighted MR image shows shading (arrowhead), compared to the T1-weighted MR image (not shown), due to endometriosis. Presence of normal ovarian tissue (arrow) on the T2-weighted image is also noted. D. T2-weighted MR image shows hyperintense broad based mural nodule (M) within the mass. ADC map of the diffusion-weighted MR image shows high ADC value (2.02 x 10⁻³ mm²/s) (not shown).

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Fig. 12: A 14-year-old woman with endometriosis in setting of uterine anomaly. A, B. Axial T2-weighted MR images show two diverged uterine cavities (arrows) and cervices (arrowhead and V), uterine didelphys was diagnosed. Left hemivaginal dilatation (V) due to transverse septum is also noted. Associated left renal agenesis is evident (not shown). Thus Herlyn-Werner-Wunderlich syndrome was diagnosed. Left ovarian cystic mass (M) is showed low SI, shading, due to associated endometriosis.

Fig. 13: A 32-year-old woman with ovarian endometriosis and adenomyosis. A. Axial fat saturated T1-weighted MR image shows hyperintense mass (M) in the Cul de sac. B. On
T2-weighted sagittal MR image, this mass (M) shows low SI, shading. Heterogeneous diffuse low SI and high signal intense spots (arrows), which is diagnosed adenomyosis.

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Fig. 14: A 42-year-old woman with appendiceal endometriosis. The patient complained sudden-onset RLQ pain. A. Transverse US shows the thicken appendiceal wall and swelling of appendix (arrow). Non compressibility is also evident. Acute appendicitis was suspected. B. Enhanced CT scan shows dilated, fluid-filled appendix and appendiceal wall thickening (arrow), compatible with acute appendicitis.

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Fig. 15: A 37-year-old woman with left fallopian tube involving endometriosis. A. Transvaginal US shows dilated fallopian tube and fluid-debris level (arrow) representing blood products (hematosalpinx). B. On fat saturated T1-weighted MR image, this mass shows high SI, which meant hemorrhage (not shown). T2-weighted sagittal MR image shows left pelvic tubular structure (arrow) with fluid-debris level.

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Fig. 16: A 45-year-old woman with uterine cervix involving endometriosis. A. Transvaginal US shows hypoechoic complex cystic mass (M) within cervix. B. On T2-weighted sagittal MR image, this mass (M) shows hypointense cystic mass in the posterior cervical lip. Fat saturated T1-weighted MR image shows hyperintense cystic mass (M), which meant hemorrhage (not shown).

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Fig. 17: A 38-year-old woman with bladder endometriosis. A. Transvaginal longitudinal US shows a 2-cm nodular lesion (M) in the bladder. B. Enhanced CT scan shows slightly enhancing nodule in the posterior wall (arrow). Transurethral cystoscopic biopsy was done. Pathologic results indicated bladder endometriosis.

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Fig. 18: A 32-year-old woman with left distal ureter endometriosis. A. Retrograde pyelography (RGP) shows focal short segment abrupt luminal narrowing in the left distal ureter (near the inferior aspect of the sacroiliac joint, arrow) with hydronephrosis. B. Enhanced CT scan shows hydronephrosis and hydroureter with wall thickening in left distal ureter (arrow).

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Fig. 19: A 39-year-old woman with TES (Thoracic endometriosis syndrome). She presented with recurrent spontaneous pneumothorax, each associated with the onset of menses. A, B. Posteroanterior chest radiograph (a) and CT (b) scans show a right-sided pneumothorax (arrows) and increased opacity in the right lung parenchyma (arrow).

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Fig. 20: A 31-year-old woman with abdominal wall endometriosis. A. Transverse US shows a hypoechoic septated cystic mass (M) confined to the subcutaneous fat. Increased vascularity is noted on Doppler US (not shown). B. Enhanced CT scan shows multilocular cystic mass (arrow) in the subcutaneous layer of left lower quadrant.

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Fig. 21: A 36-year-old woman with perineal endometriosis along the episiotomy scar. A. Transrectal radial US shows a 4-cm, ill-defined, hypoechoic mass (arrows) in the perianal area with adhesion to the external anal sphincter. B. Enhanced CT scan shows enhancing soft tissue mass (arrows) in the perianal area.

