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Imaging of Endometriosis

BACKGROUND

Endometriosis is a common chronic gynaecological condition, characterised by the presence of endometrial tissue outside the uterus, which can cause pelvic pain and infertility.[1-3] The aetiology of endometriosis is not fully understood, but genetic, hormonal and immunological factors are thought to play a role.[4]

Endometriosis is thought to affect approximately 10% of women in their reproductive years.[1] It is found in 20-50% of women suffering from infertility and in a majority of women who suffer from chronic pelvic pain.[1,5] There is an increased risk for endometriosis if a first-degree relative/s suffers from the condition.[1,6]

SYMPTOMS

The two most common symptoms of endometriosis are pelvic pain and infertility. Other symptoms of endometriosis are dependent on the affected locations in the pelvis (or outside of the pelvis) and include dysmenorrhea (painful menstruation), dyspareunia (pain during or after intercourse), dysuria (pain and/or burning sensation associated with urination), dyschezia (painful defaecation), haematochezia (passage of fresh blood through the anus) and cyclical pain and swelling of the Caesarean section scar. There is, however, a poor correlation between the severity/extent of the disease and symptoms.[7] In addition to the described symptoms, women affected by this condition often experience diminished quality of life, adverse effects on intimate relationships, limitations in their daily activities, loss of productivity and significant healthcare costs.[7]

The mean delay between onset of symptoms to diagnosis of endometriosis has been estimated to range between 4 and 11 years.[7] This delay contributes to the morbidity and psychological burden experienced by affected women.

DIAGNOSIS OF ENDOMETRIOSIS

Endometriosis may be divided into three types – ovarian endometriomas, superficial peritoneal endometriosis and deep infiltrative endometriosis (DIE).[8] *Ovarian endometriomas*, also referred to as "chocolate cysts" or endometriotic cysts are a localized form of endometriosis within the ovary. *Superficial peritoneal endometriotic deposits* are non-invasive implants which are often recognized at laparoscopy.

Deep infiltrative endometriosis is defined by invasion of the endometrial glands and stroma at least 5 mm beneath the peritoneal surface.[3] The latter form is associated with fibrosis and disruption of normal anatomy and is the one which is thought to contribute most frequently to pelvic pain and infertility, which are the two main manifestations of this condition.[3] Figures 1 a and b depict the most common locations of endometriotic lesions detected on MRI.

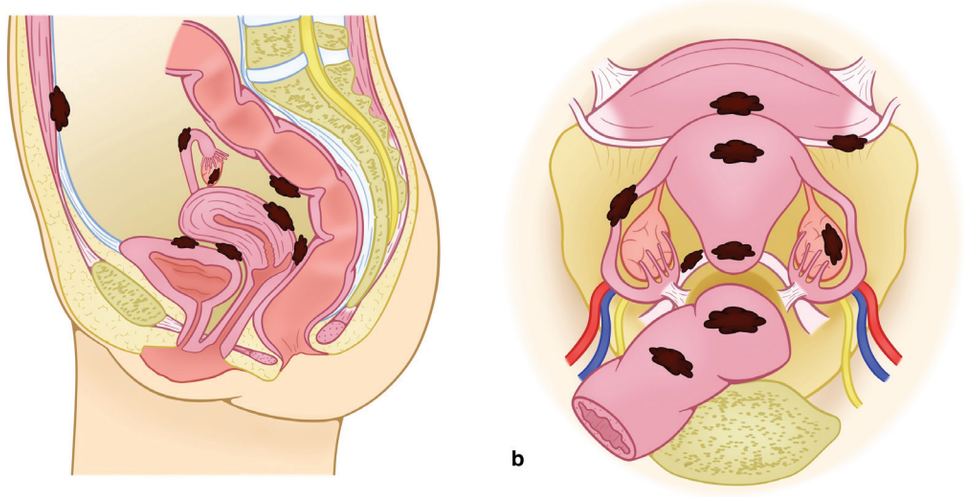


Figure 1. Drawings of the female pelvis in the sagittal (a) and axial (b) planes showing the most frequently encountered locations of endometriotic lesions on MRI.

CLINICAL EXAMINATION

While a pelvic (vaginal) examination is often an important part of the initial assessment, its diagnostic accuracy for the detection of endometriosis is low.[4] Therefore, a normal physical exam does not exclude the diagnosis.

IMAGING OF ENDOMETRIOSIS

For many years, visualization of endometriotic deposits at laparoscopy with subsequent histological confirmation was the gold standard for diagnosis.[9] Over the last years, there has been a paradigm shift towards an initial assessment with non-invasive imaging techniques in cases of suspected endometriosis.

