Gynecologic Adenomyosis and Endometriosis: Key Imaging Findings, Mimics, and Complications

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After participating in this activity, the diagnostic radiologist should be better able to utilize ultrasound and MR imaging to help differentiate between gynecologic adenomyosis and endometriosis given their divergent management despite their significant overlap in symptoms.

Adenomyosis of the Uterus

Adenomyosis of the uterus represents heterotopic endometrial glands and stroma in the myometrium with adjacent smooth muscle hypertrophy. The pathogenesis of uterine adenomyosis involves endometrial migration via a basement membrane defect or through lymphatic or vascular channels. Women age 40 to 50 years usually are affected. Although patients with uterine adenomyosis are usually asymptomatic, symptoms may include pelvic pain, menorrhagia, and dysmenorrhea. Risk factors for uterine adenomyosis include prior uterine trauma or surgery, multiparity, and hyperestrogenemia. Imaging is important because superficial uterine adenomyosis responds significantly better to endometrial ablation than does deep uterine adenomyosis. On ultrasound imaging, pseudowidening of the endometrium with a poorly defined endomyometrial junction often is seen in diffuse uterine adenomyosis because of heterotopic endometrium extending into the inner myometrium (Figure 2). These heterotopic endometrial glands cause an appearance of subendometrial echogenic linear striations. Also, the uterus is often globular and enlarged with heterogeneous myometrial echotexture.

On MRI, diffuse uterine adenomyosis demonstrates thickening of the junctional zone of at least 12 mm. The junctional zone corresponds to the innermost layer of myometrium and is visualized as a distinct area of low signal on T2-weighted MR images, separating the high-signal endometrium from the intermediate-signal outer myometrium (Figure 3). Although a junctional zone thickness greater than 12 mm is diagnostic of uterine adenomyosis (Figure 4), a junctional zone thickness of 8 mm or less effectively excludes adenomyosis as a diagnostic consideration.

Key words: Adenomyosis, Endometriosis, Ovarian Endometrioma

Adenomyosis and endometriosis are gynecologic processes with characteristic pathophysiologic, clinical, and imaging differences. Although adenomyosis refers to the presence of heterotopic endometrial glands and stroma within the myometrium, endometriosis involves the presence of endometrial glands and stroma outside of the uterus (Figure 1). Patients with either adenomyosis or endometriosis can have a similar clinical presentation. Imaging can be of great utility in differentiating between these 2 gynecologic pathologic processes, thereby guiding appropriate clinical management. Accurate diagnosis also is important because endometriosis has potentially more significant complications. Finally, differentiating an ovarian endometrioma from its mimics can obviate the need for more invasive procedures, such as laparoscopy or oophorectomy.
Additional MR findings include poorly defined junctional zone margins, intrazonal T2-hyperintense punctate foci representing cystic dilatation of heterotopic glands.

Figure 1. Adenomyosis represents heterotopic endometrial glands and stroma in the myometrium. Endometriosis represents functional ectopic endometrial glands and stroma outside of the uterine cavity, commonly manifesting as an endometrioma.

Figure 2. Transvaginal ultrasound of the uterus demonstrates endometrial pseudowidening (white arrow) with a poorly defined endomyometrial junction (dashed arrow). Heterogeneity of the myometrium also is present.

Figure 3. Sagittal, T2-weighted MR image of the uterus demonstrates its normal zonal anatomy. The outer myometrium (1) is intermediate signal intensity. The inner myometrium (2) (also known as the junctional zone) is hypointense and normally <12 mm in thickness. The endometrium (3) is normally hyperintense. (see Figure 4), and T1-hyperintense punctuate foci indicating hemorrhage, all of which are findings that add specificity to the diagnosis. Because of its superior sensitivity and specificity compared with ultrasound, MRI is the imaging modality of choice for the diagnosis of uterine adenomyosis.

The definitive treatment for diffuse uterine adenomyosis is hysterectomy, particularly in women with debilitating symptoms. Endometrial ablation can be performed for more superficial disease, which is best evaluated on MRI.

Mimics of Focal Adenomyosis. A myometrial contraction could mimic focal adenomyosis, but myometrial contractions are transient and change in appearance over time. Although typically diffuse, uterine adenomyosis also can occur focally and even appear mass-like as an adenomyoma. Uterine leiomyomas (fibroids) are well-defined, rounded lesions with mass effect on the endometrium, unlike focal uterine adenomyosis, which is poorly defined, elliptical, and without mass effect. Although both uterine fibroids and adenomyosis are hypointense on T2-weighted MR images, focal uterine adenomyosis contains punctate hyperintense foci, signifying dilated cystic endometrial glands. Differentiating the two conditions is clinically relevant because of divergent management: uterine conservation with myomectomy for leiomyomas versus hysterectomy for uterine adenomyosis.
endometriomas. Less commonly, endometriomas may demonstrate echogenic wall nodularity and have thin or thick septations. Ultrasound is highly sensitive and specific in the evaluation of endometriomas. However, ultrasound is extremely poor in evaluating the other forms of endometriosis (i.e., endometrial implants and deep pelvic endometriosis with adhesions), which are thought to be the principal causes of pelvic pain and infertility in affected patients.

