Ovarian Cysts, Endometriosis

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Endometriosis is a benign entity that affects women of reproductive age. It is defined as the presence of endometrial tissue outside the uterus. The clinical manifestations of endometriosis are protean. The presence of endometrial tissue in the myometrium is termed adenomyosis. Superficial implants of endometrial tissue may occur throughout the peritoneal cavity, along serosal surfaces and in the abdominal wall. Deep infiltrating endometriosis occurs when implants infiltrate the peritoneum and serosa by at least 5 mm and involve visceral organs. Histologically, these lesions are characterized by fibromuscular hyperplasia around foci of endometriosis which sometimes contain small cavities (Koninckx et al. 1994). The majority of patients have superficial endometriosis, usually asymptomatic, with the commonest site of involvement being the ovaries, uterine ligaments, pouch of Douglas, serosal uterine surface, fallopian tubes, rectosigmoid junction, and bladder dome. Deep infiltrative endometriosis is symptomatic and causes significant morbidity including chronic pelvic pain, infertility, haematuria, and rectal pain and bleeding.

A variety of imaging techniques including TVUS, TRUS, CT, and MRI have been used to evaluate deep pelvic endometriosis. Ultrasound is best suited to the detection and follow-up of endometriomas and bladder lesions. Transrectal ultrasound can be used to detect infiltrative lesions of the serosa or wall of the bowel but this technique does not allow evaluation of the complete pelvis. The value of imaging in superficial endometriosis is limited as small scattered deposits are easily masked by bowel and hence laparoscopy remains the gold standard for diagnosis. The therapeutic options for patients depend on the location and extent of disease and the relative proportion of active and fibrous endometriosis. Active endometriotic deposits are receptive to medical hormone treatment whilst scarring fibrous endometriosis, when symptomatic requires surgical lysis.

Imaging Features

Increasingly in clinical practice, information on the distribution, pattern of disease, and ratio of active to fibrotic disease is provided by detailed TVUS and high resolution MR imaging of the pelvis.

Endometriomas

The ovary is the most commonly involved site, where endometriotic cysts may be termed “chocolate cysts” or “endometriomas.” Extra-ovarian endometriomas have similar imaging characteristics but lie distant from the ovaries in the pelvis and occur anywhere in the abdomen and pelvis.

On high resolution TVUS, the sensitivity of detection of endometriomas is excellent, with reports of 83% sensitivity and 98% specificity.

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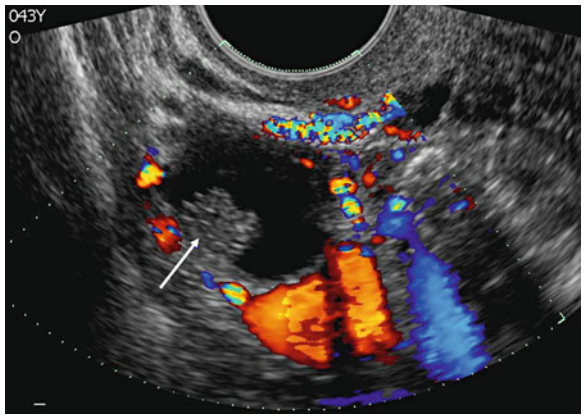

Fig. 131.1 TVUS showing a thick walled cyst in the right ovary with a mural non-enhancing nodule (*arrow*). In this patient, the diagnosis of endometriosis was known, the patient had a low RMI and the cyst was followed up with gradual resolution over 4 months

Diagnostic accuracy may be enhanced by Doppler flow studies where blood flow in endometriomas is usually around the cyst with a resistive index above 0.45 (Bis et al. 1997).

There is a wide range of ultrasound appearances of endometriomas including multilocular cysts, cysts with diffuse, low level internal echoes (occur in 95% of endometriomas), and cysts with hyperechoeic foci within the wall (Patel et al. 1999) (Figs. 131.9, 131.1).

The role of CT, due to its poor specificity and high radiation dose, has been replaced by MRI. Endometriomas have nonspecific appearances appearing as solid, cystic, or mixed solid and cystic lesions, resulting in a broad overlap in appearances with abscesses, benign functional ovarian cysts or even malignant masses.

Cyclical bleeding within the cysts results in accumulation of blood products of different ages that contain very high concentrations of paramagnetic products from hemoglobin breakdown. Consequently, endometriomas have typically high T1 signal intensity and very high signal on fat-suppressed T1-weighted images. A wide range of T2 signal intensity has been observed, ranging from a fluid hyperintensity to complete signal void and low-signal-intensity shading (Woodward et al. 2001) which has been reported as characteristic of endometriomas. The detection and characterization on MRI is excellent and sensitivities and specificities of 90% and 98%, respectively, have been achieved using standard T1 and T2 weighted sequences alone (Togashi et al. 1991). Endometriomas can appear complex, containing solid debris, clot, or calcification (Figs. 131.10, 131.2). The typically thin cyst wall shows contrast enhancement but, when fibrotic, can appear thick and irregular, mimicking malignancy. Malignant transformation is rare and only occurs in 0.6–0.8% of women with ovarian endometriosis (Takeuchi et al. 2006). The cause for the transformation is unclear but unopposed eostrogen effects are thought to contribute. Endometrioid and clear cell adenocarcinomas are the most common histological subtypes. On MRI, the most indicative finding for malignant transformation is the presence of enhancing mural nodules (Takeuchi et al. 2006). Unenhanced and contrast-enhanced subtraction images are valuable in detecting small enhancing nodules within the background of a T1-hyperintense endometriomas (Fig. 131.10).

Deep Infiltrative Endometriosis

MRI performs well in detection of infiltrative endometriosis, with a sensitivity of 68% for lesions diffusely scattered in the pelvis, typically along the posterior uterine surface and in the rectovaginal septum (Bis et al. 1997). In deep pelvic endometriosis, fibrotic changes due to inactive tissue and scarring, results in distortion of the posterior vaginal fornix, uterus, and uterosacral ligaments. This distortion is clearly seen with a high sensitivity (94%) along with extra-ovarian endometriomas and haematosalpinges (Woodward et al. 2001). The positive predictive value of MRI for deep infiltrative endometriosis is 92% and the negative predictive value is 89% (Bazot et al. 2004). Although the main imaging sequences required are T1, multiplanar high resolution T2, and T1 with fat saturation, use of gadolinium contrast agents is useful to increase the sensitivity for detection of active endometrial deposits and secondly to distinguish between enhancing active endometrial tissue and non-enhancing fibrosis.

To best evaluate features of deep infiltrative endometriosis, the pelvis can be divided into posterior and anterior compartments relative to the uterus. The posterior compartment, which is most frequently involved in infiltrative endometriosis, comprises of the uterine surface, cervix, posterior vaginal wall, Pouch

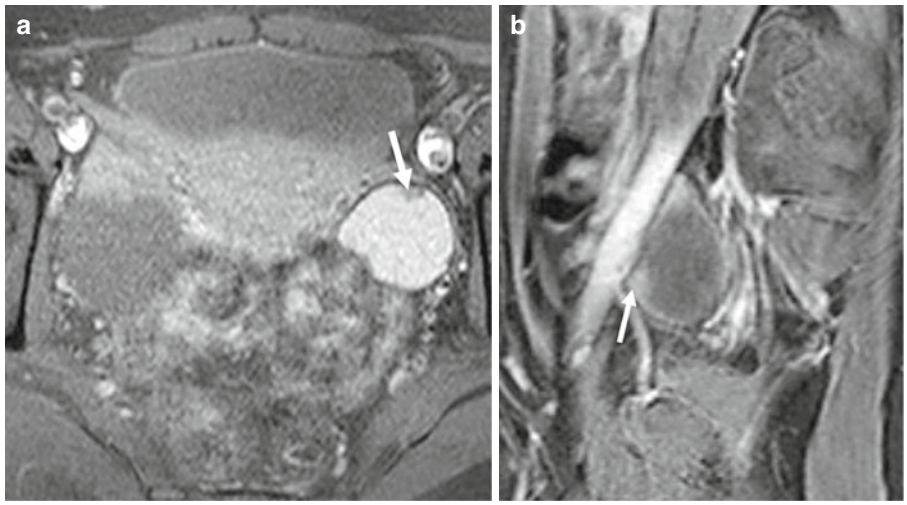

Fig. 131.2 Benign endometrioma. (**a**) Axial T2-weighted image of a left endometrioma with a small papillary nodule (*arrow*) in the anterior wall. (**b**) Axial T1-weighted image with fat saturation and intravenous gadolinium enhancement showing enhancement of the nodule (*arrow*). The endometrioma was resected but entirely benign with no malignancy despite the small enhancing nodule