Transvaginal ultrasound (TVUS) is often performed as a first-line investigation. It has a number of advantages, namely its ease of use, availability, minimal invasiveness, dynamicity and cost-effectiveness.[9] For adnexal endometriosis, the equivalence in diagnostic performance of TVUS, MRI and laparoscopy has been demonstrated.[10] TVUS performed systematically by gynaecologists specifically trained in the detection of endometriosis, may provide useful information with regard to organ mobility (e.g. ovarian mobility), assessment of the pelvic compartments (for non-bowel DIE) and of the anterior wall of the rectum (for bowel DIE).[11] It has however a number of limitations in assessing for deep pelvic endometriosis as a number of affected structures are beyond its reach and while it shows high specificity, it may lack sensitivity.[10]

MRI

MRI is often performed following an initial TVUS when deep pelvic endometriosis is detected or suspected. It is the imaging modality showing the highest accuracy for assessing the burden of DIE and shows high sensitivity for endometriotic deposits in view of its excellent soft-tissue resolution.[9] MRI is considered the gold standard imaging examination for DIE and provides exquisitely detailed multiplanar anatomical images of the pelvis without the inherent operator-dependency of US. It also provides a roadmap which is essential in preoperative planning.[8]

Patient Preparation for MRI

Patients undergoing MRI for endometriosis should fast from food for at least four hours prior to the start of the examination and avoid large meals before this period. A moderately filled bladder is recommended. Just before commencing the scan, an antispasmodic agent (IV hyoscine butylbromide) is administered (unless contraindicated) to reduce bowel peristalsis and prevent associated artefacts.

MRI Protocol

MRI examinations for endometriosis are mainly based on the acquisition of multiplanar T2-weighted images (T2w) and T1-weighted (T1w) images. The examination is performed without injection of IV contrast and further sequences are not usually required unless unexpected pathology (e.g. malignancy) is detected. Scan time is usually not longer than about 30 minutes.

MR Imaging Features and Staging of Endometriosis

Endometriosis is a condition that can involve multiple pelvic organs and structures, and can also occur in areas outside the pelvis.[1,9] A standardized compartment-based reading and reporting approach, such as that proposed by the ENDOVALIRM group[8] may be used for MRIs performed for DIE. This provides a degree of standardization and facilitates communication between radiologists and surgeons.

DIE is seen more frequently in the posterior pelvic compartments, including the torus, rectovaginal septum, USLs, Douglas pouch and anterior rectal wall. It is seen less frequently in the anterior pelvic compartments including the vesicouterine pouch and the bladder.[9]

DIE often manifests in the pelvis as nodules, or plaque-like lesions and adhesions with a low signal intensity on T2w images and intermediate signal intensity on T1w images.[1,3,9]

Ovarian endometriomas may be seen as single or multiple thick-walled cysts with a high signal intensity on T1w fat-saturated images (corresponding to haemorrhagic content) and may sometimes demonstrate T2w shading on MRI.[1,3,9]

MRI is also excellent at detecting adenomyosis, which in 30% of cases is associated with deep infiltrating endometriosis.[9] This usually manifests as either thickening of the junctional zone >12 mm or as nodules with hyperintense foci within the uterine wall on T1w and T2w.[9]

Bowel involvement commonly manifests as nodular or plaque-like T2w hypointense deposits along its wall with loss of the fat planes between the bowel loops and uterus or other organs, with the most frequently affected sites being the rectum and sigmoid colon.[9] Bowel involvement may result in cyclical symptoms of dyschezia, bloating and bowel cramping which are relieved after passage of air or faeces.[1]

Urinary tract endometriosis presents in around 20% of cases with the bladder being the most frequently involved organ.[1] Symptomatic women may experience dysuria, urgency and gross haematuria during menstruation. Endometriotic bladder lesions may result in infiltration of the bladder wall muscle and appear as a mass within the bladder wall which projects into the bladder lumen.[1]