The most common and specific MR appearance of endometriomas is the presence of lesions that are homogeneously T1-hyperintense (referred to as "light bulb bright") and T2-hypointense (referred to as "T2 shading") because of the high concentration of iron, protein, and viscosity. This finding is classically referred to as "T2-shading.”

Figure 4. T2-weighted MR image demonstrates a poorly defined, widened junctional zone (box) containing hyperintense punctate foci (arrow), representing cystic dilatation of heterotopic endometrial glands in diffuse uterine adenomyosis.

Endometriosis

Endometriosis represents functional ectopic endometrial glands and stroma outside of the uterine cavity. Endometriosis is in some ways similar to uterine adenomyosis, which was formerly referred to as endometriosis interna. The most accepted theory of the pathogenesis of endometriosis is that it results from metastatic implantation of endometrial tissue into the peritoneal cavity from retrograde menstruation. Endometriosis is seen predominantly in women of childbearing age, with an overall prevalence of 10%. In addition, 5% of cases are seen in postmenopausal women. The most common presenting symptoms are pelvic pain and infertility. Risk factors include age and prolonged exposure to menstruation, such as early menarche, nulliparity, short menstrual cycles, and prolonged menstrual flow. Endometriosis can present in three forms: ovarian endometriomas, endometrial implants, and deep pelvic endometriosis with adhesions.

Endometriomas are chronic cysts that occur within the ovary from repeated cyclic hemorrhage. These ovarian endometrial cysts are referred to as “chocolate cysts” because they contain thick, dark, degenerated blood products. On ultrasound, endometriomas contain homogeneously diffuse low-level echoes (Figure 5), a finding observed in 95% of endometriomas. Less commonly, endometriomas may demonstrate echogenic wall nodularity and have thin or thick septations. Ultrasound is highly sensitive and specific in the evaluation of endometriomas. However, ultrasound is extremely poor in evaluating the other forms of endometriosis (i.e., endometrial implants and deep pelvic endometriosis with adhesions), which are thought to be the principal causes of pelvic pain and infertility in affected patients.

The most common and specific MR appearance of endometriomas is the presence of lesions that are homogeneously T1-hyperintense (referred to as “light bulb bright”) and T2-hypointense (referred to as “T2 shading”) (Figures 6A and 6B). T2-shading occurs because of the high concentration of iron and protein and increased viscosity and protein crosslinking within the lesion. Less commonly, endometriomas can appear T2-hyperintense because of differences in concentration of blood products. A definitive diagnosis of an endometrioma is made if there is a T1-hyperintense lesion with T2 shading or if multiple T1-hyperintense cysts are visualized, regardless of their signal intensity on T2-weighted images. MRI is the most specific modality for diagnosis of endometriosis, with a sensitivity of 90% and a specificity of 98%. A T1-weighted, fat-suppressed sequence further improves sensitivity, as fat suppression narrows the dynamic signal range and increases lesion conspicuity, allowing detection of endometriomas and endometrial implants as small as 5 mm (Figure 7).
There are numerous potential sites of implantation in endometriosis. The gastrointestinal (GI) tract is the most common site, occurring in 12% to 37% of cases, most commonly the rectosigmoid colon. Serosal, and less commonly, transmural implantation may occur, with patients experiencing bloating, cramping, and pain during defecation.7 The urinary tract is the next most common site of involvement in up to 20% of cases, typically involving the urinary bladder, followed by the ureters. Patients may present with urinary urgency, dysuria, and gross hematuria.7 Up to 30% of women with endometriosis have fallopian tube involvement at laparoscopy, with hematosalpinx likely occurring secondary to adhesions. Hematosalpinx appears as a T1-hyperintense tubular adnexal structure and may be an isolated finding in a patient with endometriosis. The thorax is a rare site of involvement but is the most frequent form of extra-abdominal endometriosis. The thoracic endometriosis syndrome manifests as catamenial pneumothorax, hemothorax, and lung nodules (Figure 8). Women with thoracic endometriosis can present with pleuritic chest pain, pleural effusions, or cyclic hemoptysis.7

The treatment for endometriosis is medical when symptoms include pelvic pain or dyspareunia, usually with anti-inflammatory agents or hormonal therapy. In the case of infertility, treatment is surgical, which involves the removal of endometriomas or lysis of adhesions in a patient with deep pelvic endometriosis.7

Mimics of Endometriosis. Hemorrhagic cysts, mature cystic teratomas, and ovarian mucinous epithelial neoplasms are part of the differential diagnosis, but there are useful imaging characteristics that can help differentiate these mimics from endometriomas. Hemorrhagic cysts are usually solitary, unilocular, evolve into more complex-appearing cysts over time, and resolve within 6 weeks, unlike endometriomas that persist.7 On ultrasound, hemorrhagic cysts typically demonstrate a reticular pattern of echogenic

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Figure 7. Multiple endometriomas. A: T1-weighted MR image shows a right adnexal hyperintense lesion (dashed arrow), consistent with an endometrioma. B: T1-weighted, fat-suppressed MR image reveals a punctate left adnexal hyperintense lesion (solid arrow), also an endometrioma that could not be visualized on the sequence without fat suppression.

Figure 8. Axial CT scan demonstrates thoracic endometrial seeding with pleural thickening (calipers), round atelectasis (circle) secondary to chronic pleural irritation, and a pleural effusion found to be a hemothorax.

Figure 9. Hemorrhagic ovarian cysts. Transvaginal ultrasound (A) of an adnexal lesion with low-level echoes and thin, reticular, echogenic strands representing clot and fibrin within a hemorrhagic cyst. On MRI, hemorrhagic ovarian cysts are usually solitary T2-hyperintense (B) and T1-hyperintense (C) lesions (arrows).
Rokitansky nodule pathognomonic for a dermoid cyst typically is visible on CT (Figure 10B) and especially MRI. On MRI, T1 fat-suppressed imaging differentiates dermoid cysts from endometriomas with high specificity.

Borderline mucinous epithelial ovarian tumors may demonstrate low-level echoes on ultrasound because of loculated mucin and, therefore, may resemble endometriomas (Figure 11). However, these tumors are typically much larger than endometriomas. On MRI, these lesions may be multilocular, have enhancing solid components, or have a “stained glass” appearance because of variations in mucin concentration within loculi.

Complications of Endometriosis. Malignant transformation is rare in endometriosis, occurring less than 1% of the time. The most common malignancies arising from endometriosis are endometrioid carcinoma (Figure 12) followed by clear cell carcinoma (Figure 13). The most reliable imaging finding in evaluating for malignant transformation of an endometrioma is the presence of an MRI contrast-enhancing or Doppler-positive mural nodule (see Figure 13). On MRI, enhancing mural nodules are sensitive (97%) but not specific (56%) for malignant transformation. Other, less reliable imaging features suggesting malignant transformation include loss of T2 shading and interval increase in size.

Scar endometriosis represents iatrogenic spread of endometrial tissue related to surgery, a complication seen in 1% of all patients who have had a cesarean delivery. Patients can present with a palpable mass or cyclical pain weeks to years after surgery. On ultrasound, a solid hypoechoic mass is seen with internal vascularity on Doppler imaging. On CT, a soft tissue density is encountered in the subcutaneous tissues of the abdominal wall in the expected region of a Pfannenstiel incision (Figure 14). Tissue sampling typically is required to confirm the diagnosis.

Conclusion

Uterine adenomyosis and endometriosis are gynecologic processes with often overlapping clinical symptoms. This CME activity emphasizes the key imaging differences between these two entities and differentiates them from their mimics, thereby guiding appropriate therapy.
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1. Which one of the following MR imaging findings is most suspicious for malignant transformation of an endometrioma?
   A. Calcifications
   B. Increase in size
   C. Loss of T2 shading
   D. Enhancing mural nodule
   E. Faint peripheral enhancement

2. A 42-year-old woman experiences debilitating symptoms caused by diffuse uterine adenomyosis. The treatment for this patient should be
   A. radiation therapy
   B. hysterectomy
   C. focal excision
   D. chemotherapy
   E. analgesics

3. Which one of the following is the most common site of urinary tract involvement in a patient with endometriosis?
   A. Kidneys
   B. Proximal ureters
   C. Distal ureters
   D. Urethra
   E. Urinary bladder

4. Which one of the following uterine junctional zone measurements (thickness) on MRI is diagnostic of uterine adenomyosis?
   A. 4 mm
   B. 6 mm
   C. 8 mm
   D. 10 mm
   E. ≥12 mm

5. Which one of the following is a chronic, nonresolving ovarian cyst that occurs from repeated cyclic hemorrhage?
   A. Endometrial implant
   B. Endometrioma
   C. Deep pelvic endometriosis
   D. Hemorrhagic cyst
   E. Dermoid cyst

6. Which one of the following is the most common site of GI involvement in endometriosis?
   A. Rectosigmoid colon
   B. Cecum
   C. Terminal ileum
   D. Appendix
   E. Duodenum

7. Which one of the following MR sequences is most sensitive at detecting tiny endometrial implants?
   A. T1-weighted
   B. T1-weighted, opposed-phase
   C. T1-weighted, fat-suppressed
   D. T2-weighted
   E. Diffusion-weighted

8. Ultrasound examination of a 45-year-old woman reveals an adnexal mass with homogeneously low-level echoes. The differential diagnosis of the adnexal mass could include all of the following lesions, except
   A. endometrioma
   B. mature cystic teratoma
   C. borderline mucinous ovarian tumor
   D. clear cell carcinoma
   E. hemorrhagic cyst

9. The term “light bulb bright” refers to an endometrioma seen on which one of the following MR sequences?
   A. T1-weighted
   B. T2-weighted
   C. Short-tau inversion recovery
   D. Proton density
   E. Diffusion-weighted

10. Which one of the following conditions refers to heterotopic endometrial glands and stroma within the myometrium?
    A. Leiomyoma
    B. Adenomyosis
    C. Endometrioma
    D. Endometriosis
    E. Hemorrhagic cyst

References