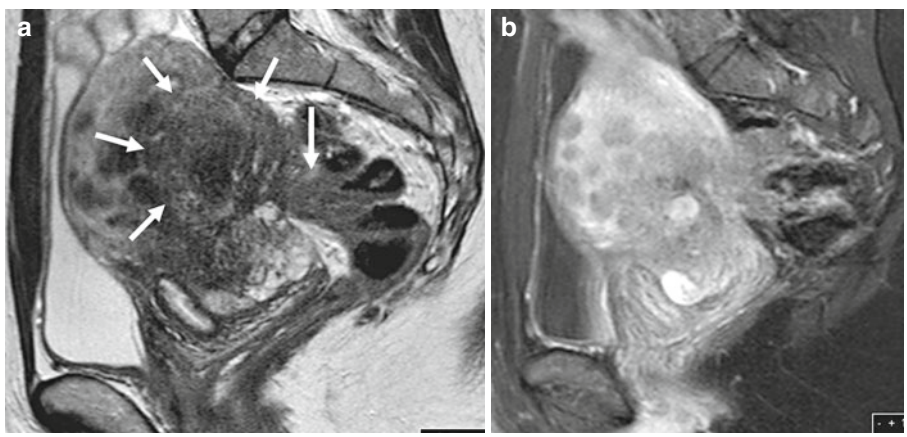

Fig. 131.3 Diffuse infiltrative endometriosis. (**a**) Sagittal T2-weighted image showing a large torus uterinus mass with an admixture of low and high T2 signal intensity. The mass involves the posterior surface of the cervix, uterus, and rectum. It causes retroversion of the uterus and extends posteriorly, involving the rectal serosa (*arrows*). (**b**) Sagittal T1-weighted image with fat saturation and intravenous gadolinium. There is pronounced enhancement of the torus uterinus and the dense sheet like mass around the rectal serosa and rectal wall suggesting active endometriosis

of Douglas, rectum, and the uterosacral ligaments. The anterior compartment consists of vesico-uterine pouch and bladder. In the posterior compartment, in order of frequency, the commonest sites of disease involvement are uterosacral ligaments, uterine and cervical surfaces, pouch of Douglas, bowel loops, and rectosigmoid junction. Bladder involvement is rarely solitary and occurs in association with deep posterior endometriosis (Bazot et al. 2004).

The diagnosis of infiltrative endometriosis is based on signal intensity abnormalities and morphological changes. Small endometriotic deposits are seen as scattered hyperintense foci on T1 and T1 fat saturated sequences. Small cavities of high T2 signal intensity

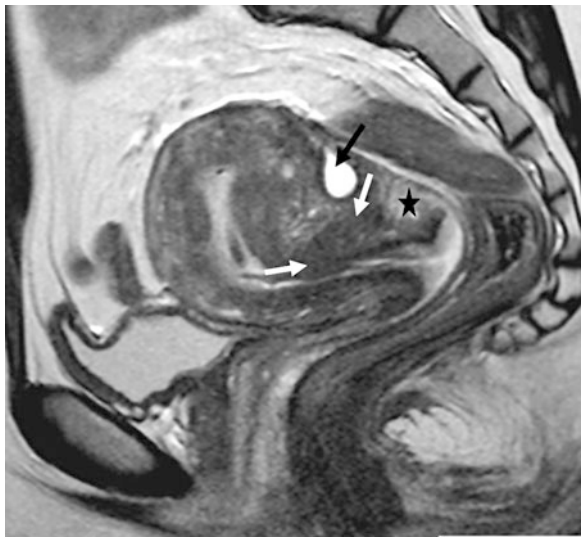

Fig. 131.4 Sagittal T2-weighted image showing a low T2 signal intensity torus uterinus mass (*white arrows*) with scarring causing upward displacement of the posterior fornix (*asterisk*) and retroversion of the uterus. A small loculated pocket of fluid is seen along the posterior uterine surface (*black arrow*)

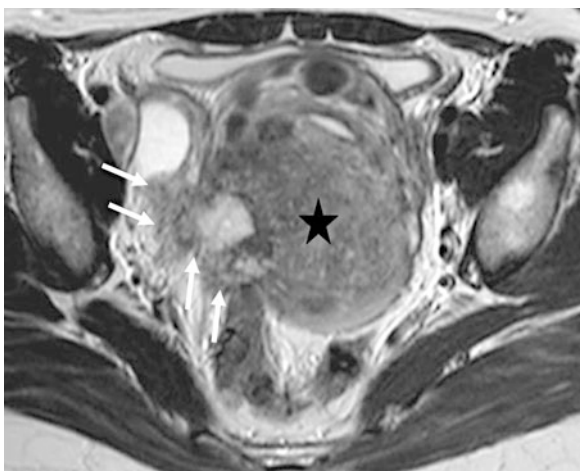

Fig. 131.5 Axial T2-weighted image showing a sheet of endometriotic tissue involving the posterior compartment, right ovary, and obliterating the right lateral uterosacral ligament. A large adenomyoma is also seen in the posterior myometrium (*asterisk*)

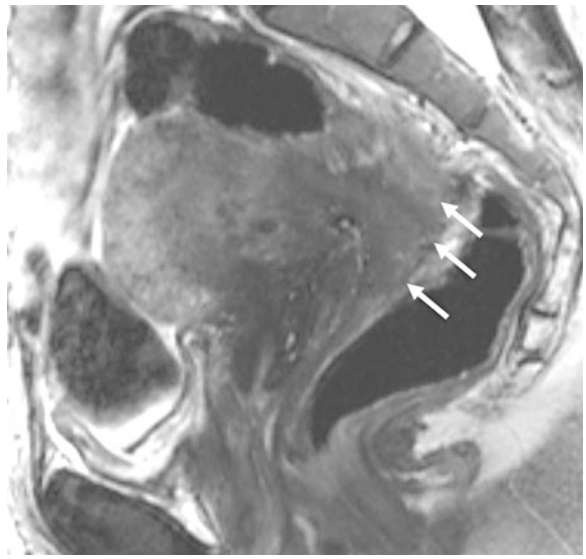

Fig. 131.6 Sagittal T2-weighted image of a large torus uterinus endometriotic deposit along the posterior uterine surface extending to the rectovaginal fat, rectal serosa and the rectal wall. On imaging, the appearances can mimic a colorectal carcinoma; however the age of the patient, the typical location of the rectosigmoid junction, and clinical history would support endometriosis

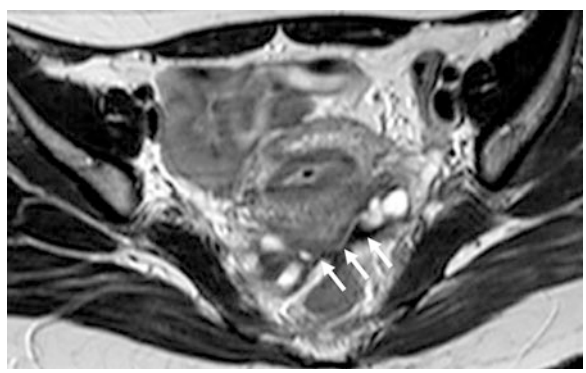

Fig. 131.7 Axial T2-weighted image with a dense fibrotic low T2 signal band posterior to the uterus (*arrows*). The fibrosis results in both ovaries being adherent to the posterior uterine surface and medially retracted. The medial retraction results in both ovaries lying in contact resulting in the kissing sign

are also indicative of endometriosis. Morphological changes in the posterior compartment include torus uterinus mass which is a mass or thickening along the upper posterior cervical surface which binds together the posterior uterine surface, the posterior vaginal fornix, and the medial portions of the uterosacral ligaments. This mass may either be mainly fibrotic with low T2 signal intensity causing extensive adhesions, active endometriotic tissue of high T2 signal intensity or an admixture of both. This causes shortening and thickening of uterosacral ligaments, retroverted uterus and raised posterior fornix sign

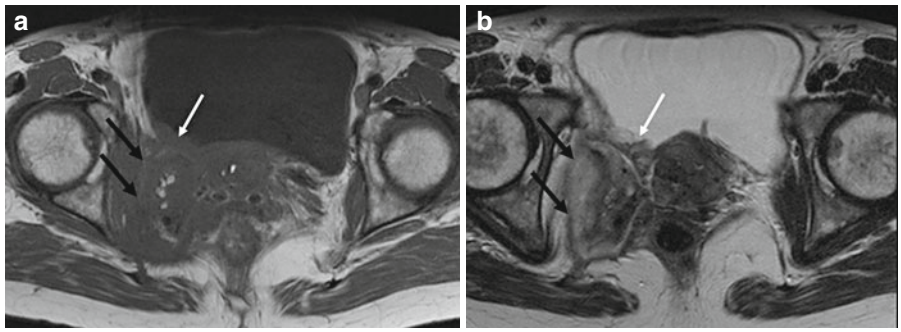

Fig. 131.8 Axial T1-weighted image with deep infiltrative endometriotic tissue along the right pelvic side wall with low T1 signal and small foci of high T1 signal intensity (*black arrows*). The endometriotic tissue extends into the posterior bladder wall (*white arrow*) including the bladder mucosa and the cervix

(Figs. 131.3, 131.4). Infiltration of the uterosacral ligaments includes the presence of irregular or regular nodules, fibrotic stellate bands, or thickening of the ligaments (Fig. 131.5). This thickening is palpable clinically within the adnexa. Associated inflammatory changes may occur causing enhancement on gadolinium administration. Obliteration of normal low T2 signal intensity of the cervix, vaginal wall and rectal wall, and loss of normal fat planes separating the vaginal and rectal walls are features of rectovaginal septal disease. Lesions at this site are almost always accompanied by endometriotic disease in other posterior compartment sites. Involvement of the rectal and bowel wall can be enhanced by use of intraluminal fluid installation, negative luminal contrast agents, and intravenous gadolinium.

The most frequent constellation of posterior compartment disease includes rectovaginal disease and torus uterinus mass. This results in upward displacement of the posterior vaginal fornix, anterior retraction and opposition of the rectum to the posterior vaginal wall, and obliteration of the pouch of Douglas with thickening of the uterosacral ligaments (Fig. 131.6).

Fibromuscular endometriosis in the broad ligaments causes retraction by fibrosis of the ovaries which come to lie along the posterior uterine surface. The ovaries may be so retracted, that they lie in the midline abutting each other resulting in the "kissing sign" (Fig. 131.7). Endometriosis may also result in a frozen pelvis where there is a block of endometriotic tissue which extends to multiple adjacent pelvic structures resulting in complete fusion of these structures. This block of endometriotic tissue is not amenable to surgical resection and a frozen pelvis has a high morbidity. These appearances have an overlap with pelvic inflammatory disease and disseminated pelvic peritoneal ovarian cancer.

Pelvic Visceral Endometriosis

The gastrointestinal tract may be involved in about 12% of cases and the urinary tract is affected in about 1% (Woodward et al. 2001). Gastrointestinal endometriosis usually involves the sigmoid colon and rectum. Endometrial implants first involve the bowel serosa followed by erosion into muscle causing bowel obstruction, pain, and rectal bleeding. Unlike neoplastic lesions, the mucosa is not affected. Typically, on barium enema studies, endometriotic lesions result in an irregular contour of the bowel wall, constricting or an eccentric intramural filling defect and loops of bowel may be tethered together. The commonest site of pelvic endometrial deposits is along the anterior wall of the mid rectum. Endometriosis less commonly involves the urinary tract with adhesions or endometriomas obstructing the ureters just below the pelvic brim. The bladder is affected in 84% of urinary tract endometriosis (Fig. 131.8). Endometrial implants on the posterior wall and dome of the bladder produce filling defects that are seen on intravenous urography and have multiple high signal foci on T1 and T2 weighted images. Bladder deposits cause cyclical haematuria or chronic cystitis.

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