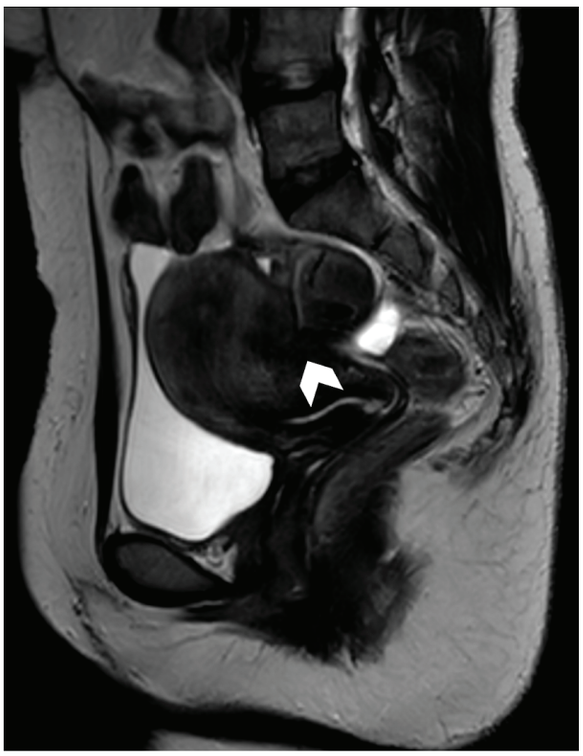
Figures 2 a-d show various endometriotic manifestations in the pelvis.

Extrapelvic involvement may be detected by MRI or by US depending on the affected location. Abdominal wall nodules (including nodules within the Caeasarean section scar) may be assessed with US or MRI (Figure 3). Involvement of the sigmoid colon, caecum-ileum-appendix or ureters is initially best assessed with MRI.

MR imaging has gained wide acceptance as the best imaging modality for the diagnosis and staging of deep pelvic endometriosis. The accuracy of MRI is dependent upon the reporting radiologist; therefore, it is recommended that such examinations are performed using a standardized MRI protocol and are reported by radiologists with appropriate training and experience in gynaecological MR imaging.

Although MRI is the most sensitive imaging modality for DIE, the use of physical examination and TVUS may increase specificity. Roditis et al. showed that a combined analysis by means of physical examination, TVUS and MRI with ≥ 2 positive tests appears to be the most valid model for diagnosing DIE, with an accuracy of 91.4% in a retrospective cohort study.[12]

Figure 2a. Sagittal T2w MR image of a patient with clinically suspected endometriosis, showing a deep infiltrating endometriotic deposit at the torus uterinus with infiltration of the posterior uterine wall (arrowhead). An ovarian endometrioma adherent to the posterior uterine wall is also seen at the same level.



LAPAROSCOPY

While a high sensitivity and specificity in the detection of endometriosis may be achieved by the combined use of TVUS and MRI, negative imaging does not rule out endometriosis. In cases of discordance between the intensity of symptoms, despite treatment, and negative imaging results, laparoscopic surgery may be indicated.[10] Laparoscopy may also detect small superficial endometriotic deposits which may not be visible on TVUS or MRI.

MANAGEMENT OF ENDOMETRIOSIS

Patients with endometriosis are managed by gynaecologists with medical treatment (pain relief and/or hormone treatment) and surgery as appropriate.[13] Cases of deep infiltrating endometriosis are optimally discussed in a multidisciplinary setting with collaboration between gynaecologists, radiologists and colorectal surgeons (in case of bowel involvement), in order to achieve an optimal tailor-made management for each patient.

CONCLUSION

Endometriosis is a common and important condition which may greatly influence the quality of life of affected women. The combined use of non-invasive imaging modalities such as TVUS and MRI provides high sensitivity and specificity in diagnosing and characterizing this disease, which can guide treatment in order to ensure the best possible patient outcomes.

ACKNOWLEDGEMENT

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Figure 2b. Axial T2w MR image of the same patient showing the 'kissing ovary sign' with the ovaries (arrows) adherent to each other and to the posterior uterine wall.

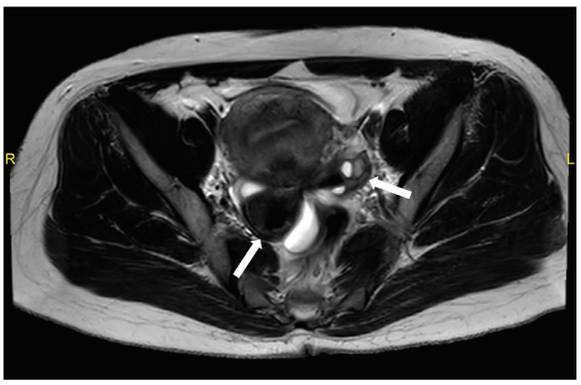


Figure 2c. Axial T1w fat-saturated MR image shows bilateral ovarian endometriomas (arrows), larger on the right, with a typical hyperintense signal on this sequence.

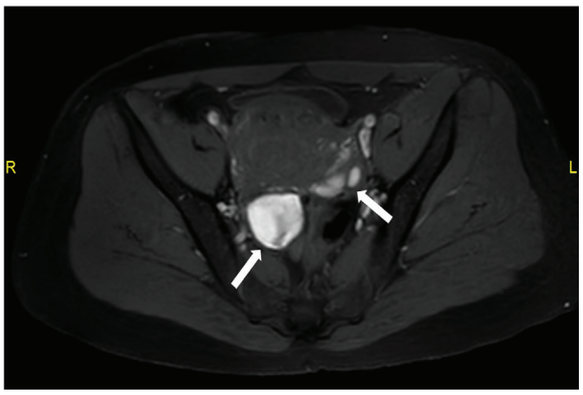


Figure 2d. Axial T2w MR image shows endometriotic deposits at the posterior uterine wall (arrow) with tethering to multiple points along the anterior rectal wall. Thickening of the right uterosacral ligament is also seen (arrowhead).

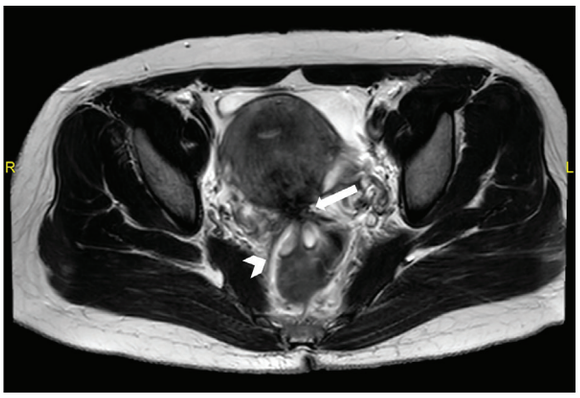
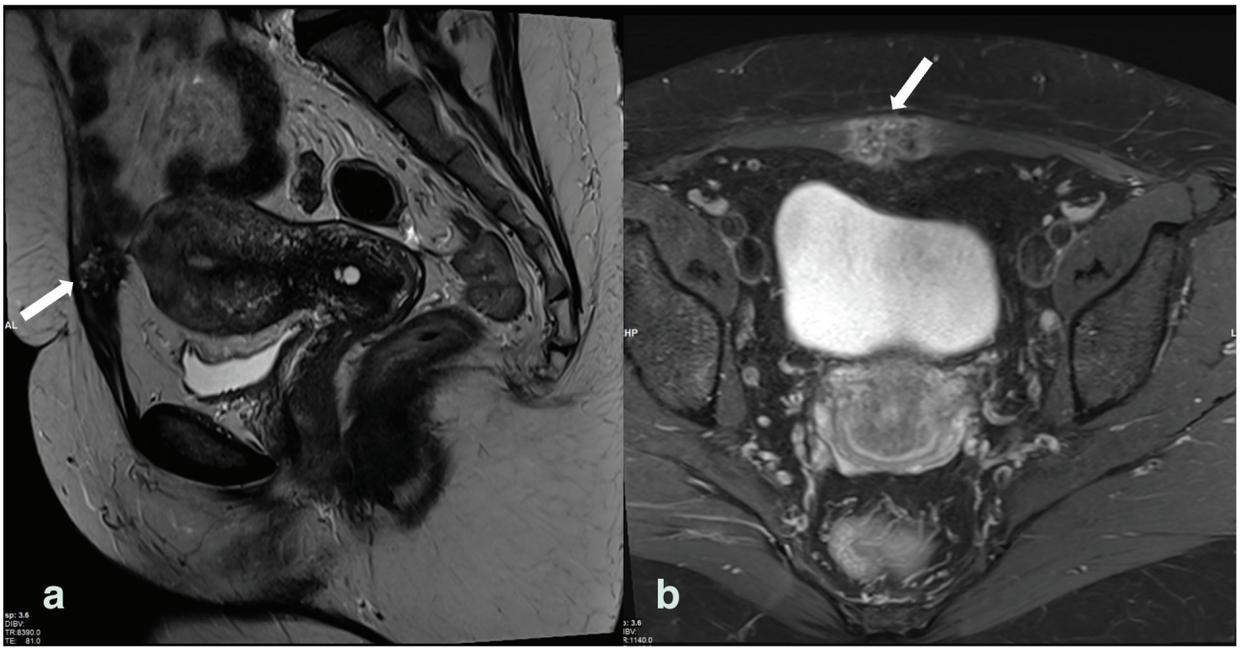


Figure 3. (a) Sagittal T2w MR image showing an abdominal wall endometrioma (arrow) within the rectus muscle at the site of the C-section scar. (b) axial T1 fat-saturated post-contrast image showing enhancement of the endometrioma (arrow) within the rectus muscle at the site of the C-section scar.



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