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**Fig. 22:** Follow-up (8 weeks) US findings of endometriosis and hemorrhagic cyst. A. Endometriosis B. Hemorrhagic cyst

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![Fig. 22](image)

**Fig. 23:** A 26-year-old woman with right hemorrhagic cyst and left endometriosis. A. Axial T2-weighted MR image shows fluid-debris level on the right ovarian cystic mass (arrowhead) and shading with low SI on the left ovarian cystic mass (arrow). B. Sagittal T2-weighted MR image shows an elevated posterior vaginal fornix and tethering (arrows). These findings are suggestive of adhesion.

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![Fig. 23](image)
Fig. 24: A 41-year-old woman with struma ovarii. A. Axial T2-weighted MR image shows a large, multilocular cystic mass (M) that has different SI locules including low signal intensities (arrows). B. In axial T1-weighted MR image, some locules persistent low signal intensities (arrows).

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Fig. 25: A 31-year-old woman with huge endometriosis, mimic epithelial neoplasm. A. Enhanced CT scan shows a huge cystic mass. Radiologic primary diagnosis was benign ovarian cystic neoplasm. D. Photograph of the gross specimen shows a huge cystic mass within the dark colored hemorrhage, so called "chocolate cyst". Pathologic results indicated endometriosis.

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Fig. 26: A 34-year-old woman with mucinous cystadenocarcinoma mimics malignant tumor arising from endometriosis. A, B. Axial T1-(a) and T2-(b) weighted MR images show high- and low-intensity right ovarian cystic mass (M); thus presumed T2 shading effect due to endometriosis. Note the solid components (arrows) within the mass. High concentrations of mucin mimic the shading effect of endometriosis.

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Fig. 27: A 45-year-old woman with mucinous cystadenocarcinoma, show T2 shading and mimic endometriosis with malignant transformation. A, B. Axial T1-(a) and T2-(b) weighted MR images show high and low SI (M) on the right ovarian mass, thus presumed T2 shading effect due to endometriosis. The enhancing solid portion (arrow) is also evident.

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Fig. 3: A 23-year-old woman with bilateral ovarian endometriosis and adhesion. A. Axial T1-weighted MR image shows bilateral ovarian cystic masses (M) within high SI. T2-weighted MR image shows shading with low SI (not shown). B. Sagittal T2-weighted MR image shows an elevated posterior vaginal fornix and spiculation to the lesion (arrows). These findings are suggestive of adhesion.

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Fig. 4: A 30-year-old woman with clear cell carcinoma arising from right ovarian endometriosis. A, B. Transvaginal and color Doppler US show unilocular complex cystic mass (calibers). Solid components with increased vascularity (arrow) are evident. C. Enhanced CT scan shows enhancing solid components (arrows) within the right ovarian cystic mass. Pathologic results indicated endometriosis and clear cell carcinoma.

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Fig. 2: A 32-year-old woman with right ovarian endometriosis and left ovarian mature cystic teratoma. A. Axial T1-weighted MR image shows bilateral ovarian masses with high signal intensity (SI). B. Axial T2-weighted MR image shows low SI on the right ovarian mass (arrow), due to blood elements, especially intracellular methemoglobin indicating "T2 shading", typical of endometriosis. C. Axial fat saturated T1-weighted MR image shows signal drop on the left ovarian mass (arrow), compared to the T1-weighted scan (a), suggesting intratumoral fat.

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Findings and procedure details

In this exhibit, we demonstrate the usual and unusual manifestations of endometriosis. Usual manifestations include radiologic diagnostic strategies according modalities and clinical issues such as adhesion, malignant transformation, deep pelvic endometriosis, rupture, decidualized endometriosis, associated with uterine anomaly, and associated with adenomyosis. Unusual manifestations include gastrointestinal tract (rectosigmoid colon, appendix), genitourinary tract (bladder, ureter), chest, subcutaneous and muscular lesion (abdominal wall, perineum) and vagina. We also discuss possible differential points from various mimicking ovarian cystic lesions such as hemorrhagic cyst, mucinous tumor.
Conclusion

The major teaching points of this exhibit are:

1. The imaging characteristics of endometriosis vary widely, with masses ranging from cystic to solid and complex, which depend on the hormonal response of the ectopic tissue during the menstrual cycle.

2. Familiarity with the clinical setting and imaging feature of both usual and unusual endometriosis as depicted with US, CT, and MR will facilitate prompt and accurate diagnosis and treatment.
Personal information

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