MR Imaging Findings of Adenomyosis: Correlation with Histopathologic Features and Diagnostic Pitfalls

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Adenomyosis is a nonneoplastic condition, characterized by benign invasion of ectopic endometrium into the myometrium with hyperplasia of adjacent smooth muscle. The common symptoms include dysmenorrhea, menorrhagia, and abnormal uterine bleeding, but these do not allow diagnosis. Therefore, imaging plays an important role because establishment of the correct preoperative diagnosis is critical to avoid unnecessary intervention. Magnetic resonance (MR) imaging is a highly accurate noninvasive modality for diagnosis of adenomyosis, differentiation of adenomyosis from other gynecologic disorders, and planning of appropriate treatment. Although the typical MR imaging findings are well established, adenomyosis actually varies widely in terms of histopathologic features (adenomyosis with sparse glands), growth patterns (polypoid adenomyoma, adenomyotic cyst, and minia- ture uterus), responses to hormonal activity (tamoxifen, decidual changes), and responses to treatment (gonadotropin-releasing hormone agonist). The MR imaging findings of adenomyosis occasionally mimic those of uterine malignancy or ovarian cancer. Furthermore, malignancy occasionally develops in otherwise benign adenomyosis. Pitfalls in diagnosis of adenomyosis include myometrial contractions, leiomyoma, adenomatoid tumor, metastases, endometrial carcinoma, and endometrial stromal sarcoma. Knowledge of the various appearances of adenomyosis and the possible pitfalls in differential diagnosis help guide the determination of appropriate treatment options.

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Abbreviations: H-E = hematoxylin-eosin, TAS = transabdominal sonography, TVS = transvaginal sonography

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Introduction

Adenomyosis is a common gynecologic condition that affects menstruating women. Diagnosis based on clinical findings is usually difficult because of the nonspecific nature of the symptoms and the frequent coexistence of other pelvic diseases. Until recently, the diagnosis was established at biopsy or surgery. With the advent of high-resolution imaging techniques, correct diagnosis can be established with imaging modalities (1).

Transabdominal sonography (TAS) or transvaginal sonography (TVS) is commonly used as the initial imaging modality. TAS does not allow reliable diagnosis of adenomyosis or consistent differentiation from leiomyomas because of its limited spatial resolution (2). TVS, which can improve spatial resolution with its higher frequency, is known to be accurate in diagnosing adenomyosis, but it actually has limitations in tissue characterization.

Magnetic resonance (MR) imaging is also an accurate, noninvasive modality for diagnosing adenomyosis and may be more helpful than TVS in distinguishing adenomyosis from a leiomyoma, which is perhaps the most clinically important distinction. Although the typical findings of the lesion are well established, MR imaging findings vary widely, occasionally mimicking uterine malignancy or ovarian cancer. Furthermore, malignancy can develop in otherwise benign adenomyosis. Precise knowledge of histopathologic backgrounds helps identify these unusual appearances and avoid unnecessary intervention.

Specific topics discussed in this article are the definition of adenomyosis and pathologic considerations, clinical information, diagnosis, a wide variety of MR imaging findings of adenomyosis, pseudolesions masquerading as adenomyosis, unusual appearances, differential diagnosis of adenomyosis, and problems related to malignancy.

Definition and Pathologic Considerations

Adenomyosis is a nonneoplastic condition, pathologically characterized by benign invasion of ectopic endometrium into the myometrium with adjacent smooth muscle hyperplasia. Although it has been referred to as endometrosis interna, this term recently is no longer used because endometrosis and adenomyosis are different disorders. Because the endometrial-myometrial junction is normally irregular, physiologic penetration of endometrium into the myometrium can be misdiagnosed as adenomyosis. In general, endometrial glands lying deeper than one-fourth of the thickness of the myometrium or deeper than one-half of a low-power field (about 2.5 mm) are defined as adenomyosis (3). However, these criteria actually vary among pathologists. According to differences in diagnostic criteria and the thoroughness of the pathologic examination, the reported prevalence of adenomyosis in hysterectomy specimens varies from 5% to 70% (4).

In gross appearance, the uterus is usually firm, enlarged, and somewhat globular. The cut surface of the thickened myometrium is trabeculated and occasionally contains hemorrhagic foci. At microscopy, the ectopic endometrium may form small or large islands within the myometrium surrounded by myometrial hypertrophy. The ectopic endometrial glands within adenomyosis are generally of the basalis type and do not respond to cyclic ovarian hormones, unlike those of endometrosis. However, unusual responses, such as secretory changes, cyclic hemorrhage, or decidual reactions, may infrequently be observed (5). These issues are discussed later.

A rare pathologic feature is adenomyosis with sparse glands, in which the glandular component is especially sparse. This condition may pathologically simulate a low-grade endometrial stromal sarcoma (LGESS) and cause diagnostic problems for pathologists, because the tumor cells of LGESS usually resemble benign endometrial stromal cells in the proliferative phase with scant cytologic atypia and even rarely have mature endometrial glands (6). Therefore, imaging study is important to make the distinction. These issues are also discussed later. Previously used designations, such as stromal adenomyosis, stromatosis, or stromal endometrosis, are not currently recommended because such designations have been wrongly applied to true endometrial stromal neoplasms in the old literature.
**Clinical Information**

Adenomyosis occurs mainly in premenopausal women, particularly those who are multiparous. The common symptoms include dysmenorrhea, menorrhagia, and abnormal uterine bleeding. However, these symptoms are nonspecific and often seen in other disorders, such as dysfunctional uterine bleeding, leiomyoma, endometriosis, and uterine malignancies. The uterus may be diffusely enlarged, but this finding can also be seen in leiomyoma. Furthermore, patients frequently have associated disorders, most commonly leiomyoma and endometriosis (5).

The etiology of adenomyosis is still under debate. However, tamoxifen, which is a nonsteroidal antiestrogen agent that is widely used for treatment of estrogen-sensitive breast cancer, is known to increase the incidence of adenomyosis in postmenopausal women (7).

Treatment for adenomyosis depends on the patient’s symptoms, age, and desire for future fertility. The definitive treatment is hysterectomy, but initially less invasive approaches should be tried. If symptomatic relief can be obtained with nonsteroidal anti-inflammatory drugs, or if the patient is perimenopausal with anticipated cessation of ovarian function, conservative therapy is warranted. If adequate relief is not obtained, menstrual-suppression hormonal therapy with danazol (oral or IUD [intrauterine device]) or gonadotropin-releasing hormone (GnRH) agonist, which induces a hypoestrogenic state, should be considered. However, hormonal therapy for adenomyosis is usually less effective than that for endometriosis because of the differences in hormonal responses of the ectopic endometrium, which is of the basalis type in adenomyosis.

Endometrial resection or ablation is considered an alternative to hysterectomy for patients with abnormal uterine bleeding. However, the success rate of this procedure is lower when there is deep adenomyosis (8). Hysterectomy will still be necessary in severe cases of adenomyosis. Uterine artery embolization (UAE), which is emerging as an alternative to hysterectomy for patients with leiomyomas, may also become an alternative for patients with symptomatic adenomyosis (9).

**Diagnosis**

Eliciting a typical history and identifying a diffusely enlarged uterus with a proven absence of pregnancy allows presumptive diagnosis of adenomyosis. However, the rate of preoperative diagnosis based on clinical findings is poor, ranging from 2.6% to 26%, because of the nonspecific nature of the symptoms and the frequent coexistence of other disorders (2). Until recently, the diagnosis was rarely established before surgical exploration.

TAS or TVS is commonly used as the initial imaging modality for patients with clinically suspected adenomyosis. The reported sensitivity and specificity of TAS are 32.5%–63% and 95%–97%, respectively (10,11). The limited resolution of TAS is insufficient for reproducible detection of subtle sonographic features of adenomyosis (2). Meanwhile, the recent advent of high resolution in TVS has markedly improved the possibility for preoperative diagnosis of adenomyosis. The reported sensitivity and specificity of TVS for diagnosing adenomyosis are 53%–89% and 67%–98%, respectively (10,12,13). Typical appearances of adenomyosis at TVS include poorly marginated hypoechoic and heterogeneous areas within the myometrium, myometrial cysts, and a globular or enlarged uterus with asymmetry (1,10).

MR imaging is also an accurate, noninvasive modality for diagnosing adenomyosis with a high sensitivity (78%–88%) and specificity (67%–93%) (10,12,13). This modality might be more helpful than TVS in delineating the location and extent of the lesion and in monitoring the evolution of disease in patients receiving hormonal therapy (1,2). Moreover, MR imaging is useful in distinguishing adenomyosis from a leiomyoma in cases of enlarged uterus, which is perhaps the most clinically important distinction (14). Few studies have compared the accuracy rates of TVS and MR imaging for diagnosing adenomyosis. Some authors reported no significant difference between TVS and MR imaging in the sensitivity (65%–89% vs 78%–86%) and specificity (89%–98% vs 86%–93%) (10,13), while others reported
Figure 1. Adenomyosis in a 48-year-old woman. (a) Sagittal T1-weighted image shows an enlarged uterus with homogeneous signal intensity. (b) Sagittal T2-weighted image shows an ill-defined myometrial lesion of low signal intensity in the anterior myometrium. Innumerable hyperintense foci (arrows) are embedded in the lesion.

Figure 3. Changing appearance of adenomyosis in a 47-year-old woman. (a) Sagittal T2-weighted image obtained on day 16 of the menstrual cycle shows a myometrial mass of high signal intensity protruding into the uterine cavity (arrows). (b) Sagittal T2-weighted image obtained 22 days later (on cycle day 10) shows the typical appearance of adenomyosis. Adenomyosis was confirmed at surgery.
that MR imaging was significantly better than TVS (88% vs 53%) (12). In patients with additional lesions like leiomyomas, the sensitivity of TVS was lower than that of MR imaging (10).

**MR Imaging Findings**

Adenomyosis appears as either diffuse or focal thickening of the junctional zone forming an ill-defined area of low signal intensity, occasionally with embedded bright foci on T2-weighted images (Fig 1). Histologically, areas of low signal intensity correspond to smooth muscle hyperplasia, and bright foci on T2-weighted images correspond to islands of ectopic endometrial tissue and cystic dilatation of glands. When menstrual hemorrhage occurs within these ectopic endometrial tissues, signal intensity on T1-weighted images may become high (Fig 2) (14–16). Even without hemorrhage or treatment, the appearance of adenomyosis and the amount of bright foci may fluctuate (Fig 3).

**Figure 2.** Adenomyosis with hemorrhagic foci in a 52-year-old woman. (a) Sagittal T1-weighted image shows an enlarged uterus with multiple hyperintense foci in the anterior myometrium (arrows), which represent hemorrhage. (b) Sagittal T2-weighted image shows an ill-defined area of low signal intensity in the anterior myometrium. Hyperintense foci (arrows) are embedded in the lesion. (c) Photograph of the cut surface of the gross specimen shows multiple hemorrhagic cysts within a thickened myometrium. (d) Photomicrograph (original magnification, ×40; hematoxylin-eosin [H-E] stain) shows an island of ectopic endometrial tissue that contains blood (arrowheads).
With the advent of high-resolution imaging techniques, these bright foci are being detected with increasing frequency, one report finding them in more than 50% of patients. Such findings may manifest as myometrial cysts, myometrial nodules, linear striations, pseudowidening of the endometrium (Fig 4), and poor definition of the endometrial junction (1) and are discussed further in the sections regarding differential diagnosis and problems related to malignancy. MR imaging findings of adenomyosis will be modified by the use of gonadotropin-releasing hormone (GnRH) agonist. In patients responding well to GnRH agonist therapy, demarcated changes of the lesion can be observed, which may resemble a leiomyoma (17). Knowledge of the patient’s medical history can prevent misdiagnosis.
Pseudolesions Masquerading as Adenomyosis

Focal thickening of the junctional zone can easily lead to a diagnosis of adenomyosis, whereas diffuse thickening should be differentiated from physiologic thickening. The presence of bright foci on T2- or T1-weighted images supports the diagnosis of adenomyosis. In general, a maximal junctional zone thickness of more than 12 mm is highly predictive of the presence of adenomyosis, while a thickness of less than 8 mm usually allows exclusion of the disease (2,18). However, in our experience, the uterus during menstruation (especially cycle days 1 and 2) may demonstrate marked thickening of the junctional zone to more than 12 mm (Fig 5). The diagnosis of adenomyosis should be made with care, possibly avoiding the menstrual phase.

Another pseudolesion that may masquerade as adenomyosis is a myometrial contraction. Sustained myometrial contraction is the focal and sporadic bulging of the myometrium into the uterine cavity. Blood is squeezed out from the contracted area, and water content is reduced because of the reduced blood volume. As a result, the contracted area exhibits ill-defined or sharply margined areas of low signal intensity on T2-weighted images (19). Contractions can be differentiated from true myometrial disease on sequential studies by their transient nature, but this is not always easy on single series (Fig 6). Previously, the detection rate of pseudolesions due to uterine contraction was about 9% with use of the static fast spin-echo technique (19). But recently, a high detection rate of up to 72%–75% has been reported with use of the multiphase single-shot fast spin-echo technique (20).

Figure 6. Myometrial contraction in a healthy 30-year-old woman, who underwent MR imaging during a study that evaluated myometrial contractions during the menstrual phase. The half-Fourier acquisition single-shot turbo spin-echo sequence was used to obtain T2-weighted images. (a) Sagittal image obtained on cycle day 1 shows a focal area of low signal intensity in the anterior myometrium (arrows), a finding that closely simulates focal adenomyosis. (b) Sagittal image obtained on cycle day 3 shows a normal uterus with a thin and distinct junctional zone.
Unusual Appearances

Unusual Growth Patterns

Adenomyoma.—Adenomyoma is defined as a localized, circumscribed form of adenomyosis. The lesion typically manifests as a polypoid mass protruding into the cavity. Less commonly, it may manifest as a myometrial mass (Fig 7) or as a subserosal mass (21). Recognition of this pathologic entity is important because it may be surgically treated with polypectomy or myomectomy, unlike an ordinary form of adenomyosis. However, adenomyoma is frequently misdiagnosed as other tumors, not only at MR imaging but also at pathologic examination. At MR imaging, myometrial adenomyoma typically exhibits low signal intensity on T2-weighted images (1,15), an appearance indistinguishable from that of the more common leiomyoma. When

Figure 7. Intramyometrial adenomyoma in a 21-year-old woman. (a, b) Axial (a) and sagittal (b) T2-weighted images show an ill-defined, low-signal-intensity mass with an embedded hyperintense cyst in the posterior myometrium (arrows). (c) Sagittal T1-weighted image shows that the cyst within the mass (arrows) has high signal intensity, which represents hemorrhage. Myomectomy was performed, and adenomyosis was pathologically confirmed.
the lesion is accompanied by small foci of high signal intensity representing ectopic endometrial tissue, adenomyoma can be considered in the differential diagnosis.

Polypoid adenomyoma (adenomyomatous polyp) and atypical polypoid adenomyoma: Adenomyoma manifesting as a polypoid mass protruding into the endometrial cavity is called polypoid adenomyoma or adenomyomatous polyp and accounts for about 2% of all endometrial polyps. It typically occurs in premenopausal women and manifests as abnormal genital bleeding. It arises most frequently in the lower uterine segment or endocervix and appears as a pedunculated or sessile polypoid mass (22). At MR imaging, the lesion appears as a hypointense polypoid mass with hyperintense foci on T2-weighted images (Fig 8) (23).

Figure 8. Tamoxifen-induced adenomyoma in a 56-year-old woman. The patient underwent breast-conserving therapy for breast carcinoma 2 years earlier and was treated with tamoxifen. (a) Sagittal T2-weighted image shows a polypoid mass of heterogeneous high signal intensity in the endometrial cavity (arrows). (b) Sagittal contrast-enhanced T1-weighted image shows that the mass (arrows) enhances as well as the myometrium. (c) Photomicrograph (original magnification, ×20; H-E stain) shows endometrial tissue surrounded by hyperplastic smooth muscle.
Atypical polypoid adenomyoma is a variant of polypoid adenomyoma and is microscopically characterized by architectural and cytologic atypia. The reported MR imaging finding is a hypointense polypoid mass with bright foci on T2-weighted images (Fig 9) (23). In the evaluation of histologic samples, especially those obtained with dilation and curettage, atypical polypoid adenomyoma may be misdiagnosed as endometrial carcinoma invading the myometrium. Preoperative information provided by MR imaging, based on the signal intensity of the lesion, can be the clue to making a distinction.

Adenomyotic Cyst.—An adenomyotic cyst is an extremely rare variation of adenomyosis caused by extensive menstrual bleeding into the ectopic endometrium. The lesion consists of a large hemorrhagic cyst, which is partly or entirely surrounded by a solid wall. The lesion can be entirely within the myometrium, submucosal, or subserosal and frequently is associated with symptoms of menorrhagia and dysmenorrhea. Rupture can rarely occur.

At MR imaging, fluid content exhibits high signal intensity on T1-weighted images and the surrounding solid wall exhibits distinct low signal intensity on T2-weighted images (Fig 10) (24,25). Occasionally, the solid wall may develop two zones consisting of an inner zone of low signal intensity that resembles a junctional zone and a relatively bright outer myometrium, and this is called miniature uterus (Fig 11). Microscopically, endometrial glands are observed along the cyst wall, which is composed of myometrial tissue.
Figure 10. Subserosal adenomyotic cyst in a 46-year-old woman. (a) Sagittal T1-weighted image shows a cystic mass posterior to the uterus (U). The lesion consists of a hyperintense cyst, on top of which is curvilinear tissue of intermediate signal intensity (arrows). (b) Sagittal T2-weighted image shows that the curvilinear tissue is hypointense (arrows). (c) Sagittal contrast-enhanced T1-weighted image shows the curvilinear tissue (arrows) enhancing as well as the myometrium. A pedicle containing enlarged vessels (arrowheads) connects the lesion to the uterus, indicating the uterine origin of the mass. Thus, the preoperative diagnosis was degenerated subserosal leiomyoma. (d) Photograph of the cut surface shows the hemorrhagic cystic mass and the curvilinear solid tissue (arrows). The initial pathologic diagnosis was leiomyoma because the lesion consisted of smooth muscle cells and hyaline degeneration. (e) Photomicrograph (original magnification, ×40; H-E stain) shows endometrial tissue containing hemorrhage (arrow) and hemosiderin (arrowhead) lining the cyst wall.
Figure 11. Submucosal adenomyotic cyst in a 37-year-old woman. (a) Sagittal T2-weighted image obtained 3 years earlier shows typical adenomyosis. (b) Sagittal T1-weighted image shows a polypoid mass in the endometrial cavity (arrows). The hyperintense area in the mass is hemorrhage. (c) Sagittal T2-weighted image shows the well-defined cystic mass (arrows). Its thick wall has inner low and outer high signal intensity (miniature uterus). The uterus is enlarged due to adenomyosis. (d) Sagittal contrast-enhanced T1-weighted image shows marked enhancement of the wall (arrows). (e) Photograph of the cut surface shows the uterus-like mass (arrows). (f) Photomicrograph (original magnification, ×40; H-E stain) shows the cyst (*) surrounded by layers of endometrial tissue and smooth muscle.
However, on pathologic studies, endometrial glands are often atrophic or missing on small tissue samples and hyaline degeneration is sometimes observed within the lesion. In this situation, an adenomyotic cyst is easily misdiagnosed as a leiomyoma from pathologic studies because the existence of smooth muscle cells and hyaline degeneration is considered almost pathognomonic for a leiomyoma. However, ectopic endometrial tissue should not be recognized with leiomyoma. In this regard, MR imaging can be crucial for a correct diagnosis (24).

**Unusual Responses to Hormonal Stimuli**

Although the ectopic endometrium of adenomyosis seldom responds to cyclic ovarian hormones, in some cases, secretory changes may be seen, and decidual reaction may be encountered if the patient is pregnant (Fig 12) (5). Even without pregnancy, the appearance of adenomyosis may occasionally fluctuate, probably reflecting hormonal responses. The lesion may appear as a mass of heterogeneous high signal intensity, masquerading as a malignant uterine neoplasm on one occasion and then showing an otherwise typical appearance of adenomyosis on another (Fig 3). Follow-up MR imaging may be helpful to identify any change in signal intensity and to avoid misdiagnosis.

**Differential Diagnosis of Adenomyosis**

**Leiomyoma.**—Leiomyoma is by far the most commonly encountered lesion that clinically resembles adenomyosis. A correct preoperative diagnosis is critical when uterine conservation is desired or myomectomy is scheduled, since...
Figure 13. Adenomyosis with leiomyomas in a 43-year-old woman. (a) Sagittal T2-weighted image shows typical adenomyosis in the anterior myometrium. Leiomyomas are demonstrated as well-circumscribed hypointense masses (arrows). (b) Photograph of the cut surface of the gross specimen shows several leiomyomas with well-defined borders (arrows) in the myometrium.

Figure 14. Adenomatoid tumor of the uterus in a 42-year-old woman. (a) Axial T2-weighted image shows an ill-defined mass (arrowheads) that is slightly hypointense relative to the myometrium. The lesion is surrounded by cystic areas of high signal intensity (arrows), especially at the serosal aspect. (b) Photograph of the cut surface of the gross specimen shows an appearance that corresponds closely to that seen on the MR image. (c) Photomicrograph (original magnification, ×40; H-E stain) shows the cystic spaces of dilated mesothelial tubules (*) within myometrial fibers.
leiomyoma can be treated with myomectomy, whereas adenomyosis requires hysterectomy (14). In contrast to leiomyoma, adenomyosis manifests with a poorly defined border, minimal mass effect, an elliptical rather than round configuration, and absence of dilated vessels at the margin of the lesion (Fig 13) (1,14).

**Adenomatoid Tumor of the Uterus.**—Adenomatoid tumor, which is a relatively rare benign mesothelial tumor, also frequently resembles a leiomyoma or adenomyoma. At microscopy, the lesion usually has an ill-defined margin with the surrounding myometrium, which helps distinguish it from leiomyoma with its distinct margin. However, at MR imaging, the lesion may appear as an ill-defined or well-circumscribed mass of low signal intensity on T2-weighted images, an appearance that can be indistinguishable from that of leiomyoma or adenomyoma (26). Uncommonly, an adenomatoid tumor has small cystic spaces representing dilated mesothelial tubules (Fig 14) or appears as a large cystic mass. With these findings, the distinction from adenomyosis is not difficult.

**Metastasis to the Uterine Corpus.**—Metastasis to the uterine corpus may appear as a diffuse hypointense area in the myometrium of an enlarged uterus on T2-weighted images and can mimic adenomyosis. Among rare metastases from extrapelvic tumors, the most common are from breast cancer (especially invasive lobular carcinoma) and gastrointestinal cancer (especially signet-ring cell carcinoma) (27,28). Patients’ history of malignancy and associated findings such as ascites, lymphadenopathy, and ovarian masses can indicate the diagnosis of uterine metastasis. If the primary site is unknown, uterine metastasis may be misdiagnosed as endometrial carcinoma with cytologic examination alone. MR imaging might be of help in demonstrating a myometrial lesion of low signal intensity.

**Myometrial Invasion by Endometrial Cancer.**—Linear striations of high signal intensity radiating out from the endometrium, pseudowidening of the endometrium, and an irregular endometrial junction, which results from the blending of these fine striations, are commonly encountered findings of adenomyosis. These findings microscopically reflect direct benign invasion of the basal endometrium into the myometrium (7). If these findings are identifiable in the presence of endometrial carcinoma, it is difficult or even impossible to distinguish these benign findings from true invasion of an endometrial malignancy into the myometrium (Figs 3, 4).

**Distinction from Unusual Appearances of Adenomyosis**
Although adenomyosis typically appears as a lesion of low signal intensity, high signal intensity or cystic change may predominate in some lesions, and thus a wide variety of diseases must be included in the list of differential diagnoses.

**Endometrial Stromal Sarcoma.**—Low-grade endometrial stromal sarcoma (LGESS), which typically appears as a polypoid endometrial mass with extensive myometrial involvement, may occasionally appear as an infiltrative myometrial lesion with only minimal involvement of the endometrium in very young women (Fig 15) (29). The simultaneous presence of both endometrial and myometrial involvement would be a clue to excluding benign myometrial lesions such as leiomyoma or adenomyosis. The role of imaging study is very important because microscopic examination may not be helpful, since cells shed from LGESS usually are not sufficiently atypical to be distinguished from benign endometrial stromal cells, as mentioned earlier.
Miscellaneous.—As mentioned in the previous section, adenomyoma may appear as a myometrial, polypoid endometrial, or subserosal mass. An adenomyoma, which is a well-circumscribed nodular form of adenomyosis, may be indistinguishable from a leiomyoma in any location. If the lesion appears as a subserosal mass, it may resemble a leiomyoma or an ovarian tumor of a fibrocollagenous nature, such as a fibroma or thecoma.

An adenomyotic cyst also can be seen intramyometrially, submucosally, or subserosally. If the lesion is intramyometrial, the differential diagnosis includes congenital uterine cysts, intramyometrial hydrosalpinx, and echinococcal cysts. If the lesion is subserosal, the differential diagnosis includes subserosal leiomyomas with degeneration and ovarian tumors of a fibrocollagenous nature, such as fibromas or thecomas or even cystic ovarian tumors. However, these lesions all rarely contain hemorrhage, unlike adenomyotic cyst (24).

Problems Related to Malignancy

Tumors Arising from Adenomyosis

An adenocarcinoma arising from adenomyosis is a rare disease. This entity is pathologically characterized by the presence of a transition from the benign adenomyotic endometrial glands to the carcinomatous glands and the absence of tumor involvement of the eutopic endometrium (30). The lesion may manifest as a discrete mass within adenomyosis and sometimes can be detectable at MR imaging (Fig 16). However, when the lesion exhibits an infiltrative form of invasion within adenomyosis and does not appear as an evident...
Figure 16. Adenocarcinoma arising from adenomyosis in a 71-year-old woman. Hysteroscopy showed a submucosal mass, but preoperative histologic evaluation showed no malignancy. (a) Sagittal T1-weighted image shows a slightly enlarged uterus for the patient’s age (arrows). (b) Sagittal T2-weighted image shows a well-demarcated mass of high signal intensity in the myometrium (arrows). (c) Sagittal contrast-enhanced T1-weighted image shows weak enhancement (arrows). (d) Photograph of the cut surface shows the mass (arrows), which resembles a leiomyoma. (e) Photomicrograph (original magnification, ×40; H-E stain) shows moderately differentiated endometrioid carcinoma (*) separated from the endometrium and surrounded by adenomyosis, which was not seen on the MR images.
mass at MR imaging, it may be difficult to distinguish from typical adenomyosis without malignancy (Fig 17). Moreover, cytologic evidence is hard to obtain at an early stage owing to the lack of involvement of the eutopic endometrium. In these cases, the lesion may be diagnosed in a more advanced stage at presentation, potentially resulting in an unfavorable prognosis (31).

An adenocarcinoma arising from adenomyosis should be distinguished from the more common situation in which endometrial carcinomas extend into foci of adenomyosis, but this is not always easy (see the next section).

**Staging Endometrial Carcinoma in the Presence of Adenomyosis**

In staging endometrial carcinoma, myometrial invasion is an extremely important factor in predicting prognosis. When an endometrial carcinoma and adenomyosis coexist in the same uterus and abut against each other, we should recognize that it is difficult to distinguish the situation of an extension of cancer into adenomyosis from that of a true invasion. The former situation involves the penetration of cancer cells into preexisting tongues of adenomyosis, whereas the latter situation is usually a type of invasion in which endometrial cancer invades shallowly or deeply into the myometrium. Distinction is very important because the former situation does not carry the same unfavorable prognostic implications as the latter.

At microscopy, a definitive finding for diagnosis of carcinoma extending into adenomyosis is the demonstration of endometrial stroma between the carcinoma and the myometrium. However, at MR imaging, distinction between these conditions may be quite difficult or impossible. Moreover, in the presence of linear striations and pseudowidening of the endometrium, otherwise
common adenomyosis might not be easily distinguished from myometrial invasion or extension of endometrial cancer (Fig 18). Occasionally, contrast-enhanced MR imaging may help in the evaluation of endometrial cancer that arises in women with adenomyosis (32).

Conclusions

MR imaging is a highly accurate noninvasive modality for diagnosing adenomyosis. Although the typical MR imaging findings are well established, adenomyosis actually differs markedly in pathologic features, in growth patterns, in responses to hormonal activity, and in responses to its treatment. It is important to be familiar with a wide variety of MR imaging findings of adenomyosis because a correct preoperative diagnosis is critical to determine appropriate treatment and avoid unnecessary intervention. Precise knowledge of histopathologic backgrounds helps one identify these unusual appearances.

References


Figure 18. Endometrial adenocarcinoma extending into adenomyosis in a 48-year-old woman. (a) Axial T2-weighted image shows linear striations extending from the posterior endometrium (arrowheads), a finding that may suggest myometrial invasion by carcinoma. (b) Photomicrograph (original magnification, ×40; H-E stain) shows endometrial carcinoma extending into a tongue of adenomyosis, thus producing the linear striations or pseudowidening of the endometrium seen on the MR image. The tumor cells (*) are completely within the adenomyosis and surrounded by the endometrial tissue, an appearance that implies absence of true myometrial invasion